

DEVIS

NO. DE SOLICITATION: 16-22146

Edifice: U-66
1920 chemin Research, campus d'Uplands
Ottawa, Ontario

PROJET: U-66, remplacement d'équipement de climatisation et de refroidissement

NO. DE PROJET : U66-5201

Date: Février 2017

DEVIS

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Directions to the Ottawa Research Facilities – Uplands

NRC Institute for Aerospace Research (NRC-IAR)

Research Road
Ottawa, Ontario, Canada

Tel: 613-991-5738

NRC Centre for Surface Transportation Technology (NRC-CSTT)

2320 Lester Road
Ottawa, Ontario, Canada

Tel: 613-998-9639

NRC Institutes/Branch/Program	Buildings
NRC Administrative Services and Property Management (NRC-ASPM)	U-62
NRC Institute For Aerospace Research (NRC-IAR)	U-61, U-66, U-67, U-69, U-70
NRC Centre for Surface Transportation Technology (NRC-CSTT)	U-84, U-86, U-87, U-88, U89, U-90, U-91

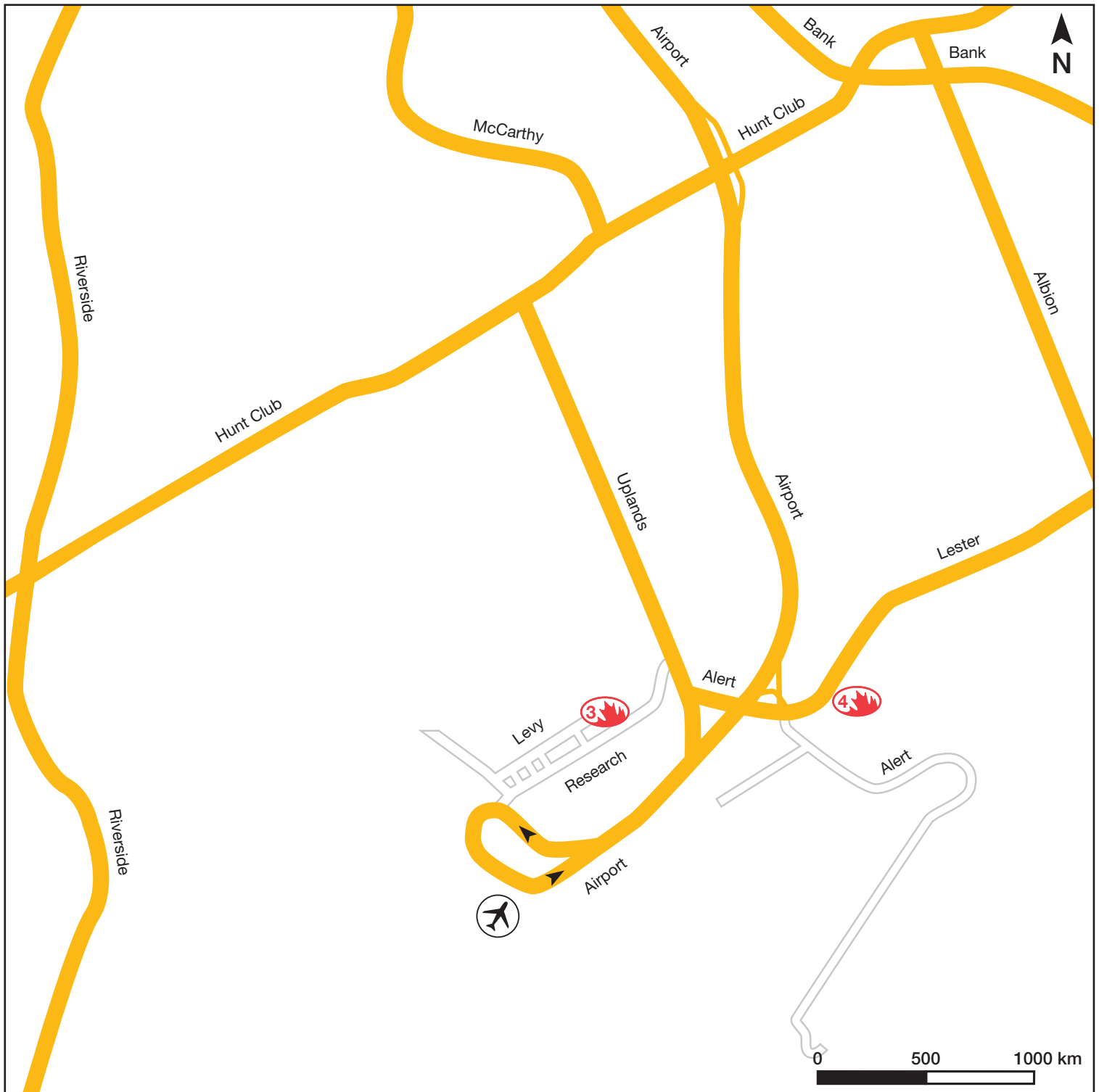
By Road, from the MONTREAL RD FACILITIES to NRC-CSTT, 2320 Lester Road

1. Drive EAST on MONTREAL RD
2. Turn RIGHT on BLAIR RD, cross OGILVIE RD
3. Take the ramp and follow Highway 174 WEST
4. Keep RIGHT and take first exit on ramp Highway 417 EAST towards Cornwall/Montreal
5. Exit at WALKLEY RD, merge RIGHT on WALKLEY
6. Turn LEFT at CONROY RD
7. Turn RIGHT at DAVIDSON RD, cross BANK ST – name changes to LESTER RD
8. Continue on LESTER RD and watch for NRC Research Facilities signs

By Road, from the MONTREAL RD FACILITIES to NRC-IAR, Research Road

1. Drive EAST on MONTREAL RD
2. Turn RIGHT on BLAIR RD, cross OGILVIE RD
3. Take the ramp and follow Highway 174 WEST
4. Keep RIGHT and take first exit on ramp Highway 417 EAST towards Cornwall/Montreal
5. Exit at WALKLEY RD, merge RIGHT on WALKLEY
6. Turn LEFT at HAWTHORNE RD
7. Turn RIGHT at HUNT CLUB RD, cross CONROY RD, ALBION RD, BANK ST
8. Turn LEFT at UPLANDS DR. Continue and watch for NRC Research Facilities signs





NRC Institute



Major HWY



Airport



Ferry



Metro



Trans Canada HWY



Secondary HWY



Train Station



Bus Station



National Research
Council Canada

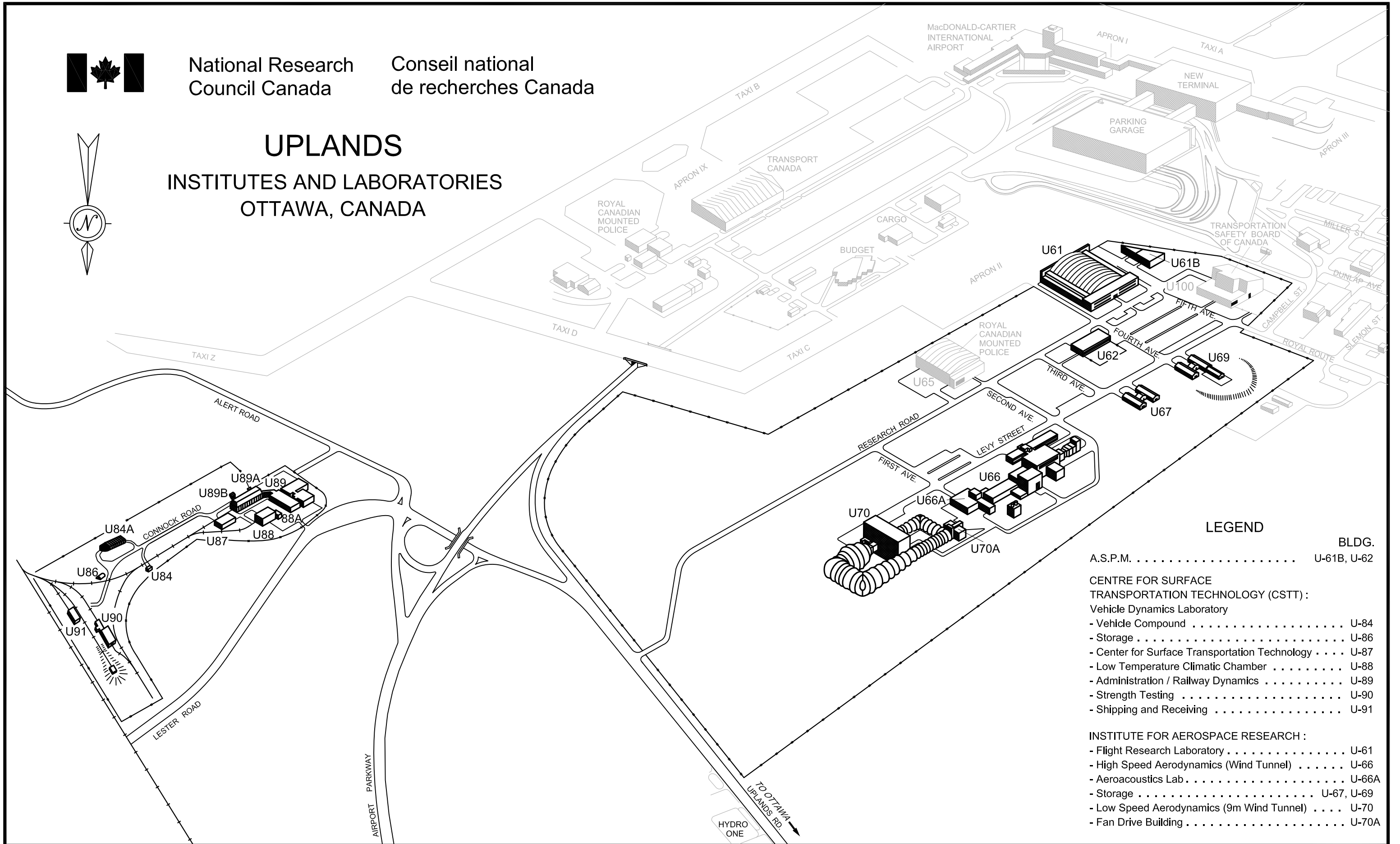
Conseil national
de recherches Canada



UPLANDS

INSTITUTES AND LABORATORIES

OTTAWA, CANADA



LEGEND

- | | |
|--|-------------------|
| A.S.P.M. | BLDG. U-61B, U-62 |
| CENTRE FOR SURFACE TRANSPORTATION TECHNOLOGY (CSTT) : | |
| Vehicle Dynamics Laboratory | |
| - Vehicle Compound | U-84 |
| - Storage | U-86 |
| - Center for Surface Transportation Technology | U-87 |
| - Low Temperature Climatic Chamber | U-88 |
| - Administration / Railway Dynamics | U-89 |
| - Strength Testing | U-90 |
| - Shipping and Receiving | U-91 |
| INSTITUTE FOR AEROSPACE RESEARCH : | |
| - Flight Research Laboratory | U-61 |
| - High Speed Aerodynamics (Wind Tunnel) | U-66 |
| - Aeroacoustics Lab. | U-66A |
| - Storage | U-67, U-69 |
| - Low Speed Aerodynamics (9m Wind Tunnel) | U-70 |
| - Fan Drive Building | U-70A |

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Administrative Services & Property management Branch (ASPM)	Direction des services administratifs et de la gestion de l'immobilier (SAGI)
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Formulaire de proposition – Marché de construction

Titre du projet U-66 Remplacement d'équipement de climatisation et de refroidissement

No. de Proposition: 16-22146

1.2 **Nom d'entreprise et adresse du soumissionnaire**

Nom _____

Adresse _____

Personne-ressource (nom en lettres moulées) _____

Téléphone (_____) _____ Téléc. (_____) _____

1.3 **Offre de prix**

Le soumissionnaire soussigné offre par les présentes à Sa Majesté du chef du Canada (ci-après appelée « Sa Majesté »), représentée par le Conseil national de recherches du Canada, d'exécuter et d'achever les travaux se rapportant au projet désigné ci-haut, conformément aux plans et devis et aux autres documents d'appel d'offres, à l'endroit et de la manière énoncés aux présentes, pour un montant total de _____, _____ \$ (montant numéraire uniquement) **dans la monnaie ayant cours légal au Canada (TPS/TVH en sus).**

Le montant de l'offre comprend toutes les taxes fédérales, provinciales et municipales applicables^(*). Cependant, si l'une des taxes imposées en vertu de la *Loi sur l'accise*, de la *Loi sur la taxe d'accise*, de la *Loi sur la sécurité de la vieillesse*, de la *Loi sur les douanes*, du tarif des douanes ou de toute autre loi provinciale imposant une taxe de vente au détail sur les achats de biens meubles incorporés à un bien immobilier est modifiée et que cette modification survient :

- .1 après que la présente proposition ait été mise à la poste ou livrée; ou
 - .2 si la présente proposition est révisée, après la dernière révision;
- le montant de l'offre de prix devra être diminué ou augmenté de la manière prévue à l'article CG22 des Conditions générales du contrat.

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1.3.1 Offre de prix (suite)

(*) Dans le cadre de la présente proposition, la taxe sur les produits et services (TPS) n'est pas une taxe applicable.

Dans la province de Québec, la taxe de vente du Québec (TVQ) ne doit pas être ajoutée au montant de l'offre, le gouvernement fédéral étant exempté de la TVQ. Les soumissionnaires doivent s'adresser directement au ministère du Revenu provincial pour récupérer toute taxe qu'ils sont appelés à verser sur des biens et services acquis dans le cadre de l'exécution du présent marché. Les soumissionnaires devraient cependant inclure dans le montant de leur offre de prix tout montant de TVQ pour lequel ils ne peuvent exiger un remboursement de taxe sur les intrants.

1.4 Acceptation et conclusion du marché

Le soumissionnaire soussigné s'engage, dans les quatorze (14) jours suivant l'avis confirmant l'acceptation de la présente proposition, à signer un contrat portant sur l'exécution des travaux, à condition que l'avis d'acceptation du Ministère parvienne au soumissionnaire dans un délai de trente (30) jours suivant la date de clôture de l'appel d'offres.

1.5 Délai d'exécution des travaux

Le soumissionnaire soussigné s'engage à achever les travaux dans le délai stipulé au devis, lequel commence à courir à compter de l'avis d'acceptation de la présente proposition.

1.6 Garantie de soumission

Le soumissionnaire soussigné joint à la présente proposition une garantie de soumission, conformément à l'article 5 des Instructions générales à l'intention des soumissionnaires.

Le soumissionnaire soussigné convient que dans l'éventualité où il refuse de conclure un contrat qu'il est tenu de conclure en vertu des présentes, tout dépôt de garantie fourni à titre de garantie de soumission sera retenu pour débit. Cependant, le Ministre peut, au nom de l'intérêt public, renoncer au droit de Sa Majesté de retenir pour débit le dépôt de garantie.

Le soumissionnaire soussigné convient que si la garantie de soumission n'est pas conforme aux modalités de l'article 5 des Instructions générales à l'intention des soumissionnaires, sa proposition peut être jugée irrecevable.

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1.7 **Garantie d'exécution**

Dans les quatorze (14) jours suivant l'avis d'acceptation de sa proposition, le soumissionnaire soussigné doit fournir une garantie d'exécution contractuelle, conformément à la section F, Conditions contractuelles, du contrat.

Le soumissionnaire soussigné convient que la garantie d'exécution visée par les présentes, si elle est fournie sous forme de lettre de change, sera versée au Trésor public du Canada.

1.8 **Annexes**

L'annexe n° n/a fait partie intégrante de la présente proposition.

1.9 **Addenda**

Le montant total de l'offre de prix porte sur l'exécution des travaux définis dans les addenda suivants :

N°	DATE	N°	DATE

(Les soumissionnaires doivent indiquer le numéro et la date des addenda.)

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1.10 Signature de la proposition

Les soumissionnaires doivent consulter l'article 2 des Instructions générales à l'intention des soumissionnaires.

**SIGNÉ, AUTHENTIFIÉ ET REMIS le _____^e jour du mois de
_____ au nom de**

(Inscrire le nom d'entreprise du soumissionnaire)

SIGNATAIRE(S) AUTORISÉ(S)

(Signature du signataire autorisé)

(Inscrire le nom et le titre du signataire en lettres moulées)

(Signature du signataire autorisé)

(Inscrire le nom et le titre du signataire en lettres moulées)

SCEAU

ANNONCE ACHATSETVENTES

U-66, Remplacement d'équipement de climatisation et de refroidissement

Le Conseil national de recherches du Canada, 1920 chemin Research, Campus d'Uplands, Ottawa, ON, a une demande pour un projet qui comprend :

Remplacement d'équipement de climatisation et de refroidissement.

1. GENERAL :

Adresser à le représentant ministériel (ou à son représentant) ou à l'Agent des contrats toute question portant sur tout aspect du projet. Ils sont les seuls autorisés à fournir des réponses.

On ne tiendra nullement compte des informations obtenues d'une personne autre que le représentant ministériel (ou son représentant) ou l'Agent des contrats et ce, autant à l'octroi du contrat qu'au cours des travaux.

Les entreprises souhaitant présenter des soumissions pour ce projet devraient obtenir les documents relatifs aux appels d'offres en s'adressant au fournisseur de service Achatsetventes.gc.ca AGAO. Si des addenda sont ajoutés, ils seront distribués par Achatsetventes.gc.ca AGAO. Les entreprises qui choisissent de préparer leurs soumissions en se fondant sur des documents d'appel d'offres provenant d'autres sources le font à leurs propres risques et seront tenues d'informer le responsable de l'appel d'offres de leur intention de soumissionner. Les trousse d'appel d'offres ne pourront être diffusées le jour même de la clôture des soumissions.

2. VISITE DU SITE OBLIGATOIRE

Les soumissionnaires ont l'obligation de participer à une des visites du site à la date et à l'heure prévues. Les soumissionnaires qui ont l'intention de présenter une soumission doivent envoyer au moins un représentant à cette visite.

Les visites de chantier se tiendront le 14 février et le 16 février, 2017 à **9 :00**. Rencontrer Maurice Richard à l'édifice U-66, 1920 chemin Research, Campus d'Uplands, Ottawa, ON. Les soumissionnaires qui, pour une raison quelconque, ne peuvent pas participer à la visite à la date et à l'heure prévues ne pourront obtenir un deuxième rendez-vous; leur soumission sera donc considérée comme non conforme. **AUCUNE EXCEPTION NE SERA FAITE.**

Pour prouver qu'ils ont participé à la visite du site, les soumissionnaires ou leurs représentants **DOIVENT** signer, lors de la visite, le formulaire de participation élaboré par l'autorité contractante. Les soumissionnaires ou leurs représentants ont la responsabilité de vérifier s'ils ont bien signé ce formulaire avant de quitter le site. Les soumissions présentées par des soumissionnaires qui n'ont pas participé à la visite du site ou qui ont oublié de signer le formulaire de participation seront considérées comme non conformes.

3. DATE DE FERMÉTURE :

La date de fermeture est le 7 mars, 2017 14 :00

4. RÉSULTATS DE L'APPEL D'OFFRES :

À la fermeture de l'appel d'offres, les résultats de l'appel d'offre seront envoyés par télécopieur à tous les entrepreneurs qui auront soumis un appel d'offre.

5. CRITÈRES DE SÉCURITÉ OBLIGATOIRES POUR LES ENTREPRENEURS

5.1 EXIGENCES OBLIGATOIRES RELATIVES A LA SECURITE

- .1 L'entrepreneur doit détenir en permanence, pendant l'exécution du contrat à commandes, une attestation de vérification d'organisation désignée (VOD) en vigueur, délivrée par la Direction de la sécurité industrielle canadienne (DSIC) de Travaux publics et Services gouvernementaux Canada (TPSGC).
- .2 Les membres du personnel de l'entrepreneur devant avoir accès à des établissements de travail dont l'accès est réglementé doivent TOUS détenir une cote de FIABILITÉ en vigueur, délivrée ou approuvée par la DSIC de TPSGC.
- .3 L'entrepreneur doit respecter les dispositions:
 - a) de la Liste de vérification des exigences relatives à la sécurité et directive de sécurité (s'il y a lieu), reproduite à l'Annexe D;
 - b) du Manuel de la sécurité industrielle (dernière édition)@ <http://ssi-iss.tpsgc-pwgsc.gc.ca/msi-ism/msi-ism-fra.html>

5.2 VÉRIFICATION DE L'ATTESTATION DE SÉCURITÉ À LA CLÔTURE DES SOUMISSIONS

- .1 Le soumissionnaire doit détenir une attestation de vérification d'organisation désignée (VOD) en vigueur, délivrée par la Direction de la sécurité industrielle canadienne (DSIC) de Travaux publics et Services gouvernementaux Canada (TPSGC) **ET DOIT L'INCLURE AVEC LEUR SOUMISSION OU FAIRE SUIVRE DANS LES 48 HEURES SUIVANT LA DATE ET L'HEURE DE CLÔTURE DE L'APPEL D'OFFRE.** Des vérifications seront effectuées par l'intermédiaire de la DSIC pour confirmer l'attestation de sécurité du soumissionnaire. L'omission de se conformer à cette exigence rendra la soumission non conforme et celle-ci sera rejetée.
- .2 L'entrepreneur général doit nommer tous ses sous-traitants dans un délai de 72 heures suivant la clôture des soumissions, et ceux-ci doivent aussi détenir une attestation VOD valide et soumettre les noms, dates de naissance ou numéros de certificats de sécurité de toutes les personnes qui seront affectées au projet.
- .3 Il faut noter que les sous-traitants qui doivent exécuter des tâches pendant l'exécution du contrat subséquent doivent aussi satisfaire aux exigences obligatoires du contrat en matière de sécurité. De plus, aucune personne ne possédant pas le niveau de sécurité exigé ne sera admise sur le site. Le soumissionnaire retenu devra s'assurer que les exigences liées à la sécurité sont satisfaites pendant toute l'exécution du contrat. La Couronne ne sera tenue responsable d'aucun retard ni d'éventuels coûts supplémentaires liés à l'inobservation par l'entrepreneur des exigences en matière de sécurité. L'omission de satisfaire à ces exigences sera suffisante pour résilier le contrat pour cause d'inexécution.
- .4 Pour toute question concernant les exigences liées à la sécurité pendant la période de soumission, les soumissionnaires doivent communiquer avec l'agente de sécurité @ 613-993-8956.

6.0 CSPAA (COMMISSION DE LA SECURITE PROFESSIONNELLE ET DE L'ASSURANCE CONTRE LES ACCIDENTS DU TRAVAIL

.1 Tous les soumissionnaires doivent fournir une attestation de la CSPAAT valide avec leur offre ou avant l'attribution du contrat.

7.0 L'OMBUDSMAN DE L'APPROVISIONNEMENT

.1 Services de règlement des différends

Les parties reconnaissent que l'ombudsman de l'approvisionnement nommé en vertu du paragraphe 22.1(1) de la *Loi sur le ministère des Travaux publics et des Services gouvernementaux* veillera à proposer aux parties concernées un processus de règlement de leur différend, sur demande ou consentement des parties à participer à un tel processus de règlement extrajudiciaire en vue de résoudre un différend entre elles au sujet de l'interprétation ou de l'application d'une modalité du présent contrat, et obtiendra leur consentement à en assumer les coûts. Le Bureau de l'ombudsman de l'approvisionnement peut être joint par téléphone, au 1-866-734-5169 ou par courriel, à l'adresse boa.opo@boa-opo.gc.ca.

.2 Administration du contrat

Les parties reconnaissent que l'ombudsman de l'approvisionnement nommé en vertu du paragraphe 22.1(1) de la *Loi sur le ministère des Travaux publics et des Services gouvernementaux* examinera une plainte déposée par [*le fournisseur ou l'entrepreneur ou le nom de l'entité à qui ce contrat a été attribué*] concernant l'administration du contrat si les exigences du paragraphe 22.2(1) de la *Loi sur le ministère des Travaux publics et des Services gouvernementaux* et les articles 15 et 16 du *Règlement concernant l'ombudsman de l'approvisionnement* ont été respectées, et si l'interprétation et l'application des modalités ainsi que de la portée du contrat ne sont pas contestées. Le Bureau de l'ombudsman de l'approvisionnement peut être joint par téléphone, au 1-866-734-5169 ou par courriel, à l'adresse boa.opo@boa-opo.gc.ca.

.3 Le Bureau de l'ombudsman de l'approvisionnement (BOA) a été mis sur pied par le gouvernement du Canada de manière à offrir aux fournisseurs un moyen indépendant de déposer des plaintes liées à l'attribution de contrats de moins de 25 000 \$ pour des biens et de moins de 100 000 \$ pour des services. Vous pouvez soulever des questions ou des préoccupations concernant une demande de soumissions ou l'attribution du contrat subséquent auprès du BOA par téléphone, au 1-866-734-5169 ou par courriel, à l'adresse boa.opo@boa-opo.gc.ca. Vous pouvez également obtenir de plus amples informations sur les services qu'offre le BOA, en consultant son site Web, à l'adresse www.opo-boa.gc.ca.

Le représentant ministériel responsable ou son représentant: **Maurice Richard**
Téléphone: **613 993-9299**

L'autorité contractante : **Collin Long** collin.long@nrc-cnrc.gc.ca
Téléphone : **613 993-0431**

INSTRUCTIONS AUX SOUMISSIONNAIRES

Article 1 - Réception des soumissions

- 1a) Aucune soumission reçue après le moment fixé pour la clôture des soumissions ne sera acceptée. LES SOUMISSIONS RECUES APRES LE MOMENT FIXÉ NE SONT PAS VALIDES et ne peuvent être prises en considération, peu importe la raison de leur retard.
- 1b) Une lettre ou une télécommunication imprimée envoyée par un soumissionnaire pour signifier un prix ne peut être considérée comme étant une soumission valide à moins qu'une soumission officielle n'ait été reçue sur la formule prescrite à cette fin.
- 1c) Il est loisible aux soumissionnaires de modifier leurs soumissions par lettre ou télécommunication imprimée mais à condition que de telles modifications ne soient pas reçues plus tard qu'au moment prévu pour la clôture des soumissions.
- 1d) Les modifications à la soumission qui sont transmises par télécopieur doivent être signées et doivent permettre d'identifier sans équivoque le soumissionnaire.

Toutes les modifications de ce genre doivent être envoyées à :

Conseil national de recherches Canada
Services d'approvisionnement
Alain Leroux, agent supérieur de contrats
Édifce M-22
Chemin Montréal, Ottawa (Ontario)
K1A OR6

Télécopieur: (613) 991-3297

Article 2 - Formule de soumission et qualifications

- 1) Toutes les soumissions doivent être présentées sur la formule de soumission - construction et être signées en conformité avec les exigences suivantes:
 - a) Société à responsabilité limitée : le nom complet de la société ainsi que le nom et le titre des fondés de signature autorisés doivent être imprimés dans l'espace prévu à cette fin. La signature des fondés de signature et le sceau de la société doivent être apposés.
 - b) Société de personne : le nom de l'entreprise ainsi que le(s) noms du (des) signataire(s) doivent être imprimés dans l'espace prévu. L'un ou plusieurs des associés doivent signer en présence d'un témoin qui, lui aussi, doit apposer sa signature. Un sceau de couleur adhésif doit être apposé en regard de chaque signature.
 - c) Entreprise à propriétaire unique : le nom de l'entreprise et le nom du propriétaire unique doivent être imprimés dans l'espace prévu. Le propriétaire est tenu de signer en présence d'un témoin qui doit lui aussi apposer sa signature. Un sceau de couleur adhésif doit être apposé en regard de chaque signature.
- 2) Toute modification à la partie imprimée de la formule de soumission - construction ou tout défaut de fournir l'information qui y est demandée peut invalider la soumission.

- 3) Toutes les rubriques de la formule de soumission - construction doivent être remplies et les corrections manuscrites ou dactylographiées apportées aux parties ainsi remplies doivent être paraphées par la ou les personnes qui signe(nt) la soumission au nom du soumissionnaire.
- 4) Les soumissions doivent être basées sur les plans, devis et documents de soumission fournis.

Article 3 - Contrat

- 1) L'entrepreneur devra signer un contrat semblable à la formule standard pour contrats de construction à prix fixe dont un exemplaire en blanc est annexé dos à la présente brochure pour information.

Article 4 - Destinataire de la soumission

- 1a) Les soumissions doivent être envoyées sous enveloppe cachetée adressée à l'Agent de contrats, **Conseil national de recherches, Services administratifs et gestion de l'immobilier, édifice M-22, 1200 chemin Montréal, Ottawa, ON. K1A 0R6** Canada, et la mention "Soumission relative à (inscrire le titre de travail apparaissant sur les dessins et le cahier des charges)" ainsi que le nom et l'adresse du soumissionnaire doivent apparaître sur l'enveloppe.
- 1b) Sauf dispositions contraires, les seuls documents à soumettre pour la soumission sont la formule de soumission et la garantie de soumission.

Article 5 - Garantie

- 1a) La garantie de soumission est requise. La garantie doit alors être soumise sous l'une ou l'autre des formes suivantes :
 - i) un chèque certifié payable au Receveur général du Canada et tiré sur un établissement membre de l'Association canadienne des paiements ou un établissement de crédit coopératif local membre d'une société centrale de crédit coopératif elle-même membre de l'Association canadienne des paiements OU
 - ii) des obligations du gouvernement du Canada, ou des obligations avec garantie inconditionnelle par le gouvernement du Canada quant au capital et aux intérêts, OU
 - iii) un cautionnement de soumission.
- 1b) Peu importe la forme de la garantie de soumission, elle ne devrait jamais dépasser la somme de 250 000 \$ calculée à 10% de la première tranche de 250 000 \$ du prix soumissionné, plus 5% de tout montant dépassant 250 000 \$.
- 2a) Une garantie de soumission doit être fournie avec chaque soumission. Elle peut aussi être envoyée séparément à condition qu'elle ne soit pas reçue plus tard qu'au moment prévu pour la clôture des soumissions. On doit fournir l'ORIGINAL de la garantie de soumission. Des garanties transmises par télécopieur ou des photocopies NE SONT PAS acceptées. **DEFAUT DE FOURNIR LA GARANTIE REQUISE RENDRA LA SOUMISSION INVALIDE.**
- 2b) Dans le cas où la soumission n'est pas acceptée, la garantie de soumission fournie en conformité avec l'article 8 sera retournée au soumissionnaire.
- 3a) L'adjudicataire doit fournir une garantie au plus tard 14 jours après réception d'un avis lui signifiant l'acceptation de sa soumission. Il doit fournir L'UN OU L'AUTRE des documents suivants :

- i) Un dépôt de garantie tel que décrit à l'alinéa 1b) ci-dessus ainsi qu'un cautionnement du paiement de la main d'oeuvre et des matériaux s'élevant à 50%, au moins, de la somme payable en vertu du contrat, OU
 - ii) Une garantie d'exécution et un cautionnement du paiement de la main d'oeuvre et des matériaux, chacun s'élevant à 50% du montant payable en vertu du contrat.
- 3b) Au cas où il ne serait pas possible d'obtenir un cautionnement du paiement de la main d'oeuvre et des matériaux, tel que requis aux termes de l'alinéa 3a) ci-dessus, en s'adressant par conséquent à au moins deux compagnies de garantie acceptables, un dépôt de garantie supplémentaire s'élevant à 10% exactement du montant payable en vertu du contrat doit être fourni.
- 3c) Lorsqu'une soumission a été accompagnée d'un dépôt de garantie tel que décrit à l'alinéa 1b) ci-dessus, le montant du dépôt de garantie requis en vertu de l'alinéa 3a) ci-dessus peut être réduit du montant du dépôt de garantie qui accompagnait la soumission.
- 3d) Les obligations doivent être de la forme approuvée et doivent être émises par des compagnies dont les obligations sont acceptées par le gouvernement du Canada. Des modèles de la forme approuvée des garanties à déposer par les soumissionnaires, des garanties d'exécution et des cautionnements du paiement de la main-d'oeuvre et des matériaux ainsi qu'une liste des compagnies de garantie acceptables peuvent être obtenus en s'adressant au Services d'approvisionnement, Conseil national de recherches du Canada, édifice M-22, chemin Montréal, Ottawa (Ontario) K1A 0R6, Canada.

Article 6 - Intérêt payé sur les dépôts de garantie

- 1) Les soumissionnaires sont avertis qu'ils doivent se mettre d'accord personnellement avec leurs banquiers relativement à l'intérêt, le cas échéant, payé sur le montant du chèque certifié accompagnant leur soumission. Le Conseil ne paiera pas d'intérêt sur ledit chèque en attendant l'adjudication du contrat et ne sera pas non plus responsable du paiement des intérêts en vertu de toute disposition prise par les soumissionnaires.

Article 7 - Taxe sur les ventes

- 1) Le montant de la soumission doit comprendre toutes les taxes prélevées en vertu de la Loi sur l'accise, de la Loi sur la taxe d'accise, de la Loi sur la sécurité de la vieillesse, de la Loi sur les douanes ou du Tarif des douanes en vigueur ou applicables à ce moment.
- 2) Au Québec, la taxe provinciale ne doit pas être incluse au montant soumissionné, car le Gouvernement Fédéral en est exclu. Les soumissionnaires devront faire les démarches nécessaires auprès du Ministère du Revenu provincial pour recouvrer toute taxe payée sur les biens et services dans le cadre de ce contrat.

Cependant, les soumissionnaires devraient inclure dans leur prix, les taxes provinciales pour lesquelles les remboursements ne s'appliquent pas.

Article 8 - Examen de l'emplacement

- 1) Tous les soumissionnaires examineront l'emplacement des travaux proposés avant d'envoyer leur soumission, étudieront minutieusement ledit emplacement et obtiendront tous les renseignements nécessaires à la bonne exécution du contrat. Aucune réclamation postérieure ne sera permise ou admise relativement à tout travail ou matériaux pouvant être requis et

nécessaires à la bonne exécution du présent contrat à l'exception des dispositions de l'article CG 35 des Conditions générales du cahier des charges général.

Article 9 - Erreurs, omissions, etc.

- 1a) Les soumissionnaires relevant des erreurs ou des omissions dans les dessins, le cahier des charges ou d'autres documents, ou ayant des doutes quant au sens ou à l'intention de n'importe quelle partie de ces derniers, devront en avvertir immédiatement l'ingénieur qui fera parvenir des directives ou des explications écrites à tous les soumissionnaires.
- 1b) Ni l'ingénieur, ni le Conseil ne seront responsables des directives orales.
- 1c) Les additions ou les corrections effectuées au cours de la présentation des soumissions seront incluses dans la soumission. Cependant, le contrat remplace toutes les communications, négociations et tous les accords, sous forme verbale ou écrite, se rapportant aux travaux et effectués avant la date du contrat.

Article 10 - Nul paiement supplémentaire pour accroissement des frais

- 1) Les seules autres modifications pouvant être apportées au prix forfaitaire sont celles précisées dans les Conditions générales du Cahier des charges général. Le prix forfaitaire ne sera pas modifié à la suite de changements dans les tarifs de transport, les cotes des changes, les échelles de salaire, le coût des matériaux, de l'outillage ou des services.

Article 11 - Adjudication

- 1a) Le Conseil se réserve le pouvoir et le droit de rejeter les soumissions provenant de parties ne possédant pas les connaissances et la préparation requises à la bonne exécution de la catégorie de travaux mentionnés dans les présentes et précisés dans les plans. Les soumissionnaires doivent fournir la preuve de leur compétence lorsque cela est exigée.
- 1b) Un soumissionnaire peut être tenu de faire parvenir au Services d'approvisionnement, Conseil national de recherches Canada, édifice M-22, chemin Montréal, Ottawa (Ontario) K1A OR6, Canada, des copies non signées des polices d'assurance auxquelles il envisage de souscrire pour satisfaire aux exigences relatives aux assurances comprises dans les Conditions d'assurance du Cahier des charges général.
- 1c) Le Conseil ne s'engage pas à accepter la soumission la plus basse ni une soumission quelconque.

Article 12 - Taxe TPS

- 1) La TPS qui est maintenant en vigueur est applicable à cette proposition; cependant, l'entrepreneur devra proposer un prix NE COMPRENNANT PAS la TPS. La TPS détaillée séparément dans toutes les factures et demandes de paiement partiel présentées pour des produits fournis ou un travail accompli et sera payée par le Canada. Le montant de la TPS sera inclus dans le prix total du contrat. L'Entrepreneur convient de verser à Revenu Canada tout montant payé ou dû au titre de la TPS.

Entrepreneurs non résidents

Guide de la TVD 804F

Date de publication : août 2006

Dernière mise à jour : août 2010

ISBN: 1-4249-2010-8 (Imprimé), 1-4249-2012-4 (PDF), 1-4249-2011-6 (HTML)

Publication archivées

Avis aux lecteurs : Concernant la taxe de vente au détail (TVD) – Le 1^{er} juillet 2010, la taxe de vente harmonisée (TVH) de 13 % est entrée en vigueur en Ontario pour remplacer la TVD provinciale en la combinant avec la taxe fédérale sur les produits et services (TPS). Conséquemment, les dispositions de la TVD décrites dans cette page et dans d'autres publications ont expiré le 30 juin 2010.

A compter du 1^{er} juillet 2010, cette publication fait partie des archives pour la TVD **seulement**. Puisque ce document reflète la loi de la TVD qui était en vigueur au moment où il fut publié et peut ne plus être valide, veuillez l'utiliser avec prudence.

- Les renseignements contenus dans le présent Guide décrivent les responsabilités d'un entrepreneur non résident qui obtient un contrat en vue d'effectuer des travaux de construction en Ontario, ainsi que celles de ses clients ontariens. Veuillez prendre note que le présent Guide remplace la version précédente publiée en mars 2001.

Définition d'un entrepreneur non résident

Un entrepreneur non résident est un entrepreneur en construction dont le siège social est situé à l'extérieur de l'Ontario et qui a obtenu un contrat de construction pour effectuer des travaux en Ontario, mais qui n'a pas tenu de façon continue un établissement stable en Ontario au cours des douze mois qui ont précédé la signature du contrat, ou qui n'est pas une société constituée en Ontario. Un contrat de construction est un contrat pour ériger, remodeler ou réparer un bâtiment ou autre structure situé sur un terrain.

Un entrepreneur est une personne qui se livre à la construction, la modification, la réparation ou la rénovation de biens immobiliers et s'entend, sans s'y limiter,

1. d'un entrepreneur général et d'un sous-traitant,
2. d'un charpentier, d'un maçon, d'un tailleur de pierres, d'un électricien, d'un plâtrier, d'un plombier, d'un peintre, d'un décorateur, d'un paveur et d'un constructeur de ponts,
3. d'un entrepreneur en tôle, en carreaux et en terrazzo, en chauffage, en climatisation, en isolation, en ventilation, en pose de papier peint, en construction de routes, en revêtement de toiture et en ciment,

qui installe ou qui incorpore des articles dans un bien immobilier. (Consultez le Guide de la taxe de vente au détail n° 206F - Biens immobiliers et accessoires fixes).

Inscription et cautionnement

Tout entrepreneur non résident à qui l'on accorde un contrat de construction pour des travaux en Ontario doit s'inscrire auprès du ministère des Finances (ministère), Unité des programmes centralisés, et verser un cautionnement équivalent à 4 p. 100 du total de la valeur de chaque contrat. Ce cautionnement peut être acquitté en espèces, par chèque certifié (libellé à l'ordre du Ministre des Finances), par lettre de crédit ou par certificat de cautionnement.

Afin de s'inscrire auprès du ministère et pour obtenir plus de précisions sur le dépôt d'un cautionnement, les entrepreneurs peuvent communiquer avec l'Unité des programmes centralisés du ministère, 33, rue King Ouest, CP 623, Oshawa, Ontario, L1H 8H7, sans frais 1 866 ONT-TAXS (1 866 668-8297) ou télécopieur 905) 435-3617.

Tout entrepreneur non résident qui vend et qui fournit seulement des biens taxables à des clients de l'Ontario, ou qui fournit des services taxables en Ontario, peut obtenir un permis de vendeur régulier lui permettant de percevoir et remettre la TVD sur ses ventes. Tout entrepreneur non résident à qui un permis de vendeur régulier a été émis doit tout de même s'inscrire séparément auprès du ministère et verser un cautionnement s'il se voit accorder un contrat de construction en Ontario.

Lettre de conformité

Après avoir reçu le cautionnement, le ministère envoie à l'entrepreneur non résident une lettre de conformité en deux exemplaires attestant que les exigences relatives à la TVD ont bien été respectées. L'entrepreneur doit alors remettre un exemplaire de cette lettre à son client.

S'il omet de le faire, le client doit retenir 4 p. 100 de chaque paiement dû à l'entrepreneur non résident et remettre les sommes retenues au Ministre des Finances (le ministre). Les paiements doivent être envoyés à l'Unité des programmes centralisés en prenant soin d'y joindre les détails du contrat visé. Au lieu d'effectuer ces paiements de 4 p. 100, le client peut remettre au ministre un certificat de cautionnement équivalent à 4 p. 100 du prix contractuel total.

Remarque : Tout client qui néglige d'observer ces règles pourrait être tenu de verser une somme égale à 4 % de tous les montants payables à l'entrepreneur non résident ou tout autre montant qui, de l'avis du ministère, devrait être assujéti à la TVD à la suite de l'exécution du contrat.

Calcul de la TVD

Juste valeur

La TVD doit être versée sur la « juste valeur » des matériaux achetés ou importés en Ontario et utilisés pour l'exécution du contrat en Ontario. Par « juste valeur », on entend :

- le prix d'achat en devises canadiennes;
- tous les frais de manutention et de livraison facturés par le fournisseur; et
- tous les droits de douane ainsi que les taxes de vente et d'accise fédérales (mais non la taxe fédérale sur les produits et services [TPS]).

L'entrepreneur est aussi tenu de payer la TVD aux fournisseurs de l'Ontario au moment de l'achat ou de la location (avec ou sans bail) de services, matériaux, machines ou d'équipement taxables.

Machines et équipement - loués à bail

Lorsque des machines ou un équipement loués auprès d'un fournisseur de l'extérieur de l'Ontario sont apportés dans la province, la TVD est exigible sur les paiements de location pendant toute la période de séjour des machines et de l'équipement en Ontario.

Machines et équipement - appartenant à l'entrepreneur

1. Si un entrepreneur apporte des machines et de l'équipement en Ontario pour une durée inférieure à douze mois, la TVD applicable doit être calculée selon la formule suivante :

$$1/36 \times \text{valeur comptable nette à la date d'importation} \times \text{nombre de mois en Ontario} \times \text{taux de taxe.}$$

Aux fins de cette formule, la TVD est exigible pour chaque mois ou partie de mois pendant lesquels les biens se trouvent en Ontario. En outre, on considère qu'un mois constitue une période de 31 jours consécutifs, et qu'une partie de mois représente plus de 12 jours. La TVD exigible est fondée sur le nombre de jours où les machines et l'équipement se trouvent en Ontario et non sur le nombre de jours d'utilisation effective des machines ou de l'équipement.

Exemple: De l'équipement est apporté en Ontario le 28 mars et sorti de la province le 8 mai. L'équipement a donc séjourné pendant 41 jours dans la province. La TVD est alors payable sur les 31 premiers jours de séjour temporaire en Ontario vs l'usage de l'équipement. Étant donné que la période restante (10 jours) n'est pas considérée comme une partie d'un mois, aucune TVD n'est exigible sur cette période.

1. Si l'on prévoit que les machines ou l'équipement apportés en Ontario resteront dans cette province pendant plus de 12 mois, l'entrepreneur doit payer la TVD selon la formule suivante :

$$\text{valeur comptable nette à la date d'importation} \times \text{taux de taxe}$$

Si, au moment de l'importation des machines et de l'équipement, la durée du séjour n'est pas connue, le vendeur peut appliquer la formule (a). Si, par la suite, il s'avère nécessaire de garder les machines et l'équipement en Ontario pendant une durée dépassant 12 mois, la TVD versée selon (a) pourra être déduite du montant de la TVD payable selon (b).

À l'aide de la formule (a) ou (b) ci-dessus, les entrepreneurs calculeront et remettront la TVD exigible sur la déclaration à produire une fois le contrat dûment exécuté.

Fabrication de matériel à des fins personnelles

Il arrive qu'un entrepreneur doive fabriquer divers éléments, tels que des portes et fenêtres, pour exécuter son contrat de construction. Par fabrication, il faut entendre tout travail effectué dans une usine à l'extérieur d'un chantier de construction, une unité mobile ou un atelier sur un chantier de construction ou à proximité de ce dernier. La fabrication a lieu lors de la transformation de matières brutes en produits fabriqués qui seront utilisés dans l'exécution de contrats immobiliers.

Un entrepreneur est considéré comme un entrepreneur fabricant si :

1. les produits fabriqués sont destinés à un usage personnel dans l'exécution de contrats immobiliers; et que
2. le coût de fabrication des produits dépasse 50 000 \$ par an.

(Consultez le Guide de la taxe de vente au détail no 401F - Entrepreneurs- fabricants).

Contrat avec le gouvernement fédéral

Lorsqu'un entrepreneur non résident conclut un contrat de construction avec le gouvernement fédéral, pour la construction d'un bâtiment et(ou) l'installation d'équipement, c'est la nature de l'équipement qui détermine si le contrat doit être soumissionné sur une base taxe comprise ou taxe non comprise.

Les contrats pour la construction d'un bâtiment et l'installation d'équipement qui dessert directement ce bâtiment (par ex. les ascenseurs, escaliers roulants, luminaires, systèmes de chauffage central, air climatisé, etc.) doivent être soumissionnés sur une base taxe comprise. L'entrepreneur est considéré comme le consommateur des articles utilisés dans l'exécution de ces contrats et doit payer ou rendre compte de la TVD sur les articles utilisés aux fins de ces contrats. Le simple fait qu'un contrat soit conclu avec le gouvernement fédéral ne donne pas droit, en soi, à une exemption.

Les contrats pour l'installation d'équipement qui devient un accessoire fixe et qui ne dessert pas directement un bâtiment (par ex. le matériel de manutention, l'outillage de production, l'équipement de télécommunication et le matériel de formation) peuvent être soumissionnés sur une base taxe non comprise. Les entrepreneurs qui entreprennent des contrats de ce genre sont permis d'acheter un tel équipement en exemption de la TVD en remettant un Certificat d'exemption de taxe valide aux fournisseurs. Seul un entrepreneur non résident inscrit auprès du ministère et ayant versé un cautionnement peut remettre un Certificat d'exemption de taxe.

Exonérations

Il arrive que des entrepreneurs fournissent et installent de l'équipement ou du matériel pour certains clients ayant droit à une exemption de la TVD (par ex. fabricants, conseils de bandes indiennes, agriculteurs et organismes diplomatiques). Une fois installés, l'équipement ou les matériaux deviennent des biens immobiliers s'ils sont fixés en permanence au sol, ou des accessoires fixes s'ils sont fixés de façon permanente à un bâtiment ou une structure immobilière. Étant donné que la responsabilité de la TVD incombe à l'entrepreneur, ce dernier doit communiquer avec le ministère pour déterminer si le client est admissible à l'exonération, avant d'offrir un contrat taxe non comprise.

Indiens inscrits, bandes indiennes et conseils de bandes indiennes

L'entrepreneur non résident peut acheter des matériaux de construction en exemption de la TVD pour certains bâtiments et certaines structures situés dans des réserves. Le coût de ces projets doit être défrayé par un conseil de bande, et les bâtiments doivent servir à des fins communautaires, au bénéfice de la réserve. Dans le cas de contrats pour des projets de construction communautaires exonérés de taxe, le contrat doit être offert sur une base taxe non comprise. L'entrepreneur non résident peut acheter les matériaux sans payer la TVD s'il remet aux fournisseurs un Certificat d'exemption de taxe valide. Comme précisé ci-dessus, seul un entrepreneur non résident inscrit auprès du ministère et ayant versé un cautionnement peut remettre un Certificat d'exemption de taxe. (Consultez le Guide de la taxe de vente au détail n° 204F - Certificats d'exemption de taxe).

Les entrepreneurs non résidents doivent payer eux-mêmes la TVD sur les articles achetés à des fins d'incorporation à un bâtiment ou une structure, érigé à l'intention d'un Indien inscrit particulier dans une réserve. (Consultez le Guide de la taxe de vente au détail n° 808F - Indiens inscrits, bandes indiennes et conseils de bandes indiennes).

Exécution du contrat

Une fois le contrat dûment exécuté, l'entrepreneur qui a dû déposer un cautionnement doit remplir une « Déclaration de la taxe de vente au détail - Entrepreneurs non résidents [PDF - 93 KO] » qui est fournie par le ministère.

Lorsque le cautionnement a été acquitté en espèces ou par chèque certifié, le montant déposé peut être déduit de la TVD que l'entrepreneur doit payer. Si le montant de cette taxe est supérieur au montant déposé, l'entrepreneur doit verser la différence. Dans le cas contraire, si le montant déposé est supérieur au montant de la taxe exigible, la différence lui sera remboursée.

Si, au lieu d'un acquittement en espèces, un certificat de cautionnement a été déposé, ce dernier fera l'objet d'une main-levée une fois que le paiement de la taxe aura été intégralement acquitté. Toutes les déclarations peuvent faire l'objet d'une vérification.

Références législatives

- Loi sur la taxe de vente au détail, paragraphes 19 (2) et 39 (3) 4 et 5
- Règlement 1012 pris en application de la Loi, paragraphes 15.3 (1) (2) (5) (6) et (7)
- Règlement 1013 pris en application de la Loi, articles 1 et 3

Pour plus de renseignements

Les informations contenues dans cette publication ne sont données qu'à titre d'indication. Pour plus de renseignements, adressez-vous au ministère des Finances de l'Ontario en composant le 1 866 ONT-TAXS (1 866 668-8297) ou visitez notre site Web à ontario.ca/finances.

Compagnies de cautionnement reconnues

Publiée septembre 2010

Voici une liste des compagnies d'assurance dont les cautionnements peuvent être acceptés par le gouvernement à titre de garantie.

1. Compagnie canadiennes

Assurance ACE INA
Allstate du Canada, Compagnie d'assurances
Ascentus Ltée, Les Assurances (cautionnement seulement)
Aviva, Compagnie d'Assurance du Canada
AXA Assurances (Canada)
AXA Pacific Compagnie d'assurance
Le Bouclier du Nord Canadien, Compagnie d'Assurance
Certas direct, compagnie d'assurances (cautionnement seulement)
Chubb, Compagnie d'assurances du Canada
Commonwealth, Compagnie d'assurances du Canada
Compagnie d'assurance Chartis du Canada (anciennement La Cie d'assurance commerciale AIG du Canada)
Co-operators General, Compagnie d'assurance
CUMIS, Compagnie d'assurances générales
La Dominion du Canada, Compagnie d'assurances générales
Échelon, Compagnie D'Assurances Générale (cautionnement seulement)
Economical, Compagnie Mutuelle d'Assurance
Elite, Compagnie d'assurances
La Compagnie d'Assurance Everest du Canada
Federated, Compagnie d'assurances du Canada
Federation, Compagnie d'assurances du Canada
La Compagnie d'assurance et de Garantie Grain
Gore Mutual Insurance Company
The Guarantee, Compagnie d'Amérique du Nord
Industrielle Alliance Pacifique, Compagnie d'Assurances Générales
Intact Compagnie d'assurance
Jevco, Compagnie d'assurances (cautionnement seulement)
Compagnie canadienne d'assurances générales Lombard
Compagnie d'assurance Lombard
Markel, Compagnie d'assurances du Canada
Missisquoi, Compagnie d'assurances
La Nordique compagnie d'assurance du Canada
The North Waterloo Farmers Mutual Insurance Company (fidélité du personnel seulement)
Novex Compagnie d'assurance (fidélité du personnel seulement)
La Personnelle, compagnie d'assurances
La Compagnie d'Assurance Pilot
Compagnie d'Assurance du Québec
Royal & Sun Alliance du Canada, société d'assurances
Saskatchewan Mutual Insurance Company
Compagnie d'Assurance Scottish & York Limitée
La Souveraine, Compagnie d'Assurance Générale
TD, Compagnie d'assurances générales
Temple, La compagnie d'assurance
Traders, Compagnie d'assurances générales
La Compagnie Travelers Garantie du Canada
Compagnie d'Assurance Trisura Garantie

Waterloo, Compagnie d'assurance
La Compagnie Mutuelle d'Assurance Wawanesa
Western, Compagnie d'assurances
Western, Compagnie de garantie

2. Compagnie provinciales

Les cautionnements de garantie des compagnies suivantes peuvent être acceptés à condition que le contrat de garantie soit conclu dans une province où la compagnie est autorisée à faire affaires, comme il est indiquée entre parenthèses.

AXA Boréal Assurances Inc. (I.-P.-É., N.-B., Qué., Ont., Man., C.-B.)
ALPHA, Compagnie d'assurances Inc. (Québec)
Canada West Insurance Company (Ont., Man., Sask., Alb., C.-B., T.-N.-O.) (cautionnement seulement)
La Capitale assurances générales inc. (T.-N.-L., N.-É., I.-P.-É., Qué. (cautionnement seulement), Man., Sask., Alb. C.-B., Nun., T.-N.-O., Yuk.)
Coachman Insurance Company (Ont.)
La Compagnie d'Assurance Continental Casualty (T.-N.-L., N.-É., I.-P.-É., N.-B., Qué., Ont., Man., Sask., Alb. C.-B., Nun., T.-N.-O., Yuk.)
GCAN Compagnie d'assurances (T.-N.-L., N.-É., I.-P.-É., N.-B., Qué., Ont., Man., Sask., Alb. C.-B., Nun., T.-N.-O., Yuk.)
The Insurance Company of Prince Edward Island (N.-É., I.-P.-É., N.-B.)
Kingsway Compagnie d'assurances générales (N.-É., N.-B., Qué., Ont., Man., Sask., Alb., et C.-B.)
La Compagnie d'Assurance Liberté Mutuelle (T.-N.-L., N.-É., I.-P.-É., N.-B., Qué., Ont., Man., Sask., Alb. C.-B., Nun., T.-N.-O., Yuk.)
Norgroupe Assurances Générales Inc.
Orléans, compagnie d'assurance générale (N.-B., Qué., Ont.)
Saskatchewan Government Insurance Office (Sask.)
SGI CANADA Insurance Services Ltd. (Ont., Man., Sask., Alb.)
Société d'assurance publique du Manitoba (Man.)
Union Canadienne, Compagnie d'assurances (Québec)
L'Unique assurances générales inc. (T.-N.-L., N.-É., I.-P.-É., N.-B., Qué. (cautionnement seulement), Ont. (cautionnement seulement), Man., Sask., Alb. C.-B. (cautionnement seulement), Nun., T.-N.-O., Yuk.)

3. Compagnie étrangères

Aspen Insurance UK Limited
Compagnie Française d'Assurance pour le Commerce Extérieur (fidélité du personnel seulement)
Eagle Star Insurance Company Limited
Société des Assurances Ecclésiastiques (fidélité du personnel seulement)
Lloyd's, Les Souscripteurs du
Mitsui Sumitomo Insurance Company, Limited
NIPPONKOA Insurance Company, Limited
Assurances Sampo du Japon
Tokio Maritime & Nichido Incendie Compagnie d'Assurances Ltée
XL Insurance Company Limited (cautionnement seulement)
Zurich Compagnie d'Assurances SA

Articles de convention

Contrat de construction – Articles de convention
(23/01/2002)

- A1 Contrat
- A2 Description des travaux et date d'achèvement
- A3 Prix du contrat
- A4 Adresse de l'entrepreneur
- A5 Tableau des prix unitaires

Articles de convention

Les présents Articles de convention faits en double le 8^{ième} jour de janvier, 2015

Entre

Sa Majesté la Reine, du chef du Canada (ci-après appelé “ Sa Majesté”) représentée par le Conseil National recherches du Canada. (ci-après appelé “ le Conseil”)

Et Les installations électriques Pichette Inc.

(ci-après appelé “l’Entrepreneur”)

Font foi que sa Majesté et l’Entrepreneur ont établi entre eux les conventions suivantes:

A1 Contrats

(23/01/2002)

1.1 Sous réserve des paragraphes A1.4 and A1.5, les documents constituant le contrat passé entre Sa Majesté et l’Entrepreneur (ci-après appelé le Contrat) sont:

- 1.1.1 les présents Articles de convention;
- 1.1.2 les documents intitulés “Plans et devis” et annexés aux présentes sous la cote “A”;
- 1.1.3 le document intitulé “Modalités de paiement” et annexé aux présentes sous la cote “B”;
- 1.1.4 le document intitulé, “Conditions générales” et annexé aux présentes sous la cote “C”;
- 1.1.5 le document intitulé, “Conditions de travail” et annexé aux présentes sous la cote “D”;
- 1.1.6 le document intitulé, “Conditions d’assurance” et annexé aux présentes sous la cote “E”;
- 1.1.7 le document intitulé, “Conditions de garantie du contract” et annexé aux présentes sous la cote “F”; et
- 1.1.8 toute modification au Contract en accord avec le Conditions générales.
- 1.1.9 le document intitulé “Échelles de juste salaire pour les contrats fédéraux de construction”, désigné dans le présent document par l’appellation “Échelles de justes salaires”.

Articles de Convention

1.2 Le Conseil désigne de **SAGI** du CNRC, du gouvernement du Canada, Ingénieur aux fins du Contrat et à toute fin, y compris aux fins accessoires, l'adresse de l'Ingénieur est réputée être:

1.3 Dans le Contrat

1.3.1 "Entente à prix fixe" désigne la partie du Contrat où il est stipulé qu'un paiement global sera fait en contrepartie de l'exécution des travaux auxquels elle se rapporte; et

1.3.2 "Entente à prix unitaire" désigne la partie du Contrat où il est stipulé que le produit d'un prix multiplié par un nombre d'unité de mesurage d'une catégorie sera versé à titre de paiement pour l'exécution des travaux visés par cette entente.

1.4 Toute dispositions du Contrat qui s'applique expressément et seulement à une Entente à prix unitaire ne s'applique à aucune partie des travaux qui relève de l' Entente à prix fixe.

1.5 Toute dispositions du Contrat qui s'applique expressément et seulement à une Entente à prix fixe ne s'applique à aucune partie des travaux qui relève de l' Entente à prix Unitaire.

A2 Description des travaux et date d'achèvement (23/01/2002)

2.1 Entre la date des présentes Articles de convention et le jour de , l'Entrepreneur exécute, avec soin et selon le règles de l'art, à l'endroit et de la manière indiquée, les travaux suivants :

plus particulièrement décrits dans les Plans et devis, incluant les addenda no.

Articles de Convention

A3 Prix du marché

(23/01/2002)

- 3.1 Sous réserve de toute addition, soustraction, déduction, réduction ou compensation prévue en vertu du Contrat, Sa Majesté, aux dates et de la manière énoncées ou mentionnées dans les Modalités de paiement, paie à l'Entrepreneur:
- 3.1.1 la somme de \$ (TPS/TVH en sus), en considération et l'exécution des travaux ou des parties de travaux à laquelle s'applique l'Entente à prix fixe, et
- 3.1.2 une somme égale à l'ensemble des produits du nombre d'unités de mesurage de chaque catégorie de travail, d'outillage ou de matériaux indiqué dans le Certificat définitif de mesurage mentionné ou paragraphe CG44.8, ce nombre d'unités étant multiplié selon le cas par le prix de chaque unité indiquée dans le Tableau des prix unitaires relativement à l'exécution des travaux ou des parties de travaux qui ont fait l'objet d'une Entente à prix unitaire.
- 3.2 Pour le gouverne de l' Entrepreneur et des personnes chargées de l'exécution du Contrat au nom de sa Majesté, mais sans toutefois comporter une garantie ou un engagement de quelque nature de la part de l'une ou l'autre partie, il est estimé que la somme totale payable par Sa Majesté à l'Entrepreneur pour la partie des travaux qui a fait l'objet d'une Entente à prix unitaire, sera d'environ N/A \$
- 3.3 L'alinéa A3.1.1 ne s'applique qu'à une Entente à prix fixe.
- 3.4 L'alinéa A3.1.2 et le paragraphe A3.2 ne s'appliquent qu'à une Entente à prix unitaire.

A4 Adresse de L'Entrepreneur

(23/01/2002)

- 4.1 Aux fins du Contrat, y compris les fins accessoires, l'adresse de l'Entrepreneur est réputé être:

Articles de Convention

A5 Tableau des prix unitaires

(23/01/2002)

5.1 Il est convenu entre Sa Majesté et l'Entrepreneur que le tableau ci-après est le Tableau des prix unitaires pour le Contrat:

Colonne 1 Postes	Colonne 2 Catégorie de travail outillage ou de matériaux	Colonne 3 Unité de mesurage	Colonne 4 Quantité totale estimative	Colonne 5 Prix unitaire	Colonne 6 Prix total estimatif
		N/A			

5.2 Le Tableau des prix unitaires présenté au paragraphe A5.1 décrit la partie des travaux visée par l'Entente à prix unitaire.

5.3 La partie des travaux qui n'est pas décrite dans le Tableau des prix unitaires mentionné au paragraphe A5.2 est la partie des travaux visée par l'Entente à prix fixe.

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1. DESCRIPTION DES TRAVAUX

- .1 Les travaux visés par le présent contrat comprennent le remplacement d'équipement de climatisation et de refroidissement dans l'édifice U-66 du Conseil national de recherches.

2. DESSINS

Les dessins suivants illustrent les travaux exécutés et font partie du présent contrat.

- | | | |
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| .23 | 5201-E06 | PARTIAL SECOND FLOOR – ELECTRICAL NEW WORK |
| .24 | 5201-E07 | PENTHOUSE 301 AND ROOF – ELECTRICAL WORK |
| .25 | 5201-E08 | PENTHOUSE 301 AND ROOF – ELECTRICAL NEW WORK |

.26	5201-E09	PARTIAL SINGLE LINE DIAGRAMS – DEMOLITION AND NEW
.27	5201-E10	SCHEDULES AND DETAILS

3. ACHÈVEMENT DES TRAVAUX

- .1 Terminer tous les travaux dans les 12 semaines qui suivent la réception de l'avis d'acceptation de la soumission.

4. GÉNÉRALITÉS

- .1 Sans objet en français.
- .2 Fournir les items mentionnés dans les dessins ou dans les spécifications

5. MATÉRIEL ET PRODUITS SPÉCIFIÉS, DÉSIGNÉS ACCEPTABLES OU SUBSTITUTS

- .1 Les produits et le matériel spécifiés dans les dessins ou les devis ont été sélectionnés dans le but d'établir des normes de rendement et de qualité. Dans la plupart des cas, lorsque l'on précise la marque de commerce et le numéro de modèle de tout produit ou matériel, on indique aussi les noms d'autres fabricants qui seraient acceptables. Les entrepreneurs peuvent calculer le montant de leur soumission en se fondant sur les prix des produits et du matériel fournis par n'importe quel des fabricants désignés comme étant des fournisseurs acceptables de produits ou de matériel particuliers.
- .2 En plus des fabricants spécifiés ou désignés comme étant acceptables, vous pouvez demander au représentant ministériel d'approuver d'autres fabricants, produits ou matériel. Pour faire approuver un produit en tant que substitut, vous devez remettre une demande par écrit au représentant ministériel au cours de la période fixée pour soumissionner, au plus tard sept (7) jours ouvrables avant la clôture de l'appel d'offres.
- .3 Vous devez attester par écrit que le substitut répond à toutes les exigences relatives aux dimensions, à la capacité, au rendement et à la qualité du matériel ou des produits spécifiés. En outre, il est entendu que l'entrepreneur assume tous les coûts qui sont reliés à l'acceptation des substituts proposés, ou qui en résultent.
- .4 L'approbation des substituts sera communiquée sous forme d'un Addendum aux documents de soumission.
- .5 Nous n'examinerons pas les demandes d'approbation d'autres fabricants, produits ou matériel qui sont incomplets et impossibles à évaluer ou qui sont soumises moins de sept (7) jours avant la clôture de l'appel d'offres.

6. NORMES MINIMALES

- .1 Se conformer aux exigences des normes minimales acceptables des divers codes fédéraux, provinciaux et municipaux pertinents tels le Code national du bâtiment, le Code national de prévention des incendies, le Code canadien de la plomberie, le Code canadien de l'électricité, le Code canadien de la sécurité sur les chantiers de construction et la Loi provinciale sur la sécurité dans la construction, ou les dépasser.

- .2 Effectuer les travaux conformément aux normes et codes dont il est fait mention, en vigueur ou révisés à la date de publication du présent devis.

7. SYSTÈME D'INFORMATION SUR LES MATIÈRES DANGEREUSES UTILISÉES AU TRAVAIL (SIMDUT)

- .1 L'entrepreneur doit se conformer aux lois fédérales et provinciales portant sur le SIMDUT. Les responsabilités de l'entrepreneur comprennent les tâches suivantes, sans s'y limiter :
 - .1 S'assurer de l'étiquetage acceptable de tout produit contrôlé introduit sur les lieux des travaux par l'entrepreneur lui-même ou un sous-traitant, ou l'un de leurs fournisseurs;
 - .2 Mettre à la disposition des travailleurs et du représentant ministériel des fiches techniques « santé - sécurité » (FTSS) portant sur ces produits contrôlés;
 - .3 Former ses propres ouvriers pour le SIMDUT et les produits contrôlés présents au chantier;
 - .4 Informer les autres entrepreneurs, les sous-traitants, le représentant ministériel, les visiteurs autorisés, ainsi que les représentants des organismes externes d'inspection, de la présence et de l'utilisation de ces produits sur les lieux des travaux.
 - .5 Le contremaître ou le surveillant des travaux doit pouvoir démontrer au représentant ministériel qu'il a reçu une formation portant sur le SIMDUT et qu'il est au courant des exigences de ce système. Le représentant ministériel peut exiger le remplacement de cette personne, si celle-ci ne satisfait pas à l'exigence susmentionnée ou si le SIMDUT n'est pas mis en œuvre de façon acceptable.

8. PRESCRIPTIONS DU RÈGLEMENT 208, SECTION 18(A)

- .1 Tel que prescrit par le Règlement 208 de la Loi sur la santé et la sécurité au travail du Ministère du Travail de l'Ontario, nous vous avisons de la présence possible sur les lieux de travail visés par le présent contrat des matières désignées suivantes:
 - .1 Amiante, Plomb, Mercure, Silice
 - .1 L'entrepreneur général a la responsabilité de s'assurer que tous les éventuels sous-traitants ont reçu une copie de liste des matières désignées qui peuvent être présentes sur le chantier
 - .2 En plus de celles énumérées par la province, il peut également s'y trouver les matières désignées suivantes : Biphényles polychlorés
 - .3 L'entrepreneur est donc averti de prendre les mesures de précaution suivantes lorsqu'il est en présence des matières nommées plus haut: se référer au rapport préparé par DST Consulting Engineers.

9. VENTILATION DES COÛTS

- .1 Avant de demander le premier paiement d'acompte, soumettre à l'approbation du représentant ministériel une ventilation des coûts.

- .2 Une fois approuvée, utiliser la ventilation des coûts comme base pour la soumission de toute autre demande.
- .3 Avant de rédiger et de soumettre une demande sous sa forme définitive, obtenir le consentement verbal du représentant ministériel quant au montant de cette demande.

10. SOUS-TRAITANTS

- .1 Dans les 72 heures qui suivent l'acceptation de la soumission, soumettre à l'étude du représentant ministériel une liste complète des sous-traitants.

11. INSIGNES D'IDENTIFICATION ET ENQUÊTES DE SÉCURITÉ DU PERSONNEL

- .1 Toute personne employée par l'Entrepreneur ou par un de ses sous-traitants et présents sur le chantier doit rencontrer les exigences d'une enquête de sécurité en accord avec la section intitulée Instructions Spéciales aux Soumissionnaires.
- .2 Toutes ces personnes doivent porter et garder visible une insigne d'identification émise par le Bureau de la sécurité du CNRC

12. HEURES DE TRAVAIL ET EXIGENCES D'ESCORTE

- .1 Les heures normales de travail au CNRC sont de 8h00 à 16h30, du lundi au vendredi inclusivement, sauf les congés fériés.
- .2 En tout autre temps, des laissez-passer spéciaux sont nécessaires pour avoir accès au chantier.
- .3 Obtenir la permission du représentant ministériel d'exécuter des tâches particulières avant de planifier tout travail après les heures normales de travail.
- .4 Après les heures normales de travail, il se peut qu'une escorte soit nécessaire. Défrayer les coûts de cette escorte si le représentant ministériel le demande.

13. CALENDRIER DES TRAVAUX

- .1 L'Entrepreneur doit soumettre un calendrier détaillé des travaux, indiquant les dates du début et de la fin des diverses étapes des travaux et le mettre à jour. Il doit remettre ce calendrier au représentant ministériel au plus tard deux semaines après l'adjudication du contrat et avant d'entreprendre tout travail au chantier.
- .2 Informer le représentant ministériel par écrit de toute modification apportée au calendrier,
- .3 7 jours avant la date d'achèvement prévue, planifier de faire une inspection provisoire avec le représentant ministériel.

14. RÉUNIONS

- .1 Tenir régulièrement des réunions aux heures et aux endroits approuvés par le représentant ministériel.
- .2 Aviser toutes les parties intéressées des réunions pour assurer une bonne coordination des travaux.

- .3 Le représentant ministériel déterminera les heures de réunions et assume la responsabilité d'enregistrer et distribuer le procès verbal.

15. DESSINS D'ATELIER

- .1 Soumettre au représentant ministériel, aux fins de vérification, les dessins d'atelier, la documentation et les échantillons prescrit 2 semaines après l'adjudication du contrat.
- .2 Soumettre au représentant ministériel aux fins de vérification, une liste complète de tous les dessins d'atelier, la documentation et les échantillons prescrits et une confirmation écrite des dates de livraison correspondantes dans l'intérieur d'une (1) semaine, suite à la date d'approbation des dessins d'atelier, de la documentation et des échantillons. Cette liste devra être mise à jour sur une base de chaque semaine et n'importe quels changements à la liste devront être immédiatement notifiés par écrit au représentant ministériel.
- .3 Examiner les dessins d'atelier, la documentation et les échantillons avant de les soumettre.
- .4 Sauf avis contraire, soumettre 5 copies de tous les dessins d'atelier, de la documentation, ainsi que des échantillons pour vérification.
- .5 Demeurer responsable des erreurs et des omissions apparaissant dans les dessins d'atelier et la documentation et s'assurer qu'ils sont conformes aux documents contractuels même s'ils sont revus par le représentant ministériel.

16. ÉCHANTILLONS ET MAQUETTES

- .1 Soumettre des échantillons aux dimensions et quantités prescrites.
- .2 Si la couleur, le motif ou la texture sont des facteurs spécifiés, soumettre tout un éventail d'échantillons.
- .3 Monter des modèles et des maquettes au chantier, aux endroits qui conviennent le représentant ministériel.
- .4 Tout travail terminé est vérifié sur place d'après les modèles ou maquettes approuvés qui servent de normes pour la façon et les matériaux.

17. MATÉRIAUX ET MISE EN ŒUVRE

- .1 Pour le présent projet, n'utiliser que des matériaux neufs, sauf si noté autrement.
- .2 Seuls les travaux de première classe seront acceptés, non seulement en ce qui a trait à la sécurité, l'efficacité et la durabilité, mais aussi à l'exactitude du détail et au bon rendement.

18. OUVRAGES ET MATÉRIAUX FOURNIS PAR LE PROPRIÉTAIRE

- .1 Les ouvrages et matériaux non inclus dans ce contrat sont décrits sur les dessins et dans le devis.
- .2 Tous les matériaux retournés au Propriétaire doivent être transportés à un lieu d'entreposage désigné par le représentant ministériel.

- .3 Sauf indication contraire, prendre possession des matériaux fournis par le Propriétaire à leur lieu d'entreposage et assurer leur transport.
- .4 Responsabilités de l'Entrepreneur :
 - .1 les décharger à pied d'œuvre;
 - .2 en faire aussitôt l'inspection et signaler tout article endommagé ou défectueux;
 - .3 par écrit, informer le représentant ministériel des articles qui sont reçus en bon état;
 - .4 les manutentionner à pied d'œuvre, ce qui comprend leur déballage et leur entreposage;
 - .5 Réparer ou remplacer les articles endommagés au chantier.
 - .6 Installer et raccorder les produits finis conformément aux prescriptions.

19. VOIES D'ACCÈS

- .1 Prendre les dispositions nécessaires avec le représentant ministériel avant de commencer les travaux ou avant de transporter des matériaux et du matériel au chantier.
- .2 Obtenir l'approbation du représentant ministériel quant aux moyens d'accès normaux au chantier pendant la période de construction.
- .3 Obtenir l'approbation du représentant ministériel avant de suspendre temporairement les travaux sur le chantier; avant de retourner au chantier et avant de quitter le chantier à la fin des travaux.
- .4 Obtenir l'approbation du représentant ministériel avant de suspendre temporairement les travaux sur le chantier; avant de retourner au chantier et avant de quitter le chantier à la fin des travaux.
- .5 Aménager et entretenir des routes provisoires et assurer leur déneigement pendant les travaux.
- .6 L'Entrepreneur doit réparer et nettoyer les routes qu'il a dû utiliser au cours des travaux.

20. UTILISATION DU CHANTIER

- .1 Limiter les travaux sur le chantier aux secteurs approuvés par le représentant ministériel au moment de la soumission.
- .2 Tous matériel, structures, abris, etc. provisoires doivent se trouver dans les secteurs désignés.
- .3 Limiter le stationnement aux secteurs désignés.

21. ACCEPTATION DU CHANTIER

- .1 Avant d'entreprendre les travaux, l'Entrepreneur doit visiter le chantier et, en compagnie du représentant ministériel, revoir toutes les conditions qui pourraient toucher ses travaux.
- .2 Le début des travaux signifiera l'acceptation des conditions existantes.

22. BUREAU ET TÉLÉPHONE AU CHANTIER

- .1 L'Entrepreneur devra ériger, à ses frais, un bureau temporaire au chantier.

- .2 Au besoin, installer un téléphone et en assurer l'entretien.
- .3 Il est interdit d'utiliser les téléphones du CNRC, sauf en cas d'urgence.

23. INSTALLATIONS SANITAIRES

- .1 Obtenir la permission du représentant ministériel pour utiliser les installations sanitaires existantes.

24. SERVICES PROVISOIRES

- .1 L'Entrepreneur pourra bénéficier d'une source provisoire d'électricité à pied d'œuvre. Il devra fournir, sans frais, tous les raccords et matériaux nécessaires pour assurer ledit service au chantier.
- .2 Fournir et installer tous les centres de distributions, disjoncteurs, conduits, câblage, commutateur de déconnexion, transformateurs nécessaires à partir de la source d'électricité.
- .3 Il n'est permis d'utiliser le courant que pour les outils électriques, l'éclairage, les commandes, les moteurs, et non pas pour chauffer.
- .4 Sur demande, il sera possible de se raccorder provisoirement au réseau de distribution d'eau.
- .5 Assumer tous les frais pour amener l'eau aux endroits nécessaires.
- .6 Se conformer aux exigences du CNRC lors du raccordement aux réseaux existants, conformément aux articles "Coopération" et "Interruptions des services" de cette section".

25. DEVIS DESCRIPTIF, BULLETINS, DESSINS D'ARCHIVES

- .1 L'Entrepreneur doit conserver à pied d'œuvre une (1) copie à jour et en bon état de tous les devis, dessins et bulletins relatifs aux travaux; le représentant ministériel ou ses représentants doivent pouvoir les consulter en tout temps.
- .2 L'Entrepreneur doit annoter au moins une (1) copie du devis et des dessins pour y indiquer tous les travaux tels qu'ils ont été exécutés. Il doit la remettre au représentant ministériel avec la Demande de paiement pour le Certificat définitif d'achèvement des travaux.

26. COOPÉRATION

- .1 Coopérer avec le personnel du CNRC pour que les travaux de recherche courants soient interrompus le moins possible.
- .2 Faire, à l'avance, un calendrier de tous les travaux qui pourraient interrompre le travail normal exécuté dans l'édifice.
- .3 Faire approuver le calendrier par le représentant ministériel.
- .4 Donner un préavis écrit de 72 heures au représentant ministériel avant toute interruption projetée des installations, des secteurs, des corridors, des services mécaniques ou électriques, et attendre son autorisation.

27. MESURES DE PROTECTION ET ÉCRITEAUX AVERTISSEMENT

- .1 Fournir et installer tous les matériaux nécessaires pour protéger le matériel existant.
- .2 Ériger des écrans anti-poussière pour éviter que la poussière et les débris ne se répandent en dehors des limites des travaux.
- .3 Protéger contre la poussière le matériel et le mobilier avec des bâches et coller ces dernières au plancher, au moyen de ruban adhésif, pour que la poussière ne s'infilte pas.
- .4 Réparer ou remplacer, gratuitement et à la satisfaction du représentant ministériel, tout bien du Propriétaire endommagé pendant les travaux.
- .5 Protéger les édifices, les routes, les pelouses, les services, etc. contre tout dommage qui pourrait survenir suite à l'exécution des présents travaux.
- .6 Planifier et coordonner les travaux pour que l'eau, la poussière, etc. ne s'infilte pas dans les édifices.
- .7 Fermer toutes les portes, fenêtres, etc. qui pourraient permettre le passage de la poussière, de vapeurs, etc. dans les autres secteurs de l'édifice.
- .8 Fermer le secteur des travaux à la fin de chaque journée de travail et être responsable des lieux.
- .9 Fournir et installer en permanence des barrières de sécurité appropriées autour du chantier pour éviter que le public et le personnel du CNRC soient blessé pendant l'exécution des travaux.
- .10 Poser des écriteaux d'avertissement pour toutes les situations où il pourrait se produire des blessures (ex : Casque protecteurs obligatoires, danger, travaux, etc.) ou lorsque le représentant ministériel le demande.
- .11 Fournir et installer des abris provisoires au-dessus des entrées et des sorties de l'édifice pour assurer la protection des piétons. Tous ces abris doivent pouvoir résister aux intempéries et à la chute de débris

28. BILINGUISME

- .1 Tous les écriteaux, avis, etc. doivent être bilingues.
- .2 Toute identification de services exigée aux termes du présent contrat.

29. DISPOSITION DES OUVRAGES

- .1 Les localisations des équipements, appareils, raccords et ouvertures tel que spécifiées ou indiquées aux dessins doivent être considérées comme approximatives.
- .2 Situer les équipements, appareils et systèmes de distributions de façon à minimiser les interférences et maximiser l'espace utilisable et en accord avec les instructions du manufacturier pour un accès et entretien sécuritaire
- .3 Engager une personne compétente pour agencer les travaux selon les documents contractuels

30. ÉCARTS ET INTERFÉRENCES

- .1 Avant de débiter les travaux, examiner les dessins et le devis. Signaler aussitôt au représentant ministériel tout écart, défaut, omission ou interférence qui touchent les travaux.
- .2 Si, au cours des travaux, l'Entrepreneur trouve que les plans ne reflètent pas la réalité, il lui incombe de le signaler immédiatement par écrit au représentant ministériel, lequel doit rapidement vérifier les allégations.
- .3 Tout travail exécuté après cette découverte, jusqu'à ce qu'il soit autorisé, doit être fait aux risques de l'Entrepreneur.
- .4 Si des obstacles ou interférences mineures sont décelés en cours d'exécution et qu'ils n'avaient pas été signalés sur la soumission originale ou sur les plans et le devis, fournir et installer des doubles coudes ou des coudes ou modifier le tracé des services pour qu'il soit appropriés aux conditions du chantier, et ce sans frais supplémentaire.
- .5 Prendre les dispositions pour que tous les travaux ne gênent d'aucune façon l'exécution des autres travaux.

31. INSTRUCTIONS DU FABRICANT

- .1 Sauf indications contraires, se conformer aux plus récentes instructions écrites du fabricant concernant les matériaux et le matériel à utiliser et les méthodes de mise en place.
- .2 Aviser le représentant ministériel par écrit de toute divergence entre le présent devis et les instructions du fabricant; le représentant ministériel déterminera alors quel document a priorité.

32. CHAUFFAGE PROVISOIRE ET VENTILATION

- .1 Assumer les frais de la ventilation et du chauffage provisoire utilisés pendant la construction, y compris les frais d'installation, de combustible, d'exploitation, d'entretien et d'enlèvement du matériel.
- .2 Sauf si le représentant ministériel l'a autorisé, il est interdit d'utiliser des appareils de chauffage autonomes répandant des émanations dans les zones de travail.
- .3 Fournir et installer le matériel provisoire de chauffage et de ventilation requis dans les endroits fermés afin de:
 - .1 faciliter l'exécution des travaux.
 - .2 protéger les ouvrages et les matériaux contre l'humidité et le froid.
 - .3 réduire la condensation de l'humidité sur les surfaces à un niveau acceptable.
 - .4 assurer les niveaux de température ambiante et d'humidité indispensables pour l'entreposage, l'installation et la période de séchage requis des matériaux.
 - .5 assurer une ventilation adéquate afin de répondre aux exigences de santé publique concernant la sécurité dans les zones de travail.
- .4 Maintenir une température d'au moins 10o C (50oF) aux endroits spécifiés, partir du début des travaux de finition jusqu'au moment de l'acceptation du bâtiment par le représentant ministériel.

- .1 Maintenir la température ambiante et l'humidité aux niveaux nécessaires pour assurer le bien être du personnel du CNRC.
- .5 Prendre les mesures nécessaires pour empêcher les accumulations dangereuses de poussières, fumées, buées, vapeurs et émanations, dans les zones occupées pendant les travaux de construction, y compris aussi les aires d'entreposage et les installations sanitaires.
 - .1 Évacuer les substances dangereuses de sorte que la santé des occupants ne soit pas mise en danger.
- .6 Assurer une surveillance constante et rigoureuse du fonctionnement du matériel de chauffage et de ventilation.
 - .1 Faire respecter les normes et les codes pertinents.
 - .2 Se conformer aux instructions de l'Agent de prévention des incendies du CNRC, ce qui comprend la désignation, sur demande, de gardiens de sécurité- incendie à temps complet.
 - .3 Faire respecter les normes de sécurité.
 - .4 Doter les appareils de combustion autonomes de mises à l'air libre vers l'extérieur.
- .7 Rédiger les soumissions en supposant que les installations et le matériel neufs ou existants ne pourront être utilisés pour le chauffage et la ventilation provisoire.
- .8 Une fois le contrat adjudgé, le représentant ministériel peut autoriser l'utilisation de l'installation permanente s'il peut y avoir entente sur ce qui suit:
 - .1 conditions d'utilisation, matériel spécial, protection et entretien, remplacement des filtres, etc.;
 - .2 méthodes pour s'assurer que le caloporteur ne sera pas perdu et, dans le cas de la vapeur, entente sur ce qu'il adviendra du condensateur;
 - .3 réduction du prix du contrat (s'il doit être débit);
 - .4 prescriptions pertinentes aux garanties du matériel.

33. INTERRUPTIONS DES SERVICES

- .1 Lorsque les travaux impliquent le raccord a des services existants, exécuter les travaux en temps et manière pré-agrées avec le représentant ministériel et autres autorités ayant juridiction avec le minimum de perturbations au personnel du CNRC, a la circulation véhiculaire et de temps d'interruption du service. L'entrepreneur ne doit en aucun cas opérer les équipements du CNRC.
- .2 Avant de commencer les travaux, établir la localisation et l'étendue des lignes de services dans l'espace de travail et ou affectés par les travaux et aviser le représentant ministériel des constatations.
- .3 Fournir une cédule et obtenir l'approbation du représentant ministériel pour toute interruption ou fermeture de services actif et allouer un préavis de 72 heures.
- .4 Aviser le représentant ministériel immédiatement suivant la rencontre de services inconnus et confirmer la découverte par écrit
- .5 Afin de minimiser les interruptions, prévoir des déviations, des ponts, des sources d'alimentation de rechange, etc., au besoin

- .6 Protéger les services existants comme il se doit et effectuer aussitôt toutes les réparations nécessaires si des dommages surviennent.
- .7 Enlever tous les lignes de services abandonnés tel qu'indiqués dans les documents contractuels et tel qu'approuvé par le représentant ministériel, boucher et ou autrement sceller aux points de coupure. Noter et fournir une copie au représentant ministériel de la localisation de toutes les lignes de services maintenues, déroutées et ou abandonnées

34. DÉCOUPAGE ET RAPIÉÇAGE

- .1 Découper les surfaces existantes de façon à ce que les ouvrages s'agencent correctement entre eux.
- .2 Supprimer tous les articles indiqués ou prescrits.
- .3 Rapiécer et réparer, à la satisfaction du représentant ministériel, les surfaces qui ont été modifiées, découpées ou endommagées, avec des matériaux identiques.
- .4 Là où des nouveaux tuyaux passent à travers des travaux existants, percer une ouverture. La dimension de l'ouverture doit laisser un jeu de 12mm (1/2") autour des tuyaux ou de l'isolation de la tuyauterie. Ne pas percer, ni couper aucune surface sans l'approbation de le représentant ministériel.
- .5 Obtenir l'approbation écrite du représentant ministériel avant de percer des ouvertures dans les pièces de charpente neuves ou existantes.
- .6 Calfeutrer toutes les ouvertures où des câbles, conduits ou tuyaux passent à travers les murs avec un calfeutrante acoustique conforme à CAN/CGSB 19.21-M87.
- .7 Là où des câbles, conduits ou tuyaux passent à travers des murs ou des planchers coupe-feu, remplir l'espace avec des fibres de verre comprimées et calfeutrer avec un calfeutrante en accord avec CAN/CGSB-19.13 et NBC 3.1.7.

35. DISPOSITIFS DE FIXATION

- .1 Sauf autorisation expresse du représentant ministériel, il est interdit d'utiliser des pistolets à charge explosive.
- .2 Se conformer aux exigences de la norme ACNOR A-166, Pistolets d'ancrage à charge explosive.
- .3 Obtenir la permission du représentant ministériel avant d'utiliser tout genre d'outils percussion.

36. SURCHARGE

- .1 S'assurer qu'aucune partie de l'ouvrage ou de l'édifice ne supporte une charge susceptible de compromettre sa sécurité ou de causer une déformation permanente ou un dommage de structure.

37. DRAINAGE

- .1 Assurer le drainage et le pompage temporaires, selon les besoins, afin de garder les excavations et le chantier propres.

38. ENCEINTES ET FERMETURES DE LA CHARPENTE

- .1 Ériger et entretenir toutes les enceintes temporaires nécessaires pour protéger les fondations, le sous-sol, le béton, la maçonnerie, etc. contre le gel ou les dommages.
- .2 Ne pas les enlever tant que tout danger de dommage n'est pas écarté et tant que la cure n'est pas terminée.
- .3 Munir les ouvertures extérieures de fermetures protectrices provisoires à l'épreuve des intempéries, jusqu'à ce que les châssis, les vitres et les portes extérieures soient installés en permanence.
- .4 Fournir et installer des fermetures avec verrou, afin d'assurer la sécurité des installations du CNRC, et en être responsable.
- .5 Sur demande, remettre des clés au personnel de sécurité du CNRC.
- .6 Disposer les ouvrages avec soin et avec précision. Vérifier toutes les dimensions et en être responsable. Situer les points de repère généraux et prendre les mesures nécessaires pour empêcher leur déplacement.
- .7 Pendant toute la durée des travaux, voir à toujours être au courant des conditions du chantier et des travaux exécutés par tous les autres gens de métier, engagés dans le présent projet.
- .8 Sauf indication contraire, dissimuler tous les services, tuyauterie, câblage, conduits, etc. dans les planchers, les murs ou les plafonds.

39. ENTREPOSAGE

- .1 Pour ne pas que les outils, matériaux, etc. soient endommagés ou volés, prévoir un entrepôt et en être responsable.
- .2 Il est interdit d'entreposer des produits inflammables ou explosifs sur le chantier à moins que l'Agent de prévention des incendies du CNRC l'autorise.

40. EXAMEN GÉNÉRAL

- .1 Même si le représentant ministériel revoit périodiquement les travaux de l'Entrepreneur, ceci ne dégage pas l'Entrepreneur de sa responsabilité d'exécuter les travaux conformément aux documents contractuels. L'Entrepreneur doit effectuer son propre contrôle de la qualité pour vérifier si ses travaux sont conformes aux documents contractuels.
- .2 Informer le représentant ministériel de tout obstacles à la bonne conduite des travaux et obtenir son approbation pour la relocalisation

41. INSPECTION DES SERVICES ENFOUIS OU DISSIMULÉS

- .1 Avant de dissimuler tout service installé, s'assurer que tous les organismes d'inspection intéressés, y compris le CNRC, ont inspecté les ouvrages et ont assisté à tous les essais. Dans le cas contraire, l'Entrepreneur peut avoir à les découvrir à ses propres frais.

42. ESSAIS

- .1 A l'achèvement des travaux, ou sur demande du représentant ministériel et (ou) des inspecteurs des organismes locaux en cours d'exécution, et avant que tout service soit couverts et que le rinçage soit terminé, faire l'essai de toutes les installations en présence du représentant ministériel.
- .2 Obtenir tous les certificats d'acceptation ou tous les résultats d'essais des organismes compétents et les remettre le représentant ministériel. Dans le cas contraire, le projet ne sera pas complet.

43. OCCUPATION PARTIELLE

- .1 Le CNRC peut demander une occupation partielle de l'installation si les travaux se poursuivent au-delà de la date d'achèvement prévue.
- .2 Ne pas limiter l'accès à l'édifice, routes et services.
- .3 Ne pas encombrer inutilement le chantier de matériaux ou de matériel.

44. ÉVACUATION DES DÉCHETS

- .1 Évacuer, en toute sécurité hors des terrains du CNRC, tous les déchets, y compris les produits volatils; voir article "Sécurité-incendie et "Sécurité générale", section 01000.

45. NETTOYAGE PENDANT LA CONSTRUCTION

- .1 Sur une base quotidienne, garder les lieux et le secteur adjacent au campus, y compris les toits, exempts de débris et de déchets.
- .2 Apporter sur les lieux des conteneurs destinés à la cueillette des déchets et des débris.

46. NETTOYAGE FINAL

- .1 A la fin des travaux, effectuer le nettoyage final à la satisfaction du représentant ministériel.
- .2 Nettoyer toutes les nouvelles surfaces, les luminaires et les surfaces existantes touchés par les présents travaux, remplacer les filtres, etc.
- .3 Nettoyer tous les couvre-planchers souples et les préparer à recevoir le fini protecteur qui sera appliqué par le personnel du CNRC.

47. GARANTIE

- .1 Voir les conditions générales C, section GC32.
- .2 Veiller à ce que toutes les garanties soient adressées au nom de l'entrepreneur et du Conseil national de recherches du Canada.

48. MANUELS D'ENTRETIEN

- .1 À la fin des travaux et avant la décharge de garantie, soumettre trois (3) exemplaires bilingues des manuels d'entretien ou deux exemplaires de chacune des versions anglaises et françaises.
- .2 Bien relier les données dans des cahiers à couverture rigide pour feuilles volantes.

- .3 Les manuels doivent renfermer les instructions d'exploitation et d'entretien, les garanties, les dessins d'atelier, la documentation technique, etc. touchant les matériaux et les appareils fournis aux termes du présent contrat.

FIN DE SECTION

1. EXIGENCES GÉNÉRALES DE SÉCURITÉ EN CONSTRUCTION

- .1 L'Entrepreneur doit prendre toutes les mesures nécessaires lors de l'exécution du contrat pour protéger le personnel (travailleurs, les visiteurs, le public général, etc...) et la propriété immobilière.
- .2 L'Entrepreneur est le seul responsable pour la sécurité de ses employés, des employés de ses sous-traitants et pour l'initiation, le maintien et la supervision des précautions, programmes et procédures de sécurité en rapport avec l'exécution des travaux.
- .3 L'Entrepreneur doit se conformer à la réglementation et les codes de sécurité Fédéraux, Provinciaux et municipaux et ainsi que la Loi sur la santé et la sécurité au travail (Ontario) à la Commission de la sécurité professionnelle et de l'assurance contre les accidents du travail (CSPAAT). Advenant des conflits entre les dispositions de la législation ou des codes, les dispositions les plus sévères s'appliqueront.
- .4 La révision périodique du travail de l'Entrepreneur par le représentant ministériel en utilisant les critères des documents contractuels ne relève pas l'Entrepreneur de ses responsabilités vis-à-vis la sécurité lors de l'accomplissement des travaux selon les documents contractuels. L'Entrepreneur doit consulter avec le représentant ministériel pour s'assurer que cette responsabilité est acquitte
- .5 L'Entrepreneur doit s'assurer que seulement des personnes compétentes puissent avoir accès et travailler sur le chantier. Tout au cours du contrat toute personne qui n'observe pas ou n'applique pas les règlements de sécurité pourra être renvoyée du chantier.
- .6 Tous les équipements doivent être sécuritaires en bon état de fonctionnement et appropriés pour la tâche.
- .7 Suivant une évaluation du projet et des risques spécifiques au site des travaux, L'Entrepreneur doit développer un Plan de sécurité spécifique au Site
 - .1 Fournir une affiche montée dans un endroit visible du site du projet contenant les informations suivantes :
 - .1 Avis de Projet
 - .2 Politique de Sécurité Spécifique au site
 - .3 Une copie de Loi sur la santé et la sécurité au travail (Ontario)
 - .4 Un schéma du bâtiment indiquant toutes les sorties d'urgence
 - .5 Les procédures en cas d'urgence spécifiques au bâtiment.
 - .6 Une liste de contacts pour le CNRC, l'Entrepreneur et tous les sous-traitants impliqués
 - .7 Toutes fiches signalétiques SIMDUT pertinentes
 - .8 Les numéros téléphoniques d'urgence du CNRC
- .8 L'Entrepreneur doit fournir du personnel compétent pour appliquer son programme de sécurité ainsi que tout article applicable de la Loi sur la santé et la sécurité au travail et pour s'assurer que ces directives sont suivies

- .9 L'Entrepreneur doit orienter tous ces employés ainsi que ceux des sous-traitants sous sa juridiction
- .10 Le représentant ministériel exercera une surveillance pour s'assurer que les exigences de sécurité sont rencontrées, que les documents pertinents sont bien remplis et conservés. Le contrat pourra être annulé et l'Entrepreneur ou ses sous-traitants pourront être renvoyés du chantier advenant le non-respect répétitif des standards de sécurité
- .11 L'Entrepreneur devra rapporter tout accident ou incident qui résulte de l'exécution des travaux par l'Entrepreneur et impliquant l'Entrepreneur, le personnel du CNRC ou le public au représentant ministériel et aux autorités ayant juridiction.
- .12 Si pour effectuer ses travaux, l'entrée dans un laboratoire est requise, l'Entrepreneur devra être fournir une session d'orientation concernant la sécurité et les procédures spécifiques à ce laboratoire à ses employés ainsi qu'à ceux de ses sous-traitants suivant les instructions fournies par le responsable du laboratoire ou le représentant ministériel.

2. EXIGENCES DE SÉCURITÉ INCENDIE

.1 Autorité

1. Le Commissaire des incendies du Canada (CIC) est l'autorité en matière de sécurité incendie au CNRC.
2. Aux fins du présent document, le représentant ministériel est le représentant de la CNRC en charge du projet.
3. Respectez les normes suivantes publiées par le Bureau du commissaire des incendies du Canada:
 - a. Norme 301 'Norme Travaux de construction', juin 1982;
 - b. Norme 302 'Norme Travaux de soudage et de coupage au chalumeau', juin 1982.

.2 Usage du Tabac

1. Il est interdit de fumer dans les immeubles du CNRC, ainsi que sur les toits.
2. Respectez les écriteaux "DÉFENSE DE FUMER".

.3 Travail à chaud

- .1 Vous devez obtenir un permis de 'Travail à chaud' du représentant ministériel avant d'entreprendre des travaux de soudage, de brasage, de brûlage ou d'utilisation de chalumeaux et de salamandres ou d'une flamme nue.
- .2 Avant le début du travail à chaud, réexaminez l'aire de travaux avec le représentant ministériel pour déterminer le niveau de sécurité incendie nécessaire.

.4 Signalisation des Incendies

- .1 Soyez au courant de l'emplacement exact du téléphone et de l'alarme manuelle d'incendie les plus près, ainsi que le numéro de téléphone d'urgence.
- .2 SIGNALER immédiatement tout incident comportant un feu en procédant comme suit :
 - .1 Déclenchez l'alarme manuelle d'incendie le plus près;
 - .2 Téléphonnez au numéro de téléphone d'urgence suivant:

D'UN TÉLÉPHONE DU CNRC

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D'UN AUTRE TÉLÉPHONE

(613) 993-2411

- .3 Lorsque vous signalez un incendie par téléphone, indiquez l'endroit exact du feu, le nom et le numéro du bâtiment, et soyez prêts à vérifier le lieu
- .4 La personne qui déclenche l'alarme manuelle d'incendie doit demeurer sur la scène d'incendie pour fournir les renseignements et les indications nécessaires au personnel du service d'incendie.

.5 Réseaux Détecteurs et Alarmes d'Incendie à l'Intérieur et à l'Extérieur

- .1 N'OBSTRUEZ PAS ET NE FERMEZ PAS LES RÉSEAUX DÉTECTEURS ET ALARMES D'INCENDIE SANS L'AUTORISATION DU REPRÉSENTANT MINISTÉRIEL..
- .2 LORS D'UNE INTERRUPTION D'UN RÉSEAU AVERTISSEUR, DES MESURES SPÉCIALES DÉFINIES PAR LE REPRÉSENTANT MINISTÉRIEL DOIVENT ÊTRE PRISES POUR S'ASSURER QUE LA PROTECTION INCENDIE SOIT MAINTENUE.
- .3 NE LAISSEZ PAS LES RÉSEAUX DÉTECTEURS ET AVERTISSEURS D'INCENDIE INACTIFS A LA FIN D'UNE JOURNÉE DE TRAVAIL SANS AVOIR AVISÉ LE REPRÉSENTANT MINISTÉRIEL ET OBTENU SON AUTORISATION. LE REPRÉSENTANT MINISTÉRIEL DOIT INFORMER L'API DES DÉTAILS À CHAQUE OCCASION.
- .4 N'UTILISEZ PAS LES BORNES D'INCENDIE NI LES RÉSEAUX DE COLONNES MONTANTES ET ROBINETS ARMÉS À D'AUTRES FINS QUE LA LUTTE CONTRE L'INCENDIE SANS L'AUTORISATION DU REPRÉSENTANT MINISTÉRIEL.

.6 Extincteurs d'Incendies

- .1 Fournissez au moins un extincteur à poudre ABC (20 lb) pour chaque site de travail à chaud.
- .2 Fournissez les extincteurs suivants pour les travaux d'asphalte chaud et de toiture:
 - .1 Près du pot de goudron - 1 extincteur à poudre ABC (20 lb);
 - .2 Toiture - 2 extincteurs à poudre ABC (20 lb)..

- .3 Prévoir des extincteurs munis:
 - .1 d'une goupille et d'un sceau;
 - .2 d'un manomètre;
 - .3 d'une étiquette portant la signature d'un préposé d'une compagnie d'entretien d'extincteurs d'incendie.
 - .4 d'une étiquette portant la signature d'un préposé d'une compagnie d'entretien d'extincteurs d'incendie.
- .4 Les extincteurs à l'anhydride carbonique (CO) ne sont pas considérés comme des substituts des extincteurs ci-dessus.

.7 Travaux de Toiture

- .1 Chaudières:
 - .1 Prévoyez l'emplacement des chaudières d'asphalte et le lieu d'entreposage avec le représentant ministériel avant la livraison au chantier. N'installez pas les chaudières sur une toiture ou sur un échafaudage et placez-les à une distance d'au moins 10 m (30 pi) de tout bâtiment..
 - .2 Les chaudières doivent être équipées de thermomètres ou de jauges en bon état de fonctionnement.
 - .3 N'utilisez pas les chaudières à des températures excédant 232C (450F).
 - .4 Assurez une surveillance permanente pendant l'usage des chaudières et fournissez des couvercles de métal pour étouffer les flammes en cas de feu dans les chaudières. Fournissez les extincteurs d'incendie exigés à l'article 2.6.
 - .5 Expliquez les capacités des récipients au représentant ministériel avant le début des travaux
 - .6 Ranger les bouteilles de gaz comprimé debout à une distance d'au moins 6M (20 pieds) de la chaudière.
- .2 Balais à franges ('vadrouilles'):
 - .1 N'utilisez que des balais à franges en fibres de verre pour toitures.
 - .2 Enlevez les balais à franges usagés du lieu de travail à la fin de chaque journée de travail.
- .3 Application au chalumeau::
 - .1 N'UTILISEZ PAS DE CHALUMEAUX À PROXIMITÉ DES MURS.
 - .2 N'UTILISEZ PAS DE CHALUMEAUX POUR APPLIQUER DES MEMBRANES SUR DU BOIS EXPOSÉS OU DANS DES CAVITÉS
 - .3 Assurez une surveillance incendie conformément à l'article 2.9 de la présente section.
- .4 Rangez tous les matériaux combustibles utilisés pour les toitures à une distance d'au moins 3 m (10 pi) de toute structure.

- .5 Les bouteilles de gaz doivent être protégées des dommages mécaniques et maintenues en position verticale et à au moins d'au moins 6m (20 pieds) de la chaudière.

.8 Operations de soudure et de meulage

- .1 L'Entrepreneur doit fournir des couvertures ignifuges, des dispositifs d'extraction de fumée, de écrans et autre équipements similaires pour prévenir l'exposition aux éclairs d'arc de soudure ou étincelles de meulage

.9 Surveillance Incendie

- .1 Assurez une surveillance incendie pendant au moins une heure après la fin d'une journée de travail à chaud.
- .2 Chauffage provisoire : voir la Section 01000, Instructions générales.
- .3 Dotez les équipes de repérage des incendies des extincteurs prévus à l'article 2.6.

.10 Obstruction des voies d'évacuation des chaussées, des couloirs, des portes et des ascenseurs

- .1 Avisez le représentant ministériel avant d'entreprendre tout travail qui entraverait le libre passage du personnel du service d'incendie et de son équipement. Cela englobe toute dérogation à la hauteur libre minimale, à l'édification de barricades et au creusage de tranchées.
- .2 Les parcours d'issue du bâtiment ne doivent nullement être obstrués sans la permission expresse du représentant ministériel, qui s'assurera que des parcours de remplacement seront maintenus.
- .3 Le représentant ministériel avisera l'API de tout obstacle pouvant justifier une planification et des dispositifs de communication plus poussés pour assurer la sécurité des occupants et l'efficacité des interventions de lutte contre l'incendie.

.11 Débris et Déchets

- .1 Limitez autant que possible les détrituts et les déchets et les ranger à une distance d'au moins 20 pieds des chaudières ou des torches.
- .2 Il est interdit de faire brûler des détrituts sur le chantier.
- .3 Bennes à déchets
 - .1 En consultation avec le représentant ministériel, déterminez un emplacement sûr et acceptable avant de livrer la benne au chantier ou installer des chutes.
 - .2 Ne pas excéder la capacité de remplissage des bennes et garder le périmètre libre de tous débris
- .4 Stockage:

- .1 Soyez extrêmement prudents lorsque vous devez stocker des déchets combustibles sur les lieux de travail. Maintenez les lieux le plus propre possible et bien ventilés et respectez les normes de sécurité.
- .2 Déposez les torchons et autres matériaux graisseux ou huileux sujets à la combustion spontanée dans des contenants approuvés et évacuez-les comme exigé au paragraphe 3.1.

.12 Liquides Inflammables

- .1 La manutention, le stockage et l'utilisation de liquides inflammables sont régis par le Code national de prévention des incendies du Canada en vigueur.
- .2 Les liquides inflammables comme l'essence, le kérosène et le naphta, peuvent être gardés sur les lieux pour fins d'usage à brève échéance en quantités ne dépassant pas 45 litres (10 Gal Imp.) , à condition d'être stockés dans les bidons de sûreté portant le sceau d'approbation des LAC (ULC). Le stockage de plus grandes quantités de liquides inflammables aux fins de l'exécution des travaux qui nécessite l'autorisation du représentant ministériel.
- .3 Il est interdit de laisser des liquides inflammable sur les toits après les heures normales de travail
- .4 Il est interdit de transvaser des liquides inflammables à l'intérieur des bâtiments..
- .5 Il est interdit de transvaser des liquides inflammables à proximité de dispositifs à flamme nue ou de tout autre type de dispositif dégageant de la chaleur.
- .6 Il est interdit d'utiliser des liquides inflammables ayant un point d'éclair inférieur à 38C (100F, tels que le naphta ou l'essence, comme solvants ou agents de nettoyage.
- .7 Stockez les liquides résiduels inflammables dans des récipients approuvés situés dans un endroit sûr bien ventilé. Les déchets constitués de liquides inflammables doivent être régulièrement évacués du chantier.
- .8 Lorsque des liquides inflammables, tels que des laques ou des uréthanes, sont utilisés, veillez à ce que la ventilation soit adéquate et éliminer toute source d'inflammation. Prévenez le représentant ministériel avant le début de tels travaux et une fois les travaux achevés.

3. Questions et/ou demandes d'explications

- .1 Adressez vos questions ou demandes d'explications concernant la sécurité incendie au représentant ministériel.

END OF SECTION

Part 1 GENERAL

1.1 Scope of Work

- .1 Provide interior protection prior to demolition work.
- .2 Protection to be constructed in such a fashion so as to afford security, dust and weather resistance.

Part 2 PRODUCTS

2.1 Materials

- .1 1/2" x 4'-0" x 8'-0" wood sheathing.
- .2 3-5/8" metal studding.
- .3 3-1/2" spruce wood, construction grade studding.
- .4 6 mil. polyethylene.
- .5 Vinyl reinforced tarps.

2.2 Erection

- .1 Construct a solid barrier in all locations where window, A/C, or roof modifications are to occur.
- .2 Construct barriers full height and line with polyethylene to ensure dust and watertightness.
- .3 Have a mock-up assembly approved by the Departmental Representative prior to proceeding with the erection.
- .4 Ensure that the barrier does not interfere with the work of the building occupants.

Part 3 SECONDARY PROTECTION

3.1 Dust Walls

- .1 As the work progresses and after all structural work and wall framing have been completed, remove the temporary interior protection walls and construct a 6 mill polyethylene dust wall in its place, to allow finish work to proceed.

- .2 Install wood sheathing in the new window openings temporarily until the new glazing units have been received.
- .3 Inspect walls on a regular basis to ensure integrity of the assembly and to avoid dust and water infiltration to the interior of the building.
- .4 Remove interior protections only when approved by the Departmental Representative.

Part 4 REINSTATEMENTS

4.1 Finishes

- .1 Reinstall the interior finishes affected by this work to the satisfaction of the Departmental Representative.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 CSA International
 - .1 CSA S350-M1980(R2003), Code of Practice for Safety in Demolition of Structures.

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling.

1.3 SITE CONDITIONS

- .1 Review "Designated Substance Report" and take precautions to protect environment.
- .2 If material resembling spray or trowel-applied asbestos or other designated substance listed as hazardous be encountered, stop work, take preventative measures, and notify Departmental Representative immediately.
- .3 Proceed only after receipt of written instructions have been received from Departmental Representative.
- .4 Notify Departmental Representative before disrupting building access or services.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not used.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Inspect building with Departmental Representative and verify extent and location of items designated for removal, disposal, alternative disposal, recycling, salvage and items to remain.
- .2 Cooperate with and coordinate all trades in marking out required locations of floor and wall penetrations necessary to accommodate installation of new services.
- .3 Locate and protect utilities. Preserve active utilities traversing site in operating condition.

- .4 Notify and obtain approval of utility companies before starting demolition.
- .5 Disconnect, cap, plug or divert, as required, existing public utilities within the property where they interfere with the execution of the work, in conformity with the requirements of the authorities having jurisdiction. Mark the location of these and previously capped or plugged services on the site and indicate location (horizontal and vertical) on the record drawings. Support, shore up and maintain pipes and conduits encountered.
- .6 Immediately notify Departmental Representative and utility company concerned in case of damage to any utility or service, designated to remain in place.
- .7 Immediately notify the Departmental Representative should uncharted utility or service be encountered, and await instruction in writing regarding remedial action.

3.2 PREPARATION

- .1 Protection of In-Place Conditions:
 - .1 Prevent movement, settlement, or damage to adjacent structures, utilities, and landscaping features and parts of building to remain in place. Provide bracing and shoring required.
 - .2 Keep noise, dust, and inconvenience to occupants to minimum.
 - .3 Protect building systems, services and equipment.
 - .4 Provide temporary dust screens, covers, railings, supports and other protection as required.
- .2 Demolition/Removal:
 - .1 Remove parts of existing building to permit new construction.

3.3 CUTTING AND CORING

- .1 Coordinate layout and marking of all required coring and cutting locations of existing slabs and walls with all sub-trades.
- .2 Locate existing reinforcement and conduit before coring or cutting existing slabs and walls. Retain an independent testing company to locate existing reinforcement and conduit in the areas of proposed openings and to mark locations on the surfaces of slabs on which the cores and cuts are to be started. X-ray concrete unless other methods can be shown by Contractor to accurately locate reinforcement and conduit. Mark locations and sizes of cores and openings and locations of reinforcement and conduit using indelible markers with red for top bars, green for bottom bars and black for cores, openings and conduit.
- .3 Coring: Do not cut existing reinforcement and conduit when coring existing concrete unless approved in advance by the Departmental Representative. Save the complete length of all cores. Label each core with location taken. Make all cores available for review by Departmental Representative. Dispose of cores only with approval of Departmental Representative.

- .4 Cutting: Do not cut existing reinforcement and conduit when cutting existing concrete unless approved in advance by the Departmental Representative. Core the corners of all openings prior to cutting sides. Saw cut sides. Do not over cut openings. Chip corners square if necessary.
- .5 Wet coring is not acceptable in normally occupied areas of building.
- .6 Carry out all cutting, coring, and drilling activities after normal business hours. Provide minimum 10 days notification to Departmental Representative for such work.

3.4 DISPOSAL

- .1 Dispose of removed materials, to appropriate recycling facilities or reuse facilities except where specified otherwise, in accordance with authority having jurisdiction.

3.5 CLEANING

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 02 62 00.01 – Schedule A – Hazardous Material Table.
- .2 Section 02 82 00.01 – Asbestos Abatement: Minimum Precautions.
- .3 Section 02 82 00.02 – Asbestos Abatement: Intermediate Precautions.
- .4 Section 02 82 00.03 – Asbestos Abatement: Maximum Precautions.
- .5 Work site may involve contact with the following:
 - .1 Asbestos.
 - .2 Lead.
 - .3 Mercury.
 - .4 Silica.
 - .5 Ozone Depleting Substances (ODSs).
 - .6 Mould.
- .6 Canadian Environmental Protection Act, 1999 (CEPA 1999).
 - .1 Export and Import of Hazardous Waste Regulations (SOR/2002-300).
 - .2 Ozone-depleting Substances Regulations, 1998.
 - .3 Federal Halocarbon Regulations, 2003.
- .7 Ontario Environmental Protection Act, R.R.O 1990.
 - .1 General – Waste Management, O. Reg. 347/90, as amended.
- .8 Occupational Health and Safety Act
 - .1 Designated Substances, O.Reg 490/09, as amended
- .9 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .10 National Fire Code of Canada 2015.
- .11 Transportation of Dangerous Goods Act (TDG Act) 1992, (c. 34).
- .12 Transportation of Dangerous Goods Regulations (T-19.01-SOR/2003-400).

1.2 DEFINITIONS

- .1 Dangerous Goods: product, substance, or organism that is specifically listed or meets hazard criteria established in Transportation of Dangerous Goods Regulations.
- .2 Hazardous Material: product, substance, or organism that is used for its original purpose; and that is either dangerous goods or a material that may cause adverse impact to environment or adversely affect health of persons, animals, or plant life when released into the environment.
- .3 Hazardous Material Waste: any hazardous material that is no longer used for its original purpose and that is intended for recycling, treatment or disposal.

- .4 Workplace Hazardous Materials Information System (WHMIS): Canada-wide system designed to give employers and workers information about hazardous materials used in workplace. Under WHMIS, information on hazardous materials is provided on container labels, material safety data sheets (MSDS), and worker education programs. WHMIS is put into effect by combination of federal and provincial laws.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for hazardous materials and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit to NRC Departmental Representative current Material Safety Data Sheet (MSDS) for each hazardous material required prior to bringing hazardous material on site.
 - .3 Submit hazardous materials management plan to NRC Departmental Representative that identifies hazardous materials, their use, their location, personal protective equipment requirements, and disposal arrangements.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Co-ordinate storage of hazardous materials with NRC Departmental Representative and abide by internal requirements for labelling and storage of materials and wastes.
- .2 Store and handle hazardous materials and wastes in accordance with applicable federal and provincial laws, regulations, codes, and guidelines.
- .3 Store and handle flammable and combustible materials in accordance with current National Fire Code of Canada requirements.
- .4 Keep no more than 45 litres of flammable and combustible liquids such as gasoline, kerosene and naphtha for ready use.
 - .1 Store flammable and combustible liquids in approved safety cans bearing the Underwriters' Laboratory of Canada or Factory Mutual seal of approval.
 - .2 Storage of quantities of flammable and combustible liquids exceeding 45 litres for work purposes requires the written approval of the NRC Departmental Representative.
- .5 Transfer of flammable and combustible liquids is prohibited within buildings.
- .6 Do not transfer flammable and combustible liquids in vicinity of open flames or heat-producing devices.
- .7 Do not use flammable liquids having flash point below 38 degrees Celsius, such as naphtha or gasoline as solvents or cleaning agents.
- .8 Store flammable and combustible waste liquids for disposal in approved containers located in safe, ventilated area. Keep quantities to minimum.
- .9 Observe smoking regulations, smoking is prohibited in areas where hazardous materials are stored, used, or handled.
- .10 Storage requirements for quantities of hazardous materials and wastes in excess of 5 kg for solids, and 5 litres for liquids:

- .1 Store hazardous materials and wastes in closed and sealed containers.
- .2 Label containers of hazardous materials and wastes in accordance with WHMIS.
- .3 Store hazardous materials and wastes in containers compatible with that material or waste.
- .4 Segregate incompatible materials and wastes.
- .5 Ensure that different hazardous materials or hazardous wastes are not mixed.
- .6 Store hazardous materials and wastes in secure storage area with controlled access.
- .7 Maintain clear egress from storage area.
- .8 Store hazardous materials and wastes in location that will prevent them from spilling into environment.
- .9 Have appropriate emergency spill response equipment available near storage area, including personal protective equipment.
- .10 Maintain inventory of hazardous materials and wastes, including product name, quantity, and date when storage began.
- .11 Ensure personnel have been trained in accordance with Workplace Hazardous Materials Information System (WHMIS) requirements.
- .12 Report spills or accidents immediately to NRC Departmental Representative. Submit a written spill report to NRC Departmental Representative within 24 hours of incident.

1.5 TRANSPORTATION

- .1 Transport hazardous materials and wastes in accordance with federal Transportation of Dangerous Goods Act, Transportation of Dangerous Goods Regulations, and applicable provincial regulations.
- .2 If exporting hazardous waste to another country, ensure compliance with federal Export and Import of Hazardous Waste Regulations.
- .3 If hazardous waste is generated on site:
 - .1 Co-ordinate transportation and disposal with NRC Departmental Representative.
 - .2 Ensure compliance with applicable federal, provincial and municipal laws and regulations for generators of hazardous waste.
 - .3 Use licensed carrier authorized by provincial authorities to accept subject material.
 - .4 Prior to shipping material obtain written notice from intended hazardous waste treatment or disposal facility that it will accept material and that it is licensed to accept this material.
 - .5 Label container(s) with legible, visible safety marks as prescribed by federal and provincial regulations.
 - .6 Ensure that trained personnel handle, offer for transport, or transport dangerous goods.
 - .7 Provide photocopy of shipping documents and waste manifests to NRC Departmental Representative.

- .8 Track receipt of completed manifest from consignee after shipping dangerous goods. Provide a photocopy of completed manifest to Departmental Representative.
- .9 Report discharge, emission, or escape of hazardous materials immediately to NRC Departmental Representative and appropriate provincial authority. Take reasonable measures to control release.

Part 2 Products

2.1 MATERIALS

- .1 Only bring on site quantity of hazardous materials required to perform work.
- .2 Maintain MSDS in proximity to where materials are being used. Communicate this location to personnel who may have contact with hazardous materials.

Part 3 Execution

3.1 DISPOSAL

- .1 Dispose of hazardous waste materials in accordance with applicable federal and provincial acts, regulations, and guidelines.
- .2 Recycle hazardous wastes for which there is approved, cost effective recycling process available.
- .3 Send hazardous wastes to authorized hazardous waste disposal or treatment facilities.
- .4 Burning, diluting, or mixing hazardous wastes for purpose of disposal is prohibited.
- .5 Disposal of hazardous materials in waterways, storm or sanitary sewers, or in municipal non-hazardous solid waste landfills is prohibited.
- .6 Dispose of hazardous wastes in timely fashion in accordance with applicable provincial regulations.
- .7 Minimize generation of hazardous waste to maximum extent practicable. Take necessary precautions to avoid mixing clean and contaminated wastes.
- .8 Identify and evaluate recycling and reclamation options as alternatives to land disposal, such as:
 - .1 Hazardous wastes recycled in manner constituting disposal.
 - .2 Hazardous waste burned for energy recovery.
 - .3 Lead-acid battery recycling.
 - .4 Hazardous wastes with economically recoverable precious metals.

END OF SECTION

SCHEDULE A: DESIGNATED SUBSTANCES/ HAZARDOUS MATERIALS ^{Note 1}

Environmental Issue	Area of Concern	Required Action
Asbestos-Containing Materials	<p>Friable and non-friable asbestos - containing materials are to be removed as part of this project. Refer to Project-Specific Designated Substances Report for this project further details.</p> <p>Any disturbance and/or removal of this ACM shall be performed by a qualified contractor.</p>	<p>Appropriate asbestos abatement practices must be utilized during the removal of asbestos-containing materials, including the use of proper personal protective equipment, as per Ontario Occupational Health and Safety Act, R.S.O., 1990, O. Reg. 278/05, Designated Substance – Asbestos on Construction Projects and in Buildings and Repair Operations. Asbestos waste is to be disposed of in accordance with O. Reg. 347/90, as amended, General Waste Management.</p> <p>Remove asbestos containing materials in accordance with the requirements of Sections 02 82 00.01, 02 82 00.02, and 02 83 00.03.</p>
Lead	<p>Lead is assumed to be present in concentrations that may result in a health risk during work activities. All paints, and all other surface coatings, including structural support system steel coatings, are considered to be lead-containing in the Room 1022.</p>	<p>Remove or disturb lead-containing materials in accordance with O. Reg. 490/09, Designated Substances, as amended and Ontario Ministry of Labour (MoL) - <i>Guideline: Lead on Construction Projects</i>. Lead is to be disposed of in accordance with O. Reg. 347/90, as amended, General Waste Management.</p> <p>No lead-containing material sampling was performed for lead leachate analysis. The disposal of construction waste containing lead is dependent on leachate testing, as governed by O. Reg. 347/90. Contractor is to retain a competent person prior to disposal to classify lead-containing waste streams as hazardous or non-hazardous for disposal purposes, using the Toxicity Characteristic Leachate Procedure (TCLP) at a certified analytical laboratory. All sampling procedures and submissions shall be approved by the NRC Departmental Representative.</p>
Mercury	<p>Mercury vapour is present in approximately 350 fluorescent light tubes, and in 10 thermostats in the project area.</p>	<p>Remove equipment containing mercury for recycling or disposal, as applicable, in accordance with O. Reg. 490/09, as amended, Designated Substances; Ontario MoL document <i>The Safe Handling of Mercury: A Guide for the Construction Industry</i>, and O. Reg. 347/90, as amended, General Waste Management.</p>

Environmental Issue	Area of Concern	Required Action
Silica	<p>Silica is assumed to be present within the following materials in the project area:</p> <ul style="list-style-type: none"> • Cement, concrete, masonry building materials (brick, terracotta, concrete block, etc.) and associated mortars; • 1'x1' acoustic ceiling tiles; • Plaster materials; • Drywall materials; and • Vinyl flooring products. 	<p>Appropriate work practices must be utilized during the disturbance of these structures in accordance with O. Reg. 490/09, as amended, Designated Substances; and Ontario MoL - <i>Guideline: Silica on Construction Projects</i>.</p>
Ozone-Depleting Substances (ODS)	<p>ODSs are assumed present in two chillers in the project area.</p>	<p>The handling, transport and disposal of ODSs are governed by the following regulations under the Canadian Environmental Protection Act (CEPA), 1999: O.Reg. 463/10, Ozone Depleting Substances and Other Halocarbons; Ozone-depleting Substances Regulations, 1998; and Federal Halocarbon Regulations, 2003.</p> <p>When ODS-containing equipment is taken out of service, the ODS refrigerants must be captured and reclaimed by a licensed technician. The presence of ODS refrigerants within units no longer in service must be verified. If ODS refrigerants are found to be present, they must be captured and reclaimed by a licensed technician, with documentation of the reclamation submitted to the NRC Departmental Representative.</p>
Mould	<p>Five (5) square metres of suspected mould-impacted fibreglass acoustic panels were observed inside ducting, Penthouse Mechanical Room.</p>	<p>Mould remediation should follow the guideline document CCA 82-2004, "Mould Guidelines for the Canadian Construction Industry", 2004.</p>

Note 1: This schedule only summarizes confirmed asbestos-containing materials and other designated substances and hazardous materials. All contractors are to verify site conditions, quantities, and hazardous material locations themselves and base their bids upon their own observations and quantity take-offs for visible materials. Contractors are responsible for understanding and confirming scope of work for project prior to removal or disturbance.

Part 1 General

1.1 SUMMARY

- .1 Comply with requirements of this Section when performing the following work:
 - .1 Removal of non-friable asbestos-containing material, if the material is removed without being broken, cut, drilled, abraded, ground, sanded or vibrated.
 - .2 Removal of non-friable asbestos-containing material, if the material is removed by breaking, cutting, drilling, abrading, grinding or vibrating, if the material is wetted to control the spread of dust and fibres, and the work is only done by non-powered hand-held tools.
- .2 Refer to the following document for details on asbestos-containing materials:
 - .1 Project-Specific Hazardous Materials Survey – Summary Report, Rev.1. Chiller and Ductwork Replacement Project. Building U-66, Ottawa, ON. Prepared by DST Consulting Engineers, Inc. Dated January 19, 2017.

1.2 RELATED SECTIONS

- .1 Section 02 81 01 – Hazardous Materials and Schedule A Table.
- .2 Section 02 82 00.02 – Asbestos Abatement: Intermediate Precautions.
- .3 Section 02 82 00.03 – Asbestos Abatement: Maximum Precautions.

1.3 REFERENCES

- .1 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-1.205-03, Sealer for Application of Asbestos-Fibre Releasing Materials.
- .2 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Protection Act, 1999 (CEPA).
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .4 Transport Canada (TC).
 - .1 Transportation of Dangerous Goods Act, 1992 (TDGA).
- .5 Ontario Environmental Protection Act, R.R.O 1990,
 - .1 General – Waste Management, O. Reg. 347/90, as amended.
- .6 Underwriters' Laboratories of Canada (ULC).
- .7 National Joint Council (NJC).
 - .1 Part XI – Hazardous Substances.
- .8 Ontario Ministry of Labour (MoL).
 - .1 Occupational Health and Safety Act, R.S.O 1990, c. O1 (OSHA)
 - .1 *O.Reg. 278/05 – Designated Substance – Asbestos on Construction Projects and in Buildings and Repair Operations, as amended*

- .2 *Ontario Occupational Health and Safety Act, R.S.O. 1990, Regulation 490/09 "Designated Substances", as amended.*
- .3 *O.Reg. 213/91 - "Construction Projects", as amended.*

1.4 DEFINITIONS

- .1 HEPA vacuum: DOP tested High Efficiency Particulate Air filtered vacuum equipment with filter system capable of collecting and retaining fibres greater than 0.3 microns in any direction at 99.97% efficiency.
- .2 Amended Water: water with non-ionic surfactant wetting agent added to reduce surface tension of water to allow thorough wetting of fibres.
- .3 Asbestos-Containing Materials (ACMs): materials that contain 0.5 percent or more asbestos by dry weight, identified under Existing Conditions including fallen materials and settled dust.
- .4 Asbestos Work Area: area where work takes place which will, or may, disturb ACMs.
- .5 Authorized Visitors: NRC Departmental Representative, and representative(s) of regulatory agencies.
- .6 Competent worker: in relation to specific work, means a worker who:
 - .1 Is qualified because of knowledge, training and experience to perform the work.
 - .2 Is familiar with the provincial laws and with the provisions of the regulations that apply to the work.
 - .3 Has knowledge of all potential or actual danger to health or safety in the work.
- .7 DOP Test: testing method used to determine integrity of unit using Dispersed Oil Particulate (DOP) HEPA-filter leak test.
- .8 Friable material: means material that:
 - .1 When dry, can be crumbled, pulverized or powdered by hand pressure, or is crumbled, pulverized or powdered.
- .9 Hazardous Material Workplan: A brief report identifying the location and quantities of hazardous materials and the methods that will be used to remove, store, transport and dispose of them.
- .10 Non-Friable Material: material that when dry cannot be crumbled, pulverized or powdered by hand pressure.
- .11 Occupied Area: any area of the building or work site that is outside Asbestos Work Area.
- .12 Polyethylene: rip-proof polyethylene sheeting with tape along edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide protection and isolation.
- .13 Sprayer: garden reservoir type sprayer or airless spray equipment capable of producing mist or fine spray. Sprayer must have appropriate capacity for work.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit proof satisfactory to the NRC Departmental Representative that suitable arrangements have been made to dispose of asbestos-containing waste in accordance with requirements of authority having jurisdiction.
- .2 Submit Provincial/Territorial and/or local requirements for Notice of Project Form.
- .3 Submit proof of Contractor's Asbestos Liability Insurance.
- .4 Submit to the NRC Departmental Representative necessary permits for transportation and disposal of asbestos-containing waste and proof that asbestos-containing waste has been received and properly disposed.
- .5 Submit proof that all asbestos workers and/or supervisor have received appropriate training and education by a competent person in the hazards of asbestos exposure, good personal hygiene and work practices while working in Asbestos Work Areas, and the use, cleaning and disposal of respirators and protective clothing.
- .6 Submit proof satisfactory to NRC Departmental Representative that employees have appropriate respirator fitting and testing (fit test certificates). Workers must be fit-tested (qualitative as a minimum) with respirator that is personally issued.
- .7 Asbestos abatement section within Hazardous Material Work Plan.

1.6 QUALITY ASSURANCE

- .1 Regulatory Requirements: comply with Federal, Provincial/Territorial, and local requirements pertaining to asbestos, provided that in case of conflict among these requirements or with these specifications, more stringent requirement applies. Comply with regulations in effect at time Work is performed.
- .2 Health and Safety:
Safety Requirements: worker protection.
 - .1 Protective equipment and clothing to be worn by workers while in Asbestos Work Area include:
 - .1 As a minimum, air purifying half-mask respirator with N-100, R-100 or P-100 particulate filter, personally issued to worker and marked as to efficiency and purpose, suitable for protection against asbestos and acceptable to Provincial Authority having jurisdiction. The respirator to be fitted so that there is an effective seal between the respirator and the worker's face, unless the respirator is equipped with a hood or helmet. The respirator to be cleaned, disinfected and inspected after use on each shift, or more often if necessary, when issued for the exclusive use of one worker, or after each use when used by more than one worker. The respirator to have damaged or deteriorated parts replaced prior to being used by a worker; and, when not in use, to be stored in a convenient, clean and sanitary location. The employer to establish written procedures regarding the selection, use and care of respirators, and a copy of the procedures to be provided to and reviewed with each worker who is required to wear a respirator. A worker not to be assigned to an operation requiring the use of a respirator unless he or she is physically able to perform the operation while using the respirator.

- .2 Disposable-type protective clothing (high-density polyethylene protective clothing (Tyvek or similar, as approved by NRC Departmental Representative) that does not readily retain or permit penetration of asbestos fibres. Protective clothing to be provided by the employer and worn by every worker who enters the work area, and the protective clothing shall consist of a head covering and full body covering that fits snugly at the ankles, wrists and neck, in order to prevent asbestos fibres from reaching the garments and skin under the protective clothing to include suitable footwear, and to be repaired or replaced if torn.
- .2 Eating, drinking, chewing, and smoking are not permitted in Asbestos Work Area.
- .3 Before leaving Asbestos Work Area, the worker can decontaminate his or her protective clothing by using a vacuum equipped with a HEPA filter, or by damp wiping, before removing the protective clothing, or, if the protective clothing will not be reused, place it in a container for dust and waste. The container to be dust tight, suitable for asbestos waste, impervious to asbestos, identified as asbestos waste, cleaned with a damp cloth or a vacuum equipped with a HEPA filter immediately before removal from the work area, and removed from the work area frequently and at regular intervals.
- .4 Facilities for washing hands and face shall be provided within or close to the Asbestos Work Area.
- .5 Ensure workers wash hands and face when leaving Asbestos Work Area.
- .6 Ensure that no person required to enter an Asbestos Work Area has facial hair that affects seal between respirator and face.

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .2 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .3 Separate for reuse, and recycling and place in designated containers steel, metal, plastic waste in accordance with Waste Management Plan.
- .4 Place materials defined as hazardous or toxic in designated containers. Location and transportation of all on-site waste containers must be approved by NRC Departmental Representative in writing prior to work.
- .5 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.
- .6 Fold up metal banding, flatten and place in designated area for recycling.
- .7 Disposal of asbestos waste generated by removal activities must comply with Federal, Provincial, Territorial and Municipal regulations. Dispose of asbestos waste in sealed double thickness 0.15 mm thick bags or leak proof drums. Label containers with appropriate warning labels.
- .8 Provide waste manifests describing and listing waste created. Transport containers by approved means to licensed landfill for burial. All waste landfill

manifests are to be provided to the Client/Client Representative at the end of the project.

1.8 EXISTING CONDITIONS

- .1 Refer to the following document for details on asbestos-containing materials:
 - .1 Project-Specific Hazardous Materials Survey – Summary Report, Rev.1. Chiller and Ductwork Replacement Project. Building U-66, Ottawa, ON. Prepared by DST Consulting Engineers, Inc. Dated January 19, 2017.
 - .2 Verification of visible quantities of asbestos-containing materials and site conditions are the responsibility of the bidding contractor. Contractors are to verify all site conditions themselves and base their abatement bids upon their own observations and quantity take-offs. Bidding contractors are to draw their own conclusions with respect to site conditions and/or factors that may affect their work.
 - .3 Notify NRC Departmental Representative of asbestos-containing material discovered during Work and not apparent from drawings, specifications, or report pertaining to Work. Do not disturb such material pending instructions from NRC Departmental Representative.

1.9 SCHEDULING

- .1 Hours of Work: perform work involving asbestos abatement located at the Building during hours specified by NRC Departmental Representative. **The work schedule must be approved in writing by the NRC Departmental Representative in advance of work.** Contractor shall be available to work continuously from beginning to end of project.

1.10 PERSONNEL TRAINING

- .1 Before beginning Work, provide NRC Departmental Representative with satisfactory proof that every worker has had instruction and training in hazards of asbestos exposure, in personal hygiene and work practices, and in use, cleaning, and disposal of respirators and protective clothing.
- .2 Instruction and training related to respirators includes, following minimum requirements:
 - .1 Fitting of equipment.
 - .2 Inspection and maintenance of equipment.
 - .3 Disinfecting of equipment.
 - .4 Limitations of equipment.
- .3 Instruction and training must be provided by a competent, qualified person.

Part 2 Products

2.1 MATERIALS

- .1 Drop Sheets:
 - .1 Polyethylene: 0.15 mm thick.
 - .2 FR polyethylene: 0.15 mm thick woven fibre reinforced fabric bonded both sides with polyethylene.

- .2 Wetting Agent: 50% polyoxyethylene ester and 50% polyoxyethylene ether mixed with water in a concentration to provide thorough wetting of asbestos-containing material.
- .3 Waste Containers: contain waste in two separate containers.
 - .1 Inner container: 0.15 mm thick sealable polyethylene waste bag.
 - .2 Outer container: sealable metal or fibre type where there are sharp objects included in waste material; otherwise outer container may be sealable metal or fibre type or second 0.15 mm thick sealable polyethylene bag.
 - .3 Labelling requirements: affix preprinted cautionary asbestos warning in both official languages that is visible when ready for removal to disposal site.

Part 3 Execution

3.1 SUPERVISION

- .1 Minimum of one Supervisor for every ten workers is required inside the asbestos work areas at all times.
- .2 Approved Supervisor must remain within Asbestos Work Area during disturbance, removal, or other handling of asbestos-containing materials.

3.2 PROCEDURES

- .1 Before beginning Work, isolate Asbestos Work Area using, at a minimum, preprinted cautionary asbestos warning signs in both official languages that are visible at access routes to Asbestos Work Area.
 - .1 Remove visible dust from surfaces in the work area where dust is likely to be disturbed during course of work.
 - .2 Use HEPA vacuum, or damp cloths where damp cleaning does not create a hazard and is otherwise appropriate.
 - .3 Do not use compressed air to clean up or remove dust from any surface.
- .2 Prevent spread of dust from Asbestos Work Area using measures appropriate to work to be done.
 - .1 Use FR polyethylene drop sheets over flooring such as carpeting that absorbs dust and over flooring in Asbestos Work Area where dust and contamination cannot otherwise be safely contained.
- .3 Wet materials containing asbestos to be cut, ground, abraded, scraped, drilled, or otherwise disturbed unless wetting creates hazard or causes damage.
 - .1 Use garden reservoir type low - velocity fine - mist sprayer.
 - .2 Perform Work to reduce dust creation to lowest levels practicable.
 - .3 Work will be subject to visual inspection.
 - .4 Contamination of surrounding areas indicated by visual inspection or air monitoring will require complete enclosure and clean-up of affected areas.
- .4 Cutting, shaping, grinding, drilling, abrading or otherwise disturbing non-friable asbestos-containing materials shall be executed using non-powered hand-tools only.
- .5 Clean-Up:

- .1 Frequently during Work and immediately after completion of Work, clean up dust and asbestos-containing waste using HEPA vacuum or by damp mopping.
- .2 Place dust and asbestos-containing waste in sealed dust-tight waste bags. Treat drop sheets and disposable protective clothing as asbestos waste; wet and fold these items to contain dust, then place in plastic bags.
- .3 Clean exterior of each waste-filled bag using damp cloths or HEPA vacuum and place in second clean waste bag immediately prior to removal from Asbestos Work Area.
- .4 Seal waste bags and remove from site. Dispose of in accordance with requirements of Provincial and Federal Authority having jurisdiction. Supervise dumping and ensure that dump operator is fully aware of hazardous nature of material to be dumped and that guidelines and regulations for asbestos disposal are followed.
- .5 Perform final thorough clean-up of Work areas and adjacent areas affected by Work using HEPA vacuum.

3.3 INSPECTION

- .1 Perform inspection of Asbestos Work Area to confirm compliance with specification and governing authority requirements. Deviation(s) from these requirements that have not been approved in writing by NRC Departmental Representative may result in Work stoppage, at no cost to Owner.
- .2 NRC Departmental Representative may inspect Work at any time during the project for:
 - .1 Adherence to specific procedures and materials.
 - .2 Final cleanliness and completion.
 - .3 No additional costs will be allowed by Contractor for additional labour or materials required to provide specified performance level.
- .3 When asbestos leakage from Asbestos Work Area has occurred or is likely to occur NRC Departmental Representative may order Work shutdown.
- .4 No additional costs will be allowed by the Contractor for additional labour or materials required to provide specified performance level.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Comply with requirements of this Section when performing the following Work:
 - .1 The removal or disturbance of one square metre or less of friable asbestos-containing material.
 - .2 Removing non-friable asbestos containing materials by breaking, cutting, drilling, abrading, grinding, sanding or vibrating if the work is done by means of power tools that are attached to dust-collecting devices equipped with HEPA filters.
 - .3 Glove bag and removal of good condition, friable, asbestos-containing material.
- .2 Refer to the following document for details on asbestos containing materials:
 - .1 Project-Specific Hazardous Materials Survey – Summary Report, Rev.1. Chiller and Ductwork Replacement Project. Building U-66, Ottawa, ON. Prepared by DST Consulting Engineers, Inc. Dated January 19, 2017.

1.2 RELATED SECTIONS

- .1 Section 02 81 01 – Hazardous Materials and Schedule A Table
- .2 Section 02 82 00.01 – Asbestos Abatement: Minimum Precautions.
- .3 Section 02 82 00.03 – Asbestos Abatement: Maximum Precautions.

1.3 REFERENCES

- .1 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-1.205-03, Sealer for Application of Asbestos-Fibre Releasing Materials.
- .2 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Protection Act, 1999 (CEPA).
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .4 Transport Canada (TC).
 - .1 Transportation of Dangerous Goods Act, 1992 (TDGA).
- .5 Ontario Environmental Protection Act, R.R.O 1990,
 - .1 General – Waste Management, O. Reg. 347/90, as amended.
- .6 Underwriters' Laboratories of Canada (ULC).
- .7 National Joint Council (NJC).
 - .1 Part XI – Hazardous Substances.
- .8 Ontario Ministry of Labour (MoL).
 - .1 Occupational Health and Safety Act, R.S.O 1990, c. O1 (OSHA)

- .1 *O.Reg. 278/05 – Designated Substance – Asbestos on Construction Projects and in Buildings and Repair Operations, as amended*
- .2 *Ontario Occupational Health and Safety Act, R.S.O. 1990, Regulation 490/09 “Designated Substances”, as amended.*
- .3 *O.Reg 213/91 - “Construction Projects”, as amended.*

1.4 DEFINITIONS

- .1 Amended Water: water with non-ionic surfactant wetting agent added to reduce surface tension of water to allow wetting of fibres.
- .2 Asbestos-Containing Materials (ACMs): materials that contain 0.5 percent or more asbestos by dry weight, identified under Existing Conditions Article, including fallen materials and settled dust.
- .3 Asbestos Work Area: area where work takes place which will, or may disturb ACMs.
- .4 Authorized Visitors: NRC Departmental Representative, and representative(s) of regulatory agencies.
- .5 Competent worker: in relation to specific work, means a worker who:
 - .1 Is qualified because of knowledge, training and experience to perform the work.
 - .2 Is familiar with the provincial laws and with the provisions of the regulations that apply to the work.
 - .3 Has knowledge of all potential or actual danger to health or safety in the work.
- .6 Curtained doorway: arrangement of closures to allow ingress or egress from one room to another while permitting minimal air movement between rooms, typically constructed as follows:
 - .1 Place two overlapping sheets of polyethylene over existing or temporarily framed doorway, secure each along top of doorway, secure vertical edge of one sheet along one vertical side of doorway, and secure vertical edge of other sheet along opposite vertical side of doorway.
 - .2 Reinforce free edges of polyethylene with duct tape and weight bottom edge to ensure proper closing.
 - .3 Overlap each polyethylene sheet at openings not less than 1.5 metres on each side.
- .7 DOP Test: testing method used to determine integrity of Negative Pressure unit using Dispersed Oil Particulate (DOP) HEPA-filter leak test.
- .8 Friable Material: material that when dry can be crumbled, pulverized or powdered by hand pressure and includes such material that is crumbled, pulverized or powdered.
- .9 Glove Bag: prefabricated glove bag as follows:
 - .1 Minimum thickness 0.25 mm (10 mil) polyvinyl-chloride bag.
 - .2 Integral 0.25 mm (10 mil) thick polyvinyl-chloride gloves and elastic ports.

- .3 Equipped with reversible, double-pull, double throw zipper on top and at approximately mid-section of the bag.
- .4 Straps for sealing ends around pipe.
- .5 Must incorporate internal closure strip if it is to be moved or used in more than one specific location.
- .10 Hazardous Material Workplan: A brief report identifying the location and quantities of hazardous materials and the methods that will be used to remove, store, transport and dispose of them.
- .11 HEPA vacuum: DOP tested, High Efficiency Particulate Air filtered vacuum equipment with filter system capable of collecting and retaining fibres greater than 0.3 microns in any dimension at 99.97% efficiency.
- .12 Non-Friable Material: material that when dry cannot be crumbled, pulverized or powdered by hand pressure.
- .13 Polyethylene: polyethylene sheeting or rip proof polyethylene sheeting with tape along edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide protection and isolation.
- .14 Occupied Area: any area of building or work site that is outside Asbestos Work Area.
- .15 Sprayer: garden reservoir type sprayer or airless spray equipment capable of producing mist or fine spray. Must have appropriate capacity for scope of work.

1.5 ACTION AND INFORMATION SUBMITTALS

- .1 Submit proof satisfactory to the NRC Departmental Representative that suitable arrangements have been made to dispose of asbestos-containing waste in accordance with requirements of authority having jurisdiction.
- .2 Submit Provincial/Territorial and/or local requirements for Notice of Project Form.
- .3 Submit proof of Contractor's Asbestos Liability Insurance.
- .4 Submit to the NRC Departmental Representative necessary permits for transportation and disposal of asbestos-containing waste and proof that asbestos-containing waste has been received and properly disposed.
- .5 Submit proof that all asbestos workers and/or supervisor have received appropriate training and education by a competent person in the hazards of asbestos exposure, good personal hygiene and work practices while working in Asbestos Work Areas, and the use, cleaning and disposal of respirators and protective clothing.
- .6 Submit proof that supervisory personnel have attended asbestos abatement course, of not less than two days duration, approved by NRC Departmental Representative. Minimum of one supervisor for every ten workers.
- .7 Submit Worker's Compensation Board status and transcription of insurance.
- .8 Submit documentation including test results, fire and flammability data, and Material Safety Data Sheets (MSDS) for chemicals or materials including:
 - .1 encapsulants;
 - .2 amended water;

- .3 slow-drying sealer.
- .9 Submit proof satisfactory to NRC Departmental Representative that employees have appropriate respirator fitting and testing (fit test certificates). Workers must be fit tested (qualitative as a minimum for Half-face respirator, quantitative for Full-face respirator) with respirator that is personally issued.
- .10 Asbestos abatement section within Hazardous Material Work Plan.

1.6 QUALITY ASSURANCE

- .1 Regulatory Requirements: comply with Federal, Provincial/Territorial and local requirements pertaining to asbestos, provided that in case of conflict among these requirements or with these specifications more stringent requirement applies. Comply with regulations in effect at the time work is performed.
- .2 Health and Safety:
 - .1 Safety Requirements: worker and visitor protection.
 - .1 Protective equipment and clothing to be worn by workers while in Asbestos Work Area include:
 - .1 As a minimum, air purifying respirator with N-100, R-100 or P-100 particulate filter, personally issued to worker and marked as to efficiency and purpose, suitable for protection against asbestos and acceptable to Provincial Authority having jurisdiction. The respirator to be fitted so that there is an effective seal between the respirator and the worker's face, unless the respirator is equipped with a hood or helmet. The respirator to be cleaned, disinfected and inspected after use on each shift, or more often if necessary, when issued for the exclusive use of one worker, or after each use when used by more than one worker. The respirator to have damaged or deteriorated parts replaced prior to being used by a worker; and, when not in use, to be stored in a convenient, clean and sanitary location. The employer to establish written procedures regarding the selection, use and care of respirators, and a copy of the procedures to be provided to and reviewed with each worker who is required to wear a respirator. A worker not to be assigned to an operation requiring the use of a respirator unless he or she is physically able to perform the operation while using the respirator.
 - .2 Disposable-type protective clothing (high-density polyethylene protective clothing (Tyvek or similar, as approved by Client/Client Representative) that does not readily retain or permit penetration of asbestos fibres. Protective clothing to be provided by the employer and worn by every worker who enters the work area, and the protective clothing shall consist of a head covering and full body covering that fits snugly at the ankles, wrists and neck, in order to prevent asbestos fibres from reaching the

garments and skin under the protective clothing to include suitable footwear, and to be repaired or replaced if torn.

- .3 Eating, drinking, chewing, and smoking are not permitted in Asbestos Work Area.
- .4 Before leaving Asbestos Work Area, the worker can decontaminate his or her protective clothing by using a vacuum equipped with a HEPA filter, or by damp wiping, before removing the protective clothing, or, if the protective clothing will not be reused, place it in a container for dust and waste. The container to be dust tight, suitable for asbestos waste, impervious to asbestos, identified as asbestos waste, cleaned with a damp cloth or a vacuum equipped with a HEPA filter immediately before removal from the work area, and removed from the work area frequently and at regular intervals.
- .5 Ensure workers wash hands and face when leaving Asbestos Work Area. Facilities for washing hands and face shall be provided within or close to the Asbestos Work Area.
- .6 Ensure that no person required to enter an Asbestos Work Area has facial hair that affects seal between respirator and face.
- .7 Visitor Protection:
 - .1 Provide protective clothing and approved respirators to Authorized Visitors to work areas.
 - .2 Instruct Authorized Visitors in the use of protective clothing, respirators and procedures.
 - .3 Instruct Authorized Visitors in proper procedures to be followed in entering into and exiting from Asbestos Work Area.

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .2 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .3 Separate for reuse, and recycling and place in designated containers steel, metal, plastic waste in accordance with Waste Management Plan.
- .4 Place materials defined as hazardous or toxic in designated containers.
- .5 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.
- .6 Fold up metal banding, flatten and place in designated area for recycling.
- .7 Disposal of asbestos waste generated by removal activities must comply with Federal, Provincial, Territorial and Municipal regulations. Dispose of asbestos waste in sealed double thickness 0.15 mm thick bags or leak proof drums. Label containers with appropriate warning labels.
- .8 Provide manifests describing and listing waste created. Transport containers by approved means to licenced landfill for burial.

1.8 EXISTING CONDITIONS

- .1 Refer to the following document for details on asbestos-containing materials:
 - .1 Project-Specific Hazardous Materials Survey – Summary Report, Rev.1. Chiller and Ductwork Replacement Project. Building U-66, Ottawa, ON. Prepared by DST Consulting Engineers, Inc. Dated January 19, 2017.
- .2 Verification of visible quantities of asbestos-containing materials and site conditions are the responsibility of the bidding contractor. Contractors are to verify all site conditions themselves and base their abatement bids upon their own observations and quantity take-offs. Bidding contractors are to draw their own conclusions with respect to site conditions and/or factors that may affect their work.
- .3 Notify NRC Departmental Representative of asbestos-containing material discovered during Work and not apparent from drawings, specifications, or report pertaining to Work. Do not disturb such material pending instructions from NRC Departmental Representative.

1.9 SCHEDULING

- .1 Hours of Work: perform work involving asbestos abatement located at the Building during hours specified by NRC Departmental Representative. **The work schedule must be approved in writing by the NRC Departmental Representative in advance of work.** Contractor shall be available to work continuously from beginning to end of project.

1.10 PERSONNEL TRAINING

- .1 Before beginning Work, provide NRC Departmental Representative satisfactory proof that every worker has had instruction and training in hazards of asbestos exposure, in personal hygiene and work practices, and in use, cleaning, and disposal of respirators and protective clothing.
- .2 Instruction and training related to respirators includes, at minimum:
 - .1 Fitting of equipment.
 - .2 Inspection and maintenance of equipment.
 - .3 Disinfecting of equipment.
 - .4 Limitations of equipment.
- .3 Instruction and training must be provided by competent, qualified person.

Part 2 Products

2.1 MATERIALS

- .1 Drop and Enclosure Sheets.
 - .1 Polyethylene: 0.15 mm thick.
 - .2 FR polyethylene: 0.15 mm thick woven fibre reinforced fabric bonded both sides with polyethylene.

- .2 Wetting Agent: 50% polyoxyethylene ester and 50% polyoxyethylene ether mixed with water in concentration to provide thorough wetting of asbestos-containing material.
- .3 Waste Containers: contain waste in two separate containers.
 - .1 Inner container: 0.15 mm thick sealable polyethylene bag
 - .2 Outer container: sealable metal or fibre type where there are sharp objects included in waste material; otherwise outer container may be sealable metal or fibre type or second 0.15 mm thick sealable polyethylene bag.
 - .3 Labelling requirements: affix preprinted cautionary asbestos warning, in both official languages, that is visible when ready for removal to disposal site.
- .4 Glove Bag: prefabricated glove bag as follows:
 - .1 Minimum thickness 0.25 mm (10 mil) polyvinyl-chloride bag.
 - .2 Integral 0.25 mm (10 mil) thick polyvinyl-chloride gloves and elastic ports.
 - .3 Equipped with reversible, double-pull, double throw zipper on top and at approximately mid-section of the bag.
 - .4 Straps for sealing ends around pipe.
 - .5 Must incorporate internal closure strip if it is to be moved or used in more than one specific location.
- .5 Tape: tape suitable for sealing polyethylene to surfaces under both dry and wet conditions using amended water.
- .6 Slow - drying sealer: non-staining, clear, water - dispersible type that remains tacky on surface for at least 8 hours and designed for purpose of trapping residual asbestos fibres.
 - .1 Sealer: flame spread and smoke developed rating less than 50.
- .7 Encapsulant: penetrating type conforming to CAN/CGSB-1.205.

Part 3 Execution

3.1 SUPERVISION

- .1 Minimum of one Supervisor for every ten workers is required.
- .2 Approved Supervisor must remain within Asbestos Work Area during disturbance, removal, or other handling of asbestos-containing materials.

3.2 PROCEDURES

- .1 Before beginning Work, at each access to Asbestos Work Area, install warning signs in both official languages in upper case 'Helvetica Medium' letters reading as follows, where number in parentheses indicates font size to be used: 'CAUTION ASBESTOS HAZARD AREA (25 mm) / NO UNAUTHORIZED ENTRY (19 mm) / WEAR ASSIGNED PROTECTIVE EQUIPMENT (19 mm) / BREATHING ASBESTOS DUST MAY CAUSE SERIOUS BODILY HARM (7 mm)'.
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- .2 Before beginning Work remove visible dust from surfaces in work area where dust is likely to be disturbed during course of work.
 - .1 Use HEPA vacuum, or damp cloths where damp cleaning does not create hazard and is otherwise appropriate.
 - .2 Do not use compressed air to clean up or remove dust from any surface.
 - .3 Prevent spread of dust from Asbestos Work Area using measures appropriate to work to be done.
 - .1 Use FR polyethylene drop sheets over flooring such as carpeting that absorbs dust and over flooring in work areas where dust or contamination cannot otherwise be safely contained.
 - .2 Erect enclosure of polyethylene sheeting around indoor Type 2 work areas, shut off mechanical ventilation system serving work area, and seal ventilation ducts to and from work area.
 - .4 Remove loose material by HEPA vacuum; thoroughly wet friable material containing asbestos to be removed or disturbed before and during Work unless wetting creates hazard or causes damage.
 - .1 Use garden reservoir type low - velocity sprayer or airless spray equipment capable of producing mist or fine spray.
 - .2 Perform Work in a manner to reduce dust creation to lowest levels practicable.
 - .5 Pipe Insulation Removal Using Glove Bag:
 - .1 A glove bag not to be used to remove insulation from a pipe, duct or similar structure if:
 - .1 It may not be possible to maintain a proper seal for any reason including, without limitation:
 - .1 The condition of the insulation.
 - .2 The temperature of the pipe, duct or similar structure.
 - .2 The bag could become damaged for any reason including, Including, without limitation:
 - .1 The type of jacketing.
 - .2 The temperature of the pipe, duct or similar structure.
 - .2 Upon installation of the glove bag, inspect bag for any damage or defects. If any damage or defects are found, the glove bag is to be repaired or replaced. The glove bag to be inspected at regular intervals for damage and defects, and repair or replaced, as appropriately. The asbestos containing contents of the damaged or defective glove bag found during removal are to be wetted and the glove bag and its contents are to be removed and disposed of in an appropriate waste disposal container. Any damaged or defective glove bags are not be reused.
 - .3 Place tools necessary to remove insulation in tool pouch. Wrap bag around pipe and close zippers. Seal bag to pipe with cloth straps.
 - .4 Place hands in gloves and use necessary tools to remove insulation. Arrange insulation in bag to obtain full capacity of bag.

- .5 Insert nozzle of garden reservoir type sprayer into bag through valve and wash down pipe and interior of bag thoroughly. Wet surface of insulation in lower section of bag.
 - .6 To remove bag after completion of stripping, wash top section and tools thoroughly. Remove air from top section through elasticized valve using a HEPA vacuum. Pull polyethylene waste container over glove bag before removing from pipe. Release one strap and remove freshly washed tools. Place tools in water. Remove second strap and zipper. Fold over into waste container and seal.
 - .7 After removal of bag ensure that pipe is free of residue. Remove residue using HEPA vacuum or wet cloths. Ensure that surfaces are free of sludge which after drying could release asbestos dust into atmosphere. Seal exposed surfaces of pipe and ends of insulation with slow drying sealer to seal in any residual fibres.
 - .8 Upon completion of Work shift, cover exposed ends of remaining pipe insulation with polyethylene taped in place.
- .6 Work is subject to visual inspection and air monitoring. Contamination of surrounding areas indicated by visual inspection or air monitoring will require complete enclosure and clean-up of affected areas at no additional costs to owners.
- .7 Clean-up:
- .1 Frequently during Work and immediately after completion of work, clean up dust and asbestos-containing waste using HEPA vacuum or by damp mopping.
 - .2 Place dust and asbestos-containing waste in sealed dust-tight waste bags. Treat drop sheets and disposable protective clothing as asbestos waste and wet and fold to contain dust and then place in waste bags.
 - .3 Immediately before their removal from Asbestos Work Area and disposal, clean each filled waste bag using damp cloths or HEPA vacuum and place in second clean waste bag.
 - .4 Seal and remove double-bagged waste from site. Dispose of in accordance with requirements of Provincial/Territorial and Federal authority having jurisdiction. Supervise dumping and ensure that dump operator is fully aware of hazardous nature of material to be dumped and that guidelines and regulations for asbestos disposal are followed.
 - .5 Perform final thorough clean-up of Asbestos Work Areas and adjacent areas affected by Work using HEPA vacuum.

3.3 AIR MONITORING

- .1 From beginning of Work until completion of cleaning operations, the NRC Departmental Representative may collect air samples on a daily basis outside of Asbestos Work Area enclosures.
- .2 If air monitoring shows that areas outside work area enclosures are contaminated, enclose, maintain, and clean these areas in same manner as that applicable to Asbestos Work Areas

- .1 Stop work and clean areas outside of Asbestos Work Areas when Phased Contrast Microscopy measurements exceed 0.05 fibres per cubic centimetre (f/cc) and correct procedures.
- .2 All required cleaning, re-cleaning, additional air testing and/or inspections will be performed at no extra charge to the Client.
- .3 Ensure that respiratory safety factors for Workers are not exceeded.
- .4 The NRC Departmental Representative may collect clearance/post-abatement air samples following a final visual inspection of the Asbestos Work Area by the NRC Departmental Representative. Samples will be analyzed and compared to applicable regulations.
 - .1 Final air monitoring results must show fibre levels of less than 0.05 fibres per cubic centimetre (f/cc).
 - .2 If air monitoring shows that areas inside the Asbestos Work Area enclosures are contaminated; enclose, maintain and clean these areas in same manner as that applicable to Asbestos Work Area at no additional cost to the client.
 - .3 Repeat as necessary until fibre levels are less than 0.05 f/cc
 - .4 No additional costs will be allowed by Contractor for additional labour or materials required to provide specified performance level.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Comply with requirements of this Section when performing following work:
 - .1 Removal or disturbance of more than one square metre of friable asbestos-containing materials.
 - .2 Breaking, cutting, drilling, abrading, grinding, sanding or vibrating of asbestos containing materials, if the work is done by means of power tools that are not attached to dust-collecting devices equipped with HEPA filters.
- .2 Refer to the following document for details on asbestos-containing materials:
 - .1 Project-Specific Hazardous Materials Survey – Summary Report, Rev.1. Chiller and Ductwork Replacement Project. Building U-66, Ottawa, ON. Prepared by DST Consulting Engineers, Inc. Dated January 19, 2017.

1.2 RELATED SECTIONS

- .1 Section 02 81 01 – Hazardous Materials and Schedule A Table.
- .2 Section 02 82 00.01 – Asbestos Abatement: Minimum Precautions.
- .3 Section 02 82 00.02 – Asbestos Abatement: Intermediate Precautions.

1.3 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.205-03, Sealer for Application to Asbestos-Fibre-Releasing Materials.
- .2 Canadian Standards Association (CSA International).
- .3 Department of Justice Canada.
 - .1 Canadian Environmental Protection Act (CEPA), 1999.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .5 Transport Canada (TC).
 - .1 Transportation of Dangerous Goods Act, 1992 (TDGA).
- .6 Ontario Environmental Protection Act, R.R.O 1990,
 - .1 General – Waste Management, O. Reg. 347/90, as amended.
- .7 Underwriters' Laboratories of Canada (ULC).
- .8 Ontario Ministry of Labour (MoL).
 - .1 Occupational Health and Safety Act, R.S.O 1990, c. O1 (OSHA)
 - .1 O.Reg. 278/05 – Designated Substance – Asbestos on Construction Projects and in Buildings and Repair Operations, as amended.
 - .2 O.Reg. 490/09 – Designated Substances
 - .3 O.Reg. 213/91 - “Construction Projects”, as amended

1.4 DEFINITIONS

- .1 Airlock: system for permitting ingress or egress without permitting air movement between contaminated area and uncontaminated area, typically consisting of two curtained doorways at least 2 m apart.
- .2 Amended Water: water with a non-ionic surfactant wetting agent added to reduce surface tension of water to allow wetting of fibres.
- .3 Asbestos-Containing Materials (ACMs): materials that contain 0.5 percent or more asbestos by dry weight, identified under Existing Conditions Article, including fallen materials and settled dust.
- .4 Asbestos Work Area: Area where actual removal and sealing and enclosure of spray or trowel-applied asbestos-containing materials takes place.
- .5 Authorized Visitors: NRC Departmental Representative, DST Representative, and representative(s) of regulatory agencies.
- .6 Competent worker: in relation to specific work, means a worker who:
 - .1 Is qualified because of knowledge, training and experience to perform the work.
 - .2 Is familiar with the provincial laws and with the provisions of the regulations that apply to the work.
 - .3 Has knowledge of all potential or actual danger to health or safety in the work.
- .7 Curtained doorway: arrangement of closures to allow ingress and egress from one room to another while permitting minimal air movement between rooms, typically constructed as follows:
 - .1 Place two overlapping sheets of polyethylene over existing or temporarily framed doorway, secure each along top of doorway, secure vertical edge of one sheet along one vertical side of doorway, and secure vertical edge of other sheet along opposite vertical side of doorway.
 - .2 Reinforce free edges of polyethylene with duct tape and weight bottom edge to ensure proper closing.
 - .3 Overlap each polyethylene sheet at openings not less than 1.5 m on each side.
- .8 DOP Test: testing method used to determine integrity of Negative Pressure unit using dispersed oil particulate (DOP) HEPA filter leak test.
- .9 Friable Material: material that when dry can be crumbled, pulverized or powdered by hand pressure and includes such material that is crumbled, pulverized or powdered.
- .10 Glove Bag: prefabricated glove bag as follows:
 - .1 Minimum thickness 0.25 mm (10 mil) polyvinyl-chloride bag.
 - .2 Integral 0.25 mm (10 mil) thick polyvinyl-chloride gloves and elastic ports.
 - .3 Equipped with reversible, double-pull, double throw zipper on top and at approximately mid-section of the bag.
 - .4 Straps for sealing ends around pipe.

- .11 Hazardous Material Work Plan: A brief report identifying the location and quantities of hazardous materials and the methods that will be used to remove, store, transport and dispose of them.
- .12 HEPA vacuum: DOP tested, High Efficiency Particulate Air filtered vacuum equipment with a filter system capable of collecting and retaining fibres greater than 0.3 microns in any direction at 99.97% efficiency.
- .13 Negative pressure: DOP tested system that extracts air directly from work area, filters such extracted air through High Efficiency Particulate Air filtering system, and discharges this air directly outside work area to exterior of building.
 - .1 System to maintain minimum pressure differential of 5 Pa relative to adjacent areas outside of work areas, be equipped with alarm to warn of system breakdown, and be equipped with instrument to continuously monitor and automatically record pressure differences.
- .14 Non-Friable Materials: material that when dry cannot be crumbled, pulverized or powdered by hand pressure.
- .15 Occupied Area: any area of building or work site that is outside Asbestos Work Area.
- .16 Polyethylene sheeting sealed with tape: Polyethylene sheeting of type and thickness specified sealed with tape along edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide continuous polyethylene membrane to protect underlying surfaces from water damage or damage by sealants, and to prevent escape of asbestos fibres through sheeting into clean area.
- .17 Sprayer: garden reservoir type sprayer or airless spray equipment capable of producing mist or fine spray. Must be appropriate capacity for scope of work.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Before beginning work:
 - .1 Obtain from appropriate agency and submit to NRC Departmental Representative necessary permits for transportation and disposal of asbestos waste. Ensure that dump operator is fully aware of hazardous nature of material being dumped, and proper methods of disposal. Submit proof satisfactory to NRC Departmental Representative that suitable arrangements have been made to receive and properly dispose of asbestos waste.
 - .2 Submit proof satisfactory to NRC Departmental Representative that every worker involved in a Type 3 operation has successfully completed the Asbestos Abatement Worker Training Program approved by the Ministry of Training, Colleges and Universities and every supervisor of a worker involved in a Type 3 operation has successfully completed the Asbestos Abatement Supervisor Training Program approved by the Ministry of Training, Colleges and Universities as outlined in O. Reg. 278/05, s. 20 (1). Submit proof of attendance in form of certificate.
 - .3 Ensure supervisory personnel have attended asbestos abatement course, of not less than two days duration, approved by NRC Departmental Representative. Submit proof of attendance in form of certificate. Minimum of one Supervisor for every ten workers.
 - .4 Submit documentation including test results for sealer proposed for use.

- .5 Submit Provincial/Territorial and/or local requirements for Notice of Project Form.
- .6 Submit proof of Contractor's Asbestos Liability Insurance.
- .7 Submit proof satisfactory to NRC Departmental Representative that employees have appropriate respirator fitting and testing. Workers must have successfully been fit-tested (**quantitative**) with respirator that is personally issued.
- .8 Submit documentation including air test results for compressor to be used for supplied air respirators.
- .9 Submit Worker's Compensation Board status and transcription of insurance.
- .10 Submit documentation including test results, fire and flammability data, and Material Safety Data Sheets (MSDS) for chemicals or materials including but not limited to following:
 - .1 amended water;
 - .2 slow-drying sealer.

1.6 QUALITY ASSURANCE

- .1 Regulatory Requirements: comply with Federal, Provincial/Territorial and local requirements pertaining to asbestos, provided that in case of conflict among those requirements or with these specifications more stringent requirement applies. Comply with regulations in effect at time work is performed.
- .2 Health and Safety:
 - .1 Safety Requirements: worker and visitor protection.
 - .1 Protective equipment and clothing to be worn by workers while in Asbestos Work Area includes:
 - .1 Where removing any asbestos-containing materials, as a minimum, full-face respirator equipped with HEPA P-100 filter cartridges. Respirators shall be personally issued to worker and marked as to efficiency and purpose, suitable for protection against asbestos and acceptable to Provincial Authority having jurisdiction.
 - .2 All respirators to be fitted so that there is an effective seal between the respirator and the worker's face, unless the respirator is equipped with a hood or helmet. The respirators are to be cleaned, disinfected and inspected after use on each shift, or more often if necessary, when issued for the exclusive use of one worker, or after each use when used by more than one worker. The respirators to have damaged or deteriorated parts replaced prior to being used by a worker; and, when not in use, to be stored in a convenient, clean and sanitary location. The employer to establish written procedures regarding the selection, use and care of respirators, and a copy of the procedures to be provided to and reviewed with each worker who is required to wear a respirator. A worker not to be assigned to an operation requiring the use of a respirator unless he or she is physically able to perform the operation while using the respirator.

- .3 Disposable-type protective clothing (high-density polyethylene protective clothing (Tyvek or similar, as approved by NRC Departmental Representative) that does not readily retain or permit penetration of asbestos fibres. Protective clothing to be provided by the employer and worn by every worker who enters the work area, and the protective clothing shall consist of a head covering and full body covering that fits snugly at the ankles, wrists and neck, in order to prevent asbestos fibres from reaching the garments and skin under the protective clothing to include suitable footwear, and to be repaired or replaced if torn
- .2 Requirements for each worker:
 - .1 Remove street clothes in clean change room and put on respirator with new filters or reusable filters that have been tested as satisfactory, clean coveralls and head covers before entering Equipment and Access Rooms or Asbestos Work Area. Store street clothes, uncontaminated footwear, towels, and similar uncontaminated articles in clean change room.
 - .2 Remove gross contamination from clothing before leaving work area then proceed to Equipment and Access Room and remove clothing except respirators. Place contaminated worksuits in receptacles for disposal with other asbestos - contaminated materials. Leave reusable items except respirator in Equipment and Access Room. Still wearing the respirator proceed naked to showers. Using soap and water wash body and hair thoroughly. Clean outside of respirator with soap and water while showering; remove respirator; remove filters and wet them and dispose of filters in container provided for purpose; and wash and rinse inside of respirator. When not in use in work area, store work footwear in Equipment and Access Room. Upon completion of asbestos abatement, dispose of footwear as contaminated waste or clean thoroughly inside and out using soap and water before removing from work area or from Equipment and Access Room.
 - .3 After showering and drying off, proceed to clean change room and dress in street clothes at end of each day's work, or in clean coveralls before eating, smoking, or drinking. If re-entering work area, follow procedures outlined in paragraphs above.
 - .4 Enter unloading room from outside dressed in clean coveralls to remove waste containers and equipment from Holding Room of Container and Equipment Decontamination Enclosure system. Workers must not use this system as means to leave or enter work area.
- .3 Eating, drinking, chewing, and smoking are not permitted in Asbestos Work Area.
- .4 Ensure workers are fully protected with respirators and protective clothing during preparation of system of enclosures prior to commencing actual asbestos abatement.

- .5 Provide and post in Clean Change Room and in Equipment and Access Room the procedures described in this Section, in both official languages.
- .6 Ensure that no person required to enter an Asbestos Work Area has facial hair or other facial condition that affects seal between respirator and face.
- .7 Visitor Protection:
 - .1 Provide protective clothing and approved respirators to Authorized Visitors to work areas.
 - .2 Instruct Authorized Visitors in the use of protective clothing, respirators and procedures.
 - .3 Instruct Authorized Visitors in proper procedures to be followed in entering into and exiting from Asbestos Work Area.

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .2 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .3 Separate for reuse, and recycling and place in designated containers steel, metal, plastic waste in accordance with Waste Management Plan.
- .4 Place materials defined as hazardous or toxic in designated containers. Exterior on-site waste containers must be closable and lockable.
- .5 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.
- .6 Fold up metal banding, flatten and place in designated area for recycling.
- .7 Disposal of asbestos waste generated by removal activities must comply with Federal, Provincial, Territorial and Municipal regulations. Dispose of asbestos waste in sealed double thickness 6 ml bags or leak proof drums. Label containers with appropriate warning labels.
- .8 Provide manifests describing and listing waste created. Transport containers by approved means to licensed landfill for burial.

1.8 EXISTING CONDITIONS

- .1 Refer to the following document for details on asbestos-containing materials:
 - .1 Project-Specific Hazardous Materials Survey – Summary Report, Rev.1. Chiller and Ductwork Replacement Project. Building U-66, Ottawa, ON. Prepared by DST Consulting Engineers, Inc. Dated January 19, 2017.
- .2 Verification of visible quantities of asbestos-containing materials and site conditions are the responsibility of the bidding contractor. Contractors are to verify all site conditions themselves and base their abatement bids upon their own observations and quantity take-offs. Bidding contractors are to draw their own conclusions with respect to site conditions and/or factors that may affect their work.

- .3 Notify NRC Departmental Representative of any suspect asbestos-containing material discovered during Work and not apparent from drawings, specifications, or report pertaining to Work. Do not disturb such material until instructed by NRC Departmental Representative.

1.9 SCHEDULING

- .1 Not later than ten (10) days before beginning Work on this Project notify following in writing:
 - .1 Provincial/Territorial, Department of Labour.
 - .2 Disposal Authority.
- .2 Inform sub-trades of presence of asbestos-containing materials as referenced in Item 1.8.
- .3 Submit to NRC Departmental Representative copy of notifications prior to start of Work.
- .4 Hours of Work: perform work involving asbestos abatement located at the Building during hours specified by NRC Departmental Representative. The work schedule must be approved in writing by the NRC Departmental Representative in advance of work. Contractor shall be available to work continuously from beginning to end of project.
- .5 Any waste loading shall only be performed after regular business hours (18:00), ensuring this does not contradict with working hours. Waste loading shall not occur through occupied areas of the building. Waste storage containers to be closed and locked overnight.

1.10 PERSONNEL TRAINING

- .1 Before beginning Work, provide to NRC Departmental Representative satisfactory proof that every worker has had instruction and training in hazards of asbestos exposure, in personal hygiene including dress and showers, in entry and exit from Asbestos Work Area, in aspects of work procedures, and in use, cleaning, and disposal of respirators and protective clothing.
- .2 Instruction and training related to respirators includes, at minimum:
 - .1 Proper fitting of equipment.
 - .2 Inspection and maintenance of equipment.
 - .3 Cleaning and Disinfecting of equipment.
 - .4 Limitations of equipment.
- .3 Instruction and training must be provided by competent, qualified person.
- .4 Every worker involved in a Type 3 operation must have successfully completed the Asbestos Abatement Worker Training Program approved by the Ministry of Training, Colleges and Universities.
- .5 Every supervisor of a worker involved in a Type 3 operation must have successfully completed the Asbestos Abatement Supervisor Training Program approved by the Ministry of Training, Colleges and Universities.

Part 2 Products

2.1 MATERIALS

- .1 Polyethylene: minimum 0.15 mm thick unless otherwise specified; in sheet size to minimize joints.
- .2 FR polyethylene: minimum 0.15 mm thick, woven fibre reinforced fabric bonded both sides with polyethylene.
- .3 Tape: fibreglass - reinforced duct tape suitable for sealing polyethylene under both dry conditions and wet conditions using amended water.
- .4 Wetting agent: 50% polyoxyethylene ester and 50% polyoxyethylene ether, or other material approved by NRC Departmental Representative mixed with water in concentration to provide adequate penetration and wetting of asbestos-containing material.
- .5 Asbestos waste containers: Metal or fibre - type acceptable to dump operator with tightly fitting covers and 0.15 mm minimum thickness sealable polyethylene liners.
 - .1 Inner container: 0.15 mm thick sealable polyethylene waste bag.
 - .2 Outer container: sealable metal or fibre type where there are sharp objects included in waste material; otherwise outer container may be sealable metal or fibre type or second 0.15 mm thick sealable polyethylene bag.
 - .3 Label containers in accordance with applicable Regulations. Label in both official languages.
- .6 Tape: tape suitable for sealing polyethylene to surfaces under both dry and wet conditions using amended water.
- .7 Scaffolding: Of appropriate size and strength to accommodate project in accordance with O.Reg 213/91, with specifications and set-up to be approved and stamped by professional engineer. Include in contract sum costs due to this requirement.
- .8 Slow - drying sealer: non-staining, clear, water - dispersible type that remains tacky on surface for at least 8 hours and designed for purpose of trapping residual asbestos fibres.
- .9 Sealer: flame spread and smoke developed rating less than 50.
- .10 Encapsulant: penetrating type conforming to CAN/CGSB-1.205.

Part 3 Execution

3.1 PREPARATION

- .1 Work Areas:
 - .1 Shut off and isolate air handling and ventilation systems for work area to prevent fibre dispersal to other building areas during work phase. Location and procedure of shut off shall be approved by the NRC Departmental Representative. Conduct smoke tests to ensure that duct work isolation measures are airtight. Location and procedure for smoke tests shall be approved by the NRC Departmental Representative.
 - .2 Utilities within the project area, including thermostats, heat detectors, smoke detectors and other wall or ceiling mounted utility devices shall remain

- functioning throughout the duration of the project, and shall be protected from debris during demolition. Where walls or ceilings are to be removed that utility devices are attached to, the utility devices can be detached and supported in such a way they can remain functioning and supported throughout the duration of the project, and be available for future use.
- .3 Pre-clean moveable furniture and carpeting within proposed work area using HEPA vacuum and remove from work area to an appropriate temporary location.
 - .4 Pre-clean fixed casework, plant, and equipment within proposed work area(s), using HEPA vacuum and cover with polyethylene sheeting sealed with tape.
 - .5 Clean proposed work area(s) using, where practicable, HEPA vacuum cleaning equipment. If not practicable, use wet cleaning method. Do not use methods that raise dust, such as dry sweeping, or vacuuming using other than HEPA vacuum equipment.
 - .6 The spread of dust from the work area to be prevented by:
 - .1 Using enclosures of polyethylene or other suitable material that is impervious to asbestos (including, if the enclosure material is opaque, one or more transparent window areas to allow observation of the entire work area from outside the enclosure), if the work area is not enclosed by walls.
 - .2 Using curtains of polyethylene sheeting or other suitable material that is impervious to asbestos, fitted on each side of each entrance or exit from the work area.
 - .7 DOP test negative pressure units within one (1) month prior to work operations. Provide documentation to Client Representative. Put negative pressure system in operation and operate continuously from time first polyethylene is installed to seal openings until final completion of work including final cleanup. Provide continuous monitoring of pressure difference using automatic recording instrument. The system to maintain a negative air pressure of 0.02 inches [5 Pa] of water, relative to the area outside the enclosed area. The system to be inspected and maintained by a competent person prior each use to ensure that there is no air leakage, and if the filter is found to be damaged or defective, it to be replaced before the ventilation system is used. Vent negative air units to the outdoors.
 - .8 Seal off openings such as corridors, doorways, windows, skylights, ducts, grilles, and diffusers, with polyethylene sheeting sealed with tape.
 - .9 Cover floor, wall surfaces, and building equipment remaining within work area with polyethylene sheeting sealed with tape. Use one layer of FR polyethylene on floors. Cover floors first so that polyethylene extends at least 300 mm up walls then cover walls to overlap floor sheeting. Use two layers of FR Polyethylene on electrical equipment/controls.
 - .10 Build airlocks at entrances to and exits from work area(s) so that work area(s) are always closed off by one curtained doorway when workers enter or exit.
 - .11 At each access to work areas install warning signs in both official languages in upper case "Helvetica Medium" letters reading as follows where number in parentheses indicates font size to be used: "CAUTION ASBESTOS HAZARD AREA (25 mm) NO UNAUTHORIZED ENTRY (19 mm) WEAR ASSIGNED PROTECTIVE EQUIPMENT (19 mm) BREATHING ASBESTOS DUST MAY CAUSE SERIOUS BODILY HARM (7 mm)".

- .12 After work area isolation, remove heating, ventilating, and air conditioning filters, pack in sealed plastic bags 0.15 mm minimum thick and treat as contaminated asbestos waste. Remove ceiling - mounted objects such as lights, partitions, other fixtures not previously sealed off, and other objects that interfere with asbestos removal, as directed by NRC Departmental Representative. Use localized water spraying during fixture removal to reduce fibre dispersal.
- .13 Maintain emergency and fire exits from work area(s), or establish alternative exits satisfactory to Fire Commissioner of Canada.
- .14 Where application of water is required for wetting asbestos-containing materials, shut off electrical power, provide 24 volt safety lighting and ground fault interrupter circuits on power source for electrical tools, in accordance with applicable CSA Standard. Ensure safe installation of electrical lines and equipment.
- .2 Worker Decontamination Enclosure System:
 - .1 Worker Decontamination Enclosure System includes Equipment and Access Room, Shower Room, and Clean Room, as follows:
 - .1 Equipment and Access Room: build Equipment and Access Room between Shower Room and work area(s), with two curtained doorways, one to Shower Room and one to work area(s). Install portable toilet, waste receptor, and storage facilities for workers' shoes and protective clothing to be reworn in work area(s). Build Equipment and Access Room large enough to accommodate specified facilities, other equipment needed, and at least one worker allowing him /her sufficient space to undress comfortably.
 - .2 Shower Room: build Shower Room between Clean Room and Equipment and Access Room, with two curtained doorways, one to Clean Room and one to Equipment and Access Room. Provide one shower for every five workers. Provide hot and cold water or water of a constant temperature that is not less than 40°C or more than 50°C. Provide individual controls inside the room to regulate water flow, and individual controls inside room to regulate temperature. Provide piping and connect to water sources and drains. Pump waste water through 5 micrometre filter system acceptable to Client Representative before directing into drains. Provide soap, clean towels, and appropriate containers for disposal of used respirator filters.
 - .3 Clean Room: build Clean Room between Shower Room and clean areas outside of enclosures, with two curtained doorways, one to outside of enclosures and one to Shower Room. Provide lockers or hangers and hooks for workers' street clothes and personal belongings. Provide storage for clean protective clothing and respiratory equipment. Install mirror to permit workers to fit respiratory equipment properly.
- .3 Container and Equipment Decontamination Enclosure System:
 - .1 Container and Equipment Decontamination Enclosure System consists of Staging Area within work area, Washroom, Holding Room, and Unloading Room. Purpose of system is to provide means to decontaminate waste containers, scaffolding, waste and material containers, vacuum and spray

- equipment, and other tools and equipment for which Worker Decontamination Enclosure System is not suitable.
- .1 Staging Area: designate Staging Area in work area for gross removal of dust and debris from waste containers and equipment, labelling and sealing of waste containers, and temporary storage pending removal to Washroom. Equip Staging Area with curtained doorway to Washroom.
 - .2 Washroom: build Washroom between Staging Area and Holding Room with two curtained doorways, one to Staging Area and one to Holding Room. Provide high - pressure low - volume sprays for washing of waste containers and equipment. Pump waste water through 5 micrometre filter system before directing into drains. Provide piping and connect to water sources and drains.
 - .3 Holding Room: build Holding Room between Washroom and Unloading Room, with two curtained doorways, one to Washroom and one to Unloading Room. Build Holding Room sized to accommodate at least two waste containers and largest item of equipment used.
 - .4 Unloading Room: build Unloading Room between Holding Room and outside, with two curtained doorways, one to Holding Room and one to outside.
- .4 Construction of Decontamination Enclosures:
- .1 Build suitable framing for enclosures or use existing rooms where convenient, and line with polyethylene sheeting sealed with tape. Use one layer of FR polyethylene on floors, as applicable.
 - .2 Build curtained doorways between enclosures so that when people move through or when waste containers and equipment are moved through doorway, one of two closures comprising doorway always remains closed.
- .5 Separation of Work Areas from Occupied Areas:
- .1 Separate parts of building required to remain in use from parts of building or exterior used for asbestos abatement by means of airtight barrier system constructed as follows:
 - .1 Build suitable floor to ceiling lumber or metal stud framing, cover with polyethylene sheeting sealed with tape, and apply 9 mm minimum thick plywood. Seal joints between plywood sheets and between plywood and adjacent materials with surface film forming type sealer, to create airtight barrier.
 - .2 Cover plywood barrier with polyethylene sealed with tape, as specified for work areas.
- .6 Maintenance of Enclosures:
- .1 Maintain enclosures in tidy condition.
 - .2 Ensure that barriers and polyethylene linings are effectively sealed and taped. Repair damaged barriers and remedy defects immediately upon discovery.
 - .3 Visually inspect enclosures at beginning of each working period.
 - .4 Use smoke methods to test effectiveness of barriers when directed by NRC Departmental Representative.

- .7 Do not begin Asbestos Abatement work until:
 - .1 Arrangements have been made for disposal of waste.
 - .2 For wet stripping techniques, arrangements have been made for containing, filtering, and disposal of waste water.
 - .3 Work area(s) and decontamination enclosures and parts of building required to remain in use are effectively segregated.
 - .4 Tools, equipment, and materials waste containers are on hand.
 - .5 Arrangements have been made for building security.
 - .6 Warning signs are displayed where access to contaminated areas is possible.
 - .7 Notifications have been completed and other preparatory steps have been taken.
 - .8 Work area enclosure has been inspected and approved by the NRC Departmental Representative.
 - .9 Locations for waste bins will be designated by the NRC Departmental Representative. Keep bins covered and enclosed while at the site. Bin loading area shall be kept clean at all times.

3.2 SUPERVISION

- .1 Minimum of one Supervisor for every ten workers is required.
- .2 Approved Supervisor must remain within Asbestos Work Area during disturbance, removal, or other handling of asbestos-containing materials.

3.3 ASBESTOS REMOVAL

- .1 Before removing asbestos:
 - .1 Prepare site.
 - .2 Spray asbestos-containing material with water containing specified wetting agent, using airless spray equipment capable of providing "mist" application to prevent release of fibres. Saturate asbestos material sufficiently to wet it to substrate without causing excess dripping. Spray asbestos material repeatedly during work process to maintain saturation and to minimize asbestos fibre dispersion.
- .2 Remove saturated asbestos material in small sections. Do not allow saturated asbestos to dry out. As it is being removed pack material in sealable plastic bags 0.15 mm minimum thick and place in labelled containers for transport.
- .3 Seal filled containers. Clean external surfaces thoroughly by wet sponging. Remove from immediate working area to Staging Area. Clean external surfaces thoroughly again by wet sponging before moving containers to decontamination Washroom. Wash containers thoroughly in decontamination Washroom, and store in Holding Room pending removal to Unloading Room and outside. Ensure that containers are removed from Holding Room by workers who have entered from uncontaminated areas dressed in clean coveralls.
- .4 After completion of stripping work, wire brushed and wet-sponge surfaces from which asbestos has been removed to remove visible material. During this work keep surfaces wet.

- .5 After wire brushing and wet sponging to remove visible asbestos and after encapsulating asbestos containing material impossible to remove, wet clean entire work area including Equipment and Access Room, and equipment used in process. After 24 hour period to allow for dust settling, wet clean these areas and objects again. During this settling period no entry, activity, or ventilation will be permitted. After second 24 hour period under same conditions, clean these areas and objects again using HEPA vacuum followed by wet cleaning. After inspection by NRC Departmental Representative or designate, apply continuous coat of slow drying sealer to surfaces of work area. Allow at least 16 hours with no entry, activity, ventilation, or disturbance other than operation of negative pressure units during this period.
- .6 Work is subject to daily visual inspection and air monitoring by NRC Departmental Representative. Contamination of surrounding areas indicated by visual inspection or air monitoring will require complete enclosure and clean-up of affected areas.
- .7 Cleanup:
 - .1 Frequently during Work and immediately after completion of work, clean up dust and asbestos containing waste using HEPA vacuum or by damp mopping.
 - .2 Place dust and asbestos containing waste in sealed dust tight waste bags. Treat drop sheets and disposable protective clothing as asbestos waste and wet and fold to contain dust and then place in waste bags.
 - .3 Immediately before their removal from Asbestos Work Area and disposal, clean each filled waste bag using damp cloths or HEPA vacuum and place in second clean waste bag.
 - .4 Seal and remove double bagged waste from site. Dispose of in accordance with requirements of Provincial/Territorial and Federal authority having jurisdiction. Supervise dumping and ensure that dump operator is fully aware of hazardous nature of material to be dumped and that guidelines and regulations for asbestos disposal are followed.
 - .5 Perform final thorough clean-up of Asbestos Work Areas and adjacent areas affected by Work using HEPA vacuum.

3.4 INSPECTION

- .1 Perform inspection of Asbestos Work Area to confirm compliance with specification and governing authority requirements. Deviation(s) from these requirements that have not been approved in writing by the NRC Departmental Representative may result in Work stoppage, at no cost to the Owner.
- .2 NRC Departmental Representative will inspect Work for:
 - .1 Adherence to specific procedures and materials.
 - .2 Final cleanliness and completion.
 - .3 No additional costs will be allowed by Contractor for additional labour or materials required to provide specified performance level.
- .3 When asbestos leakage from Asbestos Work Area has occurred or is likely to occur, NRC Departmental Representative may order Work shutdown.
- .4 No additional costs will be allowed by Contractor for additional labour or materials required to provide specified performance level.

3.5 AIR MONITORING

- .1 From beginning of Work until completion of cleaning operations, NRC Departmental Representative will collect air samples on daily basis outside of work area enclosure(s) in accordance with industry standard practice.
 - .1 Contractor shall be responsible for monitoring inside in accordance with applicable Provincial/Territorial Occupational Health and Safety Regulations.
 - .2 Contractor shall ensure that respiratory safety factors for Workers are not exceeded.
- .2 If air monitoring shows that areas outside work area are contaminated, enclose, maintain and clean these areas in same manner as that applicable to Asbestos Work Areas.
 - .1 Stop work and clean areas outside of Asbestos Work Areas when Phase Contrast Microscopy measurements exceed 0.05 fibres per cubic centimetre (f/cc) and correct procedures.
 - .2 All required cleaning, re-cleaning, additional air testing and/or inspections will be at no extra charge to NRC Departmental Representative.
- .3 Final air monitoring to be conducted as follows: After Asbestos Work Area has passed visual inspection by NRC Departmental Representative, and acceptable coat of lock-down agent has been applied to surfaces within enclosure, and appropriate setting period has passed, NRC Departmental Representative will perform aggressive air monitoring within Asbestos Work Area.
 - .1 Final air monitoring results must show fibre levels of less than 0.01 f/cc.
 - .2 If air monitoring results show fibre levels in excess of 0.01 f/cc, re-clean work area and apply another acceptable coat of lock-down agent to surfaces.
 - .3 Repeat as necessary until fibre levels are less than 0.01 f/cc.
 - .4 No additional costs will be allowed by Contractor for additional labour or materials required to provide specified performance level.

3.6 FINAL CLEANUP

- .1 Following cleaning and air sampling by NRC Departmental Representative shows that asbestos levels inside work area enclosure(s) do not exceed 0.01 fibres/cc, proceed with final cleanup.
- .2 Remove polyethylene sheet by rolling it away from walls to centre of work area. Vacuum visible asbestos-containing particles observed during cleanup, immediately, using HEPA vacuum equipment.
- .3 Place polyethylene seals, tape, cleaning material, clothing, and other contaminated waste in plastic bags and sealed labelled waste containers for transport.
- .4 Include in clean-up Work areas, Equipment and Access Room, Washroom, Shower Room, and other contaminated enclosures.
- .5 Include in clean-up sealed waste containers and equipment used in Work and remove from work areas, via Container and Equipment Decontamination Enclosure System, at appropriate time in cleaning sequence.
- .6 Conduct final check to ensure that no dust or debris remains on surfaces as result of dismantling operations.

- .7 As work progresses, and to prevent exceeding available storage capacity on site, remove sealed and labelled containers containing asbestos waste and dispose of at authorized disposal area in accordance with requirements of disposal authority. Ensure that each shipment of containers transported to dump is accompanied by Contractor's representative to ensure that dumping is done in accordance with governing regulations.

END OF SECTION

Part 1 GENERAL

1.1 Source Quality Control

- .1 Identify lumber and plywood by grade stamp of an agency certified by Canadian Lumber Standards Administration Board and in accordance with applicable CSA standards.

1.2 PRODUCTS

1.3 Lumber Material

- .1 Except as indicated or specified otherwise lumber shall be softwood, S4S, moisture content (MC) not greater than 19% at time of installation, in accordance with following standards:
 - .2 CSA O141-91.
 - .3 NLGA Standard Grading Rules for Canadian Lumber.
 - .4 Furring, blocking, nailing strips, grounds, rough bucks:
 - .5 Use S2S or S4S material.
 - .6 Board sizes: C or D species, utility grade.
 - .7 Dimension sizes: C or D species, utility grade.
 - .8 Plywood, exterior quality, GIS to CSA O121-M1978.

1.4 Fastenings & Hardware

- .1 In accordance with Part 9 of NBC 1977 as supplemented by following requirement except where specific type is indicated.
 - .2 Nails, spikes and staples to NBC 9.23.3 except:
 - .3 Use common spiral nails and spiral spikes except where indicated otherwise.
 - .4 Use hot galvanized finish steel for exterior work, interior high humidity areas and for pressure treated lumber except where indicated otherwise.
 - .5 Bolt, nut, washer, screw and pin type fasteners: with hot-dip galvanized finish to CSA G164-M92 for exterior work, interior high humidity areas and for pressure treated lumber.

- .6 Use surface fastenings of following types, except where specific type is indicated.
 - .1 To hollow masonry, plaster and panel surfaces use toggle bolt.
 - .2 To solid masonry and concrete use expansion shield with lag screw, jute fibre or lead plug with wood screw.
 - .3 To structural steel use bolts through drilled hole, or welded stud-bolts or power driven self-drilling screws.
 - .4 Submit alternate fasteners for Engineer's approval.

Part 2 EXECUTION

2.1 Furring & Blocking

- .1 Install furring and blocking as required to space-out and support surface applied materials or other work as indicated.
- .2 Align and plumb faces of furring and blocking to tolerance of 1:600.

2.2 Nailers

- .1 Install wood nailers as indicated.
- .2 Except where indicated otherwise use material at least 40 mm (1-1/2") thick secured with 10 mm (3/8") bolts located within 300 mm (1 ft.) from ends of members and uniformly spaced at 1200 mm (4 ft.) between.
- .3 Countersink bolts where necessary to provide clearance for other work.

END OF SECTION

Part 1 GENERAL

1.1 Reference Standards

- .1 Do work in accordance with elastomeric membrane manufacturer's printed application instructions, except where specified otherwise.

1.2 Quality Assurance

- .1 Membrane: applied by applicator trained and approved by manufacturer for application of its products.
- .2 Applicators: minimum 5 years proven experience.
- .3 Manufacturers representative:
 - .1 Inspect substrate prior to commencement of work, during application of membrane and upon completion of work.
 - .2 Provide technical assistance to applicator and assist where required in correct installation of membrane.

1.3 Mock-Up

- .1 Construct mock-ups in accordance with Section 01000.
- .2 Construct mock-up 10 m² (108 ft²) minimum, of elastomeric membrane waterproofing including one lap joint, one inside corner, one outside corner and complete window. Mock-up may be part of finished work.
- .3 Allow 24 hrs. for inspection of mock-up by Departmental Representative before proceeding with waterproofing work.

1.4 Samples

- .1 Submit samples in accordance with Section 01000.
- .2 Submit duplicate 300 x 300 mm (1' -0" x 1' -0") samples of sheet membrane material

Part 2 PRODUCTS

2.1 Materials

- .1 Modified bitumen cold applied self-adherent sheet membrane such as Colphene 1000 GSA from Soprema, Blue Skin SSA from Bakor, Perm-A-Barrier System 4000 from Grace or equal approved by the Departmental Representative.
- .2 Primer or surface conditioner as recommended by air-barrier membrane manufacturer.
- .3 Mastic, adhesive tape and sealant as recommended by air-barrier membrane manufacturer.

2.2 Compatibility

- .1 Use same membrane throughout whole project.
- .2 All products to be from same manufacturer or to be approved by him.

Part 3 EXECUTION

3.1 Preparation

- .1 Carefully inspect surfaces to be covered with air barrier membrane. Remove dirt, dust, peeling paint, or other substances that might impair adherence to air barrier.
- .2 Remove sharp protuberances and round sharp angles.
- .3 Secure unsound substrate, fill holes and cracks and even surface repaired.

3.2 Primer

- .1 Follow manufacturer's printed instructions.
- .2 Prime a surface area no bigger than what can be covered with air barrier within recommended setting time limits for primer used on the job.
- .3 Re-prime surface areas where primer has set before being covered with membrane.

3.3 Application of Membrane

- .1 Apply membrane over the entire exterior face of existing building, from two (2) feet below grade up to roof parapets.
- .2 Provide air/watertight junction with existing roof waterproofing system.
- .3 Coordinate work with other trades to ensure air-tightness at junction with windows, doors, louvers and other openings thru exterior walls.
- .4 Detailed application of air barrier membrane should be similar to standard roof membrane details: reinforced corners, expansion joints, etc.; add bituminous flashings around wall penetrations, protrusions, etc.
- .5 Install air barrier membrane plumb and on straight lines. Stagger end joints. Overlap as recommended.
- .6 Provide positive seal at overlaps.
- .7 Repair damages to air barrier as soon as they are discovered.
- .8 Redo areas that prove to be unacceptable due to inadequate substrate preparation, deficient priming, defective materials, lack of bonding and/or improper installation.

3.4 Inspection

- .1 Allow enough time to Departmental Representative for review of membrane installed before covering it with new insulation.

END OF SECTION

Part 1 GENERAL N/A

Part 2 PRODUCTS

2.1 Insulation

- .1 Sound batt insulation: fabricated from friction fit batts, mineral fibre, 76 mm (3") and 63mm (2 ½") thickness (thickness to fill stud cavity).
- .2 Sound batt insulation on top of ceiling: fabricated from friction fit batts, mineral fibre, 76 mm (3").

Part 3 EXECUTION

3.1 Workmanship

- .1 Install insulation after building substrate materials are dry.
- .2 Install insulation to maintain continuity of acoustic insulation in wall construction.
- .3 Install insulation on top of ceiling installation at partitions as noted on drawings.
- .4 Fit insulation closely around electrical boxes, plumbing and heating pipes and ducts, around exterior doors and windows and other protrusions.
- .5 Cut and trim insulation neatly to fit spaces. Butt joints tightly, offset vertical joints. Use only insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.
- .6 Offset both vertical and horizontal joints in multiple layer applications.
- .7 Do not enclose insulation until it has been inspected and approved by Departmental Representative.

END OF SECTION

Part 1 GENERAL

1.1 Qualifications

- .1 The manufacturer shall have regularly marketed an Exterior Insulated Finish System (EIFS) in this country for at least five years and shall have satisfactorily completed a minimum of 20 installations [5 being of the "Hard" coat system].
- .2 The applicator shall be approved by the manufacturer and the manufacturer shall ensure that the applicator installs the EIFS as per his recommendation.
- .3 The applicator must provide proof that his firm has successfully completed at least two projects of a minimum size of 10,000 square feet.

1.2 Scope of Work

- .1 The applicator will be responsible for installing the entire new wall system, starting with the anchoring wall angles/studs, levelling studs and through to the finish coat of the EIFS, or as indicated on the drawings. (This also includes the foundation insulation and coatings.)
- .2 [The EIFS for this project is what is known in the industry as a "soft-coat" system.][The EIFS for this project is what is known in the industry as a "hard-coat" system.][The EIFS for this project is a combination of what is known in the industry as a "hard" and "soft-coat" system.]

1.3 Acceptance

- .1 Certificates of Compliance: Submit two copies in accordance with Section 01000, attesting that the EIFS meets the specified requirements.
- .2 Instructions: Submit two copies of the manufacturers' standard printed instructions for installation, manufacturers' specifications and product data of the system.
- .3 Certificates: Two copies of the applicator's certificate of training signed by the manufacturer.
- .4 Samples: Submit two samples 610mm x 610mm (24" x 24") for each finish, texture and colour specified. Each sample shall be prepared using the same tools and techniques proposed for the actual installation by the applicator selected for the project. One of the samples shall remain at the jobsite for use in comparing the approved appearance to that being installed.
- .5 The applicator shall construct a field/on- site sample in a location as directed by the Departmental Representative. This sample will be required for final acceptance of the proposed texture, colour of the proposed material and workmanship of the EIFS Trade Contractor (applicator.) The area of this sample shall be a maximum of 13.4 square metres (144 square feet).

1.4 Materials Acceptance

- .1 Products that comply with the evaluation program conducted by the Canadian Construction Materials Centre (CCMC) are deemed to satisfy the requirements of Canada's building codes and standards. NRC accepts construction products evaluated by

the Canadian Construction Materials Centre (CCMC) when they comply with these drawings and specifications.

1.5 Delivery and Storage

- .1 Materials shall be delivered to the job site in their original unopened packages, clearly marked with the manufacturer's name, brand name and description of contents. Storage shall be in accordance with the manufacturer's recommendations in a clean, dry, well-ventilated area(s). Materials shall be protected from sunlight, and kept away from excessive heat and moisture, kept at a temperature of not less than 40°F (4.4°C). Polystyrene board shall not be exposed to flame or other ignition sources.

1.6 Job Conditions

- .1 Environmental Conditions: Ambient air temperature shall be 40°F (4.4°C) or greater and rising at the time of installation of the synthetic stucco and shall remain at 40°F (4.4°C) or greater for at least 24 hours after application. For installation in temperatures below the minimum, the General Contractor shall provide supplementary heat as per section 01000 of this specification to maintain required temperatures. The installed EIFS materials shall be protected against freezing and rain until completely dry. Installed EIFS finishes shall be protected from wind above 25km/hr (16m/hr), rain, hail, snow etc. Protect finishes from too rapid evaporation during dry, sunny and warm weather. Temperatures should meet manufacturer's minimum standards.
- .2 Protection: Adjacent materials shall be protected from damage during the installation by the applicator. If cap flashing is not installed immediately after finish application, then, temporary protection shall be provided at all parapets and where flashing is not in place by the General Contractor.
- .3 Scheduling: Installation of the EIFS shall be coordinated with the other construction trades. Sufficient manpower and equipment shall be employed to ensure a continuous operation, free of cold joints, scaffold lines, texture variations, etc. Sufficient qualified manpower will be employed to ensure that the project schedule is met.

SPEC NOTE: Select subsection GC 32.2 for public tender projects or subsection 25 for invited tenders.

1.7 Warranty

- .1 For work of this section, the 12 months warranty period prescribed in [subsection GC 32.2 of General Conditions "C"] [subsection 25 of General Conditions "B"] is extended to [60] months.

Part 2 PRODUCTS

2.1 Materials

- .1 General: Materials shall be as per the manufacturer's recommendations required for the installation of the EIFS, in either the "HARD" and "SOFT" coat systems, locations determined by the drawings and must meet the following minimum requirements. NRC reserves the right to reject any materials which, in its opinion, will not produce the quality of work specified herein.

- .2 Surface Acceptance: Inspection of all surfaces to be covered shall be reviewed and approved by the applicator prior to the installation of the EIFS. By applying the EIFS, including anchoring wall angles/studs, levelling studs, framing studs and specified sheathing/backer board, the applicator accepts the condition of the substrate and shall be responsible for same.
- SPEC NOTE: Edit the following clauses to suit the application or design.*
- .3 Anchoring Wall Angles/Studs, Steel Levelling Studs: 20 gauge, load bearing type refer to Section 07400.
- .4 Steel Framing Studs: Same as for levelling studs.
- .5 Semi-rigid Insulation: Mineral fiber insulation; refer to Section 07200.
- .6 Sheathing/Backer Board: Refer to Section 07410.
- .7 Mechanical Fasteners: Shall be of non- corroding screw type, with 40mm (1-1/2") nylon washer as recommended by the EIFS manufacturer. Provide samples for approval by the Departmental Representative. All fasteners will be supplied with pull-out test results to be reviewed by the NRC Departmental Representative and approved by the EIFS Manufacturer for use in their system. Penetration into the levelling studs shall be a minimum of 13mm (1/2") without breaking the surface face of the polystyrene.
- .8 Temporary Mechanical Fasteners: To attach the reinforcing mesh and accessories, shall be approved by the EIFS manufacturer and be of non-corrosive type.
- .9 Reinforcing Fabric: Shall be balanced, open weave, glass fibre fabric made from twisted multi end strands conforming to ASTM D-1682 and approved and supplied by the EIFS manufacturer.
- .10 Heavy Duty Reinforcing Fabric: Extra heavy-duty double strand, interwoven glass fibre mat, for high impact protection 915mm (3'-0") around all doors and where indicated on drawings.
- .11 Foundation Wall Insulation: Shall conform to Fed. Spec. HH-1-524, Type IV, thickness as indicated on drawings, minimum 50mm (2") extruded polystyrene, maximum board size 610 x 2440mm (2'-0" x 8'-0"). Insulation to extend a minimum of 610mm (24") below finish grade. Foundation wall insulation to be cut at a 45° angle at bottom edge. Refer to the drawings.
- .12 [Substrate Polystyrene (hard-coat system): Shall conform to Fed. Spec. HH-1-524, Type IV; thickness as indicated on drawings, minimum 25mm (1") extruded polystyrene, maximum board size 610 x 2440mm (2'-0" x 8'-0").][Substrate Polystyrene (soft-coat system): Shall conform to Fed. Spec. FS1-GP-20M, moulded expanded polystyrene, with a nominal density of 1.0 P.C.F.; Type 1; thickness as indicated on the drawings, minimum 19mm (3/4"); maximum board size 610 x 1220mm (2'-0" x 4'-0").]
- .13 Trim Accessories: Expansion and control joints in the "hard coat" system to be of the "Deep V" type. All expansion and control joints, corner beads, corner reinforcement, etc. to be of pure zinc metal (only end channel "J" trim may be of P.C.V. vinyl, colour to be selected by the Departmental Representative), as needed and as indicated on the drawings and as recommended by the manufacturer of the EIFS.

- .14 Foundation Wall Base Coat: Ready mix pure acrylic copolymer base coat to be used in combination with Portland cement (Type 1) in a 1:1 ratio. Foundation wall base coat to extend to the bottom of insulation substrate.
- .15 Foundation Wall Base Coat Primer: Acrylic copolymer or silicone emulsion as recommended by the manufacturer, to match basecoat and finishes. Primer to be applied between base coat and finish coat, if required by the manufacturer.
- .16 Foundation Wall Finish Coat: Foundation finish coat to extend 300mm (12") below finished grade or as indicated. Ready-mixed silicone based emulsion textured coating with 1.2-2.8 graded white Georgian marble aggregate, sand texture finish.
- .17 [New Wall System Base Coat: hard-coat system base coat shall be polymer-modified Portland cement (Type 1) and silica sand to function as base coat for coating application and mixed with base coat liquid admixture.][New Wall System Base Coat: soft-coat system base coat shall be a 100% acrylic polymer or co-polymer, completely flexible and non-cementitious, for bedding the reinforcing fabric.]
- .18 Primer: Acrylic copolymer or silicone emulsion as recommended by the manufacturer, to match the different finishes. Primer to be applied between all base coats and finish coats, if required by the manufacturer.
- .19 Conditioner: A pretreatment sealer/adhesive, utilized to stabilize the existing substrate prior to the application of the base coat, as required by the manufacturer.
- .20 Finish Coat: [A flexible non-cementitious top coating of premixed 100% pure acrylic based material with 1.5mm graded Georgian white marble and clear drying, non-yellowing, UV resistant binder][A flexible top coating of premixed acrylic based, elastomeric material, with 1.5mm graded Georgian white marble and clear drying, non-yellowing, UV resistant binder].
- .21 All finishes to be uniform in colour and texture, within the areas of the same selection of colour and texture.
- .22 [Texture to match the Council's Building's M-12/M-20.][Texture to be [trowel][spray][sponge] applied, with a [fine][coarse][light stipple][coarse stipple] finish.]
- .23 Colours:
 - .1 Main wall areas:
 - .2 Window surrounds:
 - .3 Foundation:
 - .4 Decorative bands:
 - .5 [_____]
- .24 All final colours and textures to be selected by the Departmental Representative. Samples are to be submitted for approval.

2.2 Finish System

- .1 Finish system to comply with:
 - Accelerated Weathering ASTM G-53
 - Freeze Thaw Resistance ASTM A67-84

Impact Resistance	ASTM E695
Salt Spray Resistance	ASTM B1117
Sand Abrasion Resistance	ASTM D968
Mildew Resistance	MIL STD 810B
Rain Test (Wind driven rain)	FED STD TT-C-55B
Permeability	CAN/CGSB-1.162

2.3 Fire Hazard Tests

- .1 Finish materials shall comply with fire requirements applicable, as per the National Building Code (latest edition).

Part 3 EXECUTION

3.1 Installation

- .1 Installation shall conform to the manufacturer's printed recommendations except where otherwise specified.
- .2 Inspection of all surfaces to be covered shall be conducted and approved by the applicator prior to installation.
- .3 Polystyrene Boards and Reinforcing Fabric:
 - .1 Polystyrene boards shall be placed horizontally from a level base line.
 - .2 Vertical joints shall be staggered and polystyrene boards interlocked at corners.
 - .3 Joints of polystyrene boards shall be butted tightly.
 - .4 Surfaces of adjacent polystyrene boards shall be flush at joints. Secure with a minimum of three (3) fasteners per polystyrene board into the substrate, more in soft-coat applications.
 - .5 Both "Hard" and "Soft" coat EIFS are to be mechanically fastened. Depending on the manufacturer, the meshes only on the "Soft Coat" system, may not be mechanically fastened, or rather, embedded in the base coat material while still wet. Polystyrene boards must be mechanically fastened in both systems.

3.2 Installation of Hard-Coat System

- .1 In General: provide continuous expansion joint in the EIFS, (joint size, detail and caulking as per manufacturer's recommendations) including through the sheathing/backing board and structural studs' assembly, at the same locations of existing building expansion joints. Provide a break formed, prefinished aluminum cover, minimum 20 gauge, fastened on one side with weatherproof fasteners coloured to match the cover, in order to protect and finish the expansion joint. Submit a shop drawing in accordance with section 01000 of the specification showing the proposed details, colours, and methods to be utilized for approval by the Departmental Representative.

- .2 Install accessories (example, corner bead, expansion joint, etc.) as indicated with temporary fasteners pushed through the polystyrene board.
- .3 Reinforcing glass fabric shall be overlapped 75 mm (3") and mesh overlapped onto the flange of surface mount accessories. Fasten temporarily through polystyrene board.
- .4 Insulation and reinforcing fabric shall be mechanically anchored with manufacturer's standard anchors spaced not more than 300mm (12") vertically and not more than 400mm (16") horizontally on masonry, concrete or structural studs.
- .5 Provide system expansion joints so that no area exceeds 13.4m² (144 ft²).
- .6 Placement shall be as shown on drawings. Ensure compliance with the manufacturer's printed instructions.
- .7 Base Coat: Base coat shall be mixed in accordance with the manufacturer's instructions and applied to the polystyrene wall surfaces, trowelling the materials into the reinforcing fabric in a tight coat and doubling back to 4.8mm (3/16") thickness. Base coat shall be applied to level out surface areas and to fill joints smooth with adjacent areas.
- .8 Prime base coat surface as per manufacturer's recommendations before texture finish application, if so required.
- .9 Foundation: Base material and meshes shall be applied 610mm (24") below finish grade or as shown on the drawings. Finish materials shall be applied 300mm (12") below finish grade or as directed by the Departmental Representative.
- .10 Textured finish coat shall be applied onto the base coat surface and floated to achieve the desired texture..

3.3 Installation Soft-Coat System

- .1 In General: provide continuous expansion joint in the EIFS, (joint size, detail and caulking as per manufacturer's recommendations) including through the sheathing/backing board and structural studs' assembly, at the same locations of existing building expansion joints. Provide a break formed, prefinished aluminum cover, minimum 20 gauge, fastened on one side with weatherproof fasteners coloured to match the cover, in order to protect and finish the expansion joint. Submit a shop drawing in accordance with section 01000 of the specification showing the proposed details, colours, and methods to be utilized for approval by the Departmental Representative.
- .2 Rasp/sand polystyrene surfaces as required, to level and improve bond of the base coat.
- .3 Route any detailing or control joint requirements or as shown on the drawings.
- .4 Utilize wood grounds or appropriate methods to ensure straight and even lines during the application of base coat.
- .5 Apply base coat to the complete polystyrene surface and while the mixture is still wet, embed a complete layer of reinforcing fabric over the entire surface area, ensuring that the fabric laps are a minimum of 75mm (3"). Level out with a stainless steel trowel. Allow base coat to dry a minimum of 48 hours or as recommended by the manufacturer.

- .6 In high impact areas such as around doorways and where shown on the drawings, apply heavy duty reinforcing fabric. Embed reinforcing fabric in a secondary coating of base material while it is still wet. Ensure that the fabric laps are a minimum of 75mm (3"). Level out with a stainless steel trowel. Allow the material to dry a minimum of 48 hours or as recommended by the manufacturer.
- .7 Apply wall base coat primer as required by the manufacturer to ensure thickness and bonding.
- .8 Foundation: Base material and meshes shall be applied 610mm (24") below finish grade or as shown on the drawings. Finish materials shall be applied 300mm (12") below finish grade or as directed by the Departmental Representative.
- .9 Textured finish coat shall be applied onto the base coat surface and floated to achieve the desired texture.

3.4 Installation Direct-Applied

- .1 Rake out all caulking at the cracks. Remove caulking at the perimeter of window openings and at the vertical control joints if loose. Remove all deleterious materials which may affect the bond of the base coat.
- .2 Remove all paint coatings, etc. by means of water blasting methods, back to an acceptable substrate for bonding of the base coat.
- .3 Apply conditioning material to all existing surfaces to receive new base coat materials as recommended by the manufacturer.
- .4 Fill all cracks with base coat material and while the mixture is still wet, embed a mesh and feather out a minimum of 75mm (3") on either side of the crack with a steel trowel.
- .5 Apply grounds at the control joints and around all perimeter of windows and wall terminations, to ensure even and straight control lines and caulking joints. Apply trim pieces as required.
- .6 Apply base coat to the complete wall surface and while the mixture is still wet, embed a complete layer of reinforcing fabric over the entire wall area, ensuring that the fabric laps are a minimum of 75mm (3"). Level out with a stainless steel trowel. Allow base coat to dry a minimum of 48 hours or as recommended by the manufacturer.
- .7 Apply wall base coat primer as required by the manufacturer to ensure thickness and bonding.
- .8 Foundation: Base material and meshes shall be applied 610mm (24") below finished grade or as shown on the drawings. Finish materials shall be applied 300mm (12") below finish grade or as directed by the Departmental Representative.
- .9 Textured finish coat shall be applied onto the base coat surface and floated to achieve the desired texture.

3.5 Temperature & Curing

- .1 Application of all coating materials shall be at 4.4°C (40°F) or rising and is to be maintained at this temperature for a minimum of 24 hours, or longer if so directed by the manufacturer. Each coat must sufficiently cure prior to the application of the next coat.
- .2 Curing: the applicator is responsible for the protection required by the manufacturer, for proper curing against dryout from direct sunlight exposure. Proper curing times are to be maintained.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 06 10 00.01 - Rough Carpentry.

1.2 GENERAL

- .1 Provide the necessary labour and materials to complete the removal of the existing roofing system, sheet metal flashings and membrane down to the existing structural deck and install new roofing system as specified herein. Do roofing work in accordance with applicable standards herein and supplemented with the Canadian Roofing Contractors Association (CRCA) roofing specifications manual.
- .2 The new system shall be as follows and as specified in the areas indicated on the drawings;

M38 - The Typical Roof Assembly shall be:

13mm DensDeck Sheathing

Vapour Barrier

2 base layers 75mm Rigid Insulation

Sloped Insulation and as shown on drawings over base layers of insulation.

6mm Asphalt Core Board

2 Ply Modified Bitumen Membrane

- .3 Supply all labour and materials necessary to complete the new two ply Modified Bitumen Membrane Flashings, as specified and detailed in the areas indicated on the drawings.
- .4 Examine all surfaces to receive new roof assembly, and if corrective measures are necessary, report items to Consultant in writing. Substrate shall be smooth, clean, dry and free from depressions or sharp edges. All required wood blocking and curbs shall be securely in place prior to start of roofing work. Notify the Departmental Representative in writing, prior to commencing contracted work, should corrective measures be required.
- .5 Examine drawings and existing conditions, provide for all vents, curbs, stacks roof mounted equipment curbs, and other openings through membrane roofing.

1.3 REFERENCES

- .1 ASTM International Inc.

- .1 ASTM C 1177/C 1177M-08, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
- .2 ASTM D 41/D 41M-11, Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
- .3 ASTM D 6162-00a(2008), Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fibre Reinforcements.
- .2 Canadian General Standards Board (CGSB)
 - .1 CGSB 37-GP-9Ma-83, Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing.
 - .2 CGSB 37-GP-56M, Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing.
- .3 Canadian Roofing Contractors Association (CRCA)
 - .1 CRCA Roofing Specifications Manual-2011.
- .4 Canadian Standards Association (CSA International)
 - .1 CSA A123.21-04, Standard Test Method for the Dynamic Wind Uplift Resistance of Mechanically Attached Membrane-Roofing Systems.
- .5 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .6 Underwriters Laboratories' of Canada (ULC)
 - .1 CAN/ULC-S704-11, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Convene pre-installation meeting one week prior to beginning waterproofing Work, with Consultant to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Review manufacturer's installation instructions and warranty requirements.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals if requested.
- .2 Product Data:
 - .1 Provide two copies of most recent technical roofing components data sheets describing materials' physical properties and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Provide two copies of WHMIS MSDS for all materials to be used.

1.6 INSPECTION AND TESTING

- .1 Inspection of membrane roofing and associated work, will be done by the Independent Consultant appointed by the Owner. Notify the Consultant at least 48 hours before commencement of any roofing work.
- .2 The Consultant reserves the right to have cut tests made in the presence of the Contractor. Costs of tests and subsequent repairs shall be borne by the Contractor.
- .3 The Consultant shall be notified in the event that the specifications conflict with the Manufacturer's recommendations or CRCA guidelines.
- .4 The inspection and testing service does not relieve the Contractor of his responsibility for quality control of production and for errors made by him.

1.7 QUALITY ASSURANCE

- .1 Installer qualifications: company or person specializing in application of modified bituminous roofing systems with 5 years documented experience approved by manufacturer.
- .2 Compatibility between all components of roofing system is essential.
- .3 The Contractor shall be responsible for ensuring that all items he elects to use are compatible with each other.
- .4 Study all documents which describe, or are related to any operation before commencement of that operation. Report discrepancies discovered between existing conditions and documentation. Obtain ruling on required interpretation before commencing work.
- .5 Ensure that materials, equipment, services and operatives are brought to site in sufficient quantity and in accordance with requirements of the work schedule.

1.7 FIRE PROTECTION

- .1 Fire Extinguishers:
 - .1 Maintain one cartridge operated type or stored pressure rechargeable type with hose and shut-off nozzle,
 - .2 ULC labelled for A, B and C class protection.
 - .3 Size 9 kg on roof per torch applicator, within 6 m of torch applicator.
- .2 Maintain fire watch for 2 hours after each day's roofing operations cease. Continuously use watch period to operate an infra-red thermometer over days operations to eliminate the possibility of hot spots.

1.8 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Storage and Handling Requirements:

- .1 Safety: comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of asphalt, sealing compounds, primers and caulking materials.
 - .2 Provide and maintain dry, off-ground weatherproof storage.
 - .3 Store rolls of felt and membrane in upright position. Store membrane rolls with salvage edge up.
 - .4 Remove only in quantities required for same day use.
 - .5 Place plywood runways over completed Work to enable movement of material and other traffic
 - .6 Store sealants at +5 degrees C minimum.
 - .7 Store insulation protected from daylight and weather and deleterious materials.
 - .8 Any materials damaged and/or exposed to the elements and/or moisture, shall be removed from the work site at the discretion of the Consultant.
 - .9 Stockpiling of materials on the roof will not be allowed. Distribute material as directed by the Consultant.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets crates padding and packaging materials.
- .1 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.
 - .2 Fold up metal banding, flatten and place in designated area for recycling.
- .4 Clean up as work progresses. Upon completion, remove scaffolding, temporary protections and surplus materials. Make good any defects noted at this stage. Clean areas affected under contract, to a condition at least equal to that previously existing and to satisfaction of the Consultant.

1.9 PREPARATION

- .1 All materials that may be reused on the new roof system, salvage and store for inspection by the Consultant. Credits for such materials may be requested.
- .2 The Contractor is solely responsible for the disconnection, relocation and re-installation of all existing mechanical and electrical services as required.
- .3 Ensure that the Owner is aware of any such work that may effect the interior environment of the building, prior to disconnection or shut down.
- .4 Disconnection and reconnection of all electrical services to meet latest regulations of Canadian Electrical Code and applicable Municipal and Provincial Codes and Regulations. In each and every instance of application, Code, Regulation, Statute, By-Law or Specification, the most stringent requirements shall apply.
- .5 Provide the Owner with a schedule indicating time and dates, for any work creating a disruption to the interior environment and obtain the Owner's written approval.

1.10 SITE CONDITIONS

- .1 Ambient Conditions
 - .1 Do not install roofing when temperature remains below -15°C for torch application.
 - .2 Minimum temperature for solvent-based adhesive is -5°C .
- .2 Install roofing on dry deck, free of snow and ice, use only dry materials and apply only during weather that will not introduce moisture into roofing system.
- .3 All adjacent parts of the building shall be protected from damage caused by roofing operations. Cover walls and other surfaces in the vicinity of hoisting apparatus with heavy canvas or other suitable protective material. Any damage caused by this contract shall be repaired to match the original materials and appearance.
- .4 Locate equipment and materials in areas designated by the Consultant and/or Owner.
- .5 Conduct operations so as to leave deck exposed for minimum period of time. Protect, as required, to prevent water infiltration or environmental damage to building interior.
- .6 Provide temporary membrane to render deck watertight, if for some unforeseen reason work cannot be completed as specified. All temporary membranes shall be removed completely prior to any further roofing work.
- .7 Where work must continue over finished roofing membrane, protect surface with minimum 12.5mm thick plywood sheets.
- .8 Any sharp projections, that in the opinion of the Consultant may penetrate the membrane, shall be ground smooth and flush.
- .9 All aspects of the re-roofing operation shall follow in close sequence. No part of the operation shall be so far ahead of the succeeding part that the latter cannot be finished that working day.

1.11 ADDITIONAL CONSTRUCTION FACILITIES

1. Overhead Scaffold Protection:
Scaffolding: scaffold shall provide sufficient clearance to match existing door opening height and extend 2.4m from the building unless indicated greater on drawings. Scaffold shall be temporarily anchored to wall or ballasted to prevent movement from wind action. Top surface protection shall be with pre-engineered scaffold platforms complete with claw attachment and anchorage.

1.12 WARRANTY

- .1 **The warranty shall be extended to a period of two (2) years from the date of final completion. Repair of any actual leaks shall also include the removal and replacement of all related moisture damage materials.**

- .2 Make all necessary repairs and replacements within 48 hours of receipt of written notification.
- .3 Nothing contained in this Article shall be construed as in any way restricting or limiting the liability in common law and statutory liability of the Contractor.
- .4 Provide a manufacturer's warranty, which shall guarantee the membranes and membrane flashing performance, for a period of ten years against manufacturing defects and premature deterioration.
- .5 Provide these written warranties, confirming above, issued on the corporate letterhead, signed and sealed by an authorized signing officer. The warranties will specifically reference the name of the Building, location and Owner.

Part 2 Products

2.1 PERFORMANCE CRITERIA

- .1 Compatibility between components of roofing system is essential. Provide written declaration to Consultant stating that materials and components, as assembled in system, meet this requirement.

2.3 PRIMER

- .1 Asphalt primer: to CGSB 37-GP-9Ma ASTM D 41.

2.4 SHEATHING

- .1 Glass fibre faced: Georgia-Pacific "DensDeck" or approved equal.

2.5 VAPOUR RETARDER

- .1 Base sheet: to CGSB 37-GP-56M polyester fibres to ASTM D 6164 glass fibres to ASTM D 6163 combination of polyester and glass fibres to ASTM D 6162.
 - .1 Styrene-Butadiene-Styrene (SBS) elastomeric polymer prefabricated sheet, glass or polyester reinforcement, having nominal weight of 180 g/m².
 - .2 Type 1, fully adhered.
 - .3 Class C - plain surfaced.
 - .4 Grade 1 - standard service.
 - .5 Bottom surface:
 - .1 Polyethylene.
 - .6 Top surface:
 - .1 Sanded
 - .7 Base sheet membrane properties: to CGSB 37-GP-56M.

2.6 INSULATION

- .1 Rigid closed cell polyisocyanurate insulation bonded on upper and lower surfaces to an inorganic glass fibre facer. Material shall meet CAN/CGSB-51.26-M86 and CAN/ULC-S704, The boards shall be distributed in 1200mm x 1200mm panels, pre-wrapped to prevent moisture ingress. Standard of acceptance shall be Johns Manville Enrgy 3, IKOTerm III polyisocyanurate insulation or Atlas Roofing Corp AC FOAM III.

2.7 SLOPED INSULATION

- .1 In drain sumps and at perimeter, rigid closed cell polyisocyanurate insulation bonded on upper and lower surfaces to an inorganic glass fibre facer. Material shall meet CAN/CGSB-51.26-M86 and CAN\UL-S126-M. The boards shall be distributed in 1200mm x 1200mm panels, pre-wrapped to prevent moisture ingress. Standard of Acceptance shall be Johns Manville Enrgy 3, IKOTerm III polyisocyanurate insulation or Atlas Roofing Corp AC FOAM III. or approved equal.
- .2 Insulation slopes shall be as indicated on the detailed drawings and roof plans. The degree of slope shall be 1:100 or as noted on drawing.
- .3 Modules shall be factory cut to correct slopes.

2.8 MEMBRANE

- .1 Base sheet: to CGSB 37-GP-56M polyester fibres to ASTM D 6164 glass fibres to ASTM D 6163 combination of polyester and glass fibres to ASTM D 6162.
 - .1 Styrene-Butadiene-Styrene (SBS) elastomeric polymer prefabricated sheet, glass or polyester reinforcement, having nominal weight of 180 g/m².
 - .2 Type 1, fully adhered.
 - .3 Class C - plain surfaced.
 - .4 Grade 1 - standard service.
 - .5 Top and bottom surfaces:
 - .1 Polyethylene.
 - .6 Base sheet membrane properties: to CGSB 37-GP-56M.
- .2 Cap sheet membrane and Walkways: to CGSB 37-GP-56M combination of polyester and glass fibres to ASTM 6162.
 - .1 Styrene-Butadiene-Styrene(SBS) elastomeric polymer, prefabricated sheet, glass or polyester reinforcement, having nominal weight of 250 g/m².
 - .2 Type 1, fully adhered.
 - .3 Class A-granule surfaced.
 - .1 Colour for granular surface .
 - .4 Grade 1-standard service.
 - .5 Bottom surface polyethylene.
 - .6 Cap sheet membrane properties: to CGSB 37-GP-56M.

2.9 ADHESIVE

- .1 Adhesive for securing insulation, tapered insulation and overlay board shall be;
 - a) an asphalt extended vulcanized adhesive.
 - b) a single component urethane adhesive, dispensed from a portable pre-pressurized container requiring no external power source.
 - c) a single component solvent free moisture curing adhesive.
 - d) a two component, elastomeric, moisture cured; low rise urethane foam adhesive that contains no solvents.
- .2 Adhesive for securing overlay board and insulation or a solvent-free moisture curing adhesive. Standard of acceptance shall be Duotack by Soprema, Elite by Tremco or Millennium Adhesive by IKO.

2.10 OVERLAY BOARD

- .1 Overlay Board: 6 mm thick asphalt based recovery board with non-woven glass facers, as recommended by the membrane manufacturer.
 - .1 Install over insulation to provide torch safe surface and cover joints with self adhesive fire resistant tape as specified in 2.2.2.

2.11 ACCESSORIES

- .1 Roofing Nails: to CSA B111-1974, Table 12, of galvanized steel or aluminum, sufficient length to penetrate wood substrate at least 25mm. Nails to have a minimum head diameter of 25mm.
- .2 Metal Securing Strips: 25mm wide, .67mm galvanized steel double hemmed.
- .3 Miscellaneous penetrations shall include a cement curb and rubberized filler. Pourable rubberized sealant shall be a two component urethane pourable and self levelling sealant. Curb shall be an inorganic composite material to withhold the sealer and prevent leakage of sealer. Standard of acceptance shall be by Chem-Link and Chem-curb, or Roofpart Elastomeric Silicone Sealant by Lexcor or an approved equal.
- .4 Vent Stack Flashings and guy line flashing: to be spun aluminum sleeve to fit over the vent stack with sufficient space to insulate. A spun aluminum cap to fit outside the sleeve and inside the vent stack inside diameter.

Execution**3.1 QUALITY OF WORK**

- .1 Do examination, preparation and roofing Work in accordance with Roofing Manufacturer's Specification Manual and CRCA Roofing Specification Manual Provincial Roofing Association Manual, particularly for fire safety precautions.
- .2 Do priming in accordance with manufacturers written recommendations.
- .3 The interface of the walls and roof assemblies will be fitted with durable rigid material

sheet metal or plywood providing connection point for continuity of air barrier.

- .4 Assembly, component and material connections will be made in consideration of appropriate design loads, with reversible mechanical attachments.

3.2 EXAMINATION OF ROOF DECKS

- .1 Verification of Conditions:
 - .1 Inspect with Consultant deck conditions.
- .2 Evaluation and Assessment:
 - .1 Prior to beginning of work ensure:
 - .1 Decks are firm, straight, smooth, dry, free of snow, ice or frost, and swept clean of dust and debris. Do not use calcium or salt for ice or snow removal.
 - .2 Curbs have been built.
 - .3 Plywood and lumber nailer plates have been installed to deck, walls and parapets as indicated.
 - .4 Openings are cut and spray foam applied to complete air and vapour barriers.
 - .3 Do not install roofing materials during rain or snowfall.

3.3 PROTECTION OF IN-PLACE CONDITIONS

- .1 Cover walls, walks and adjacent work where materials hoisted or used.
- .2 Use warning signs and barriers. Maintain in good order until completion of Work.
- .3 Clean off drips and smears of bituminous material immediately.
- .4 Protect roof from traffic and damage. Comply with precautions deemed necessary by Consultant.
- .5 At end of each day's work or when stoppage occurs due to inclement weather, provide protection for completed Work and materials out of storage.

3.4 PRIMING

- .1 Apply primer to roofing substrate at the rate recommended by manufacturer 2.5 L per 10 m² in areas not covered with protection board.

3.5 VAPOUR RETARDER

- .1 Install as detailed on the drawings and lap over parapets.
- .2 Commencing at the lowest point of the roof, apply vapour barrier by torching application.

Apply membrane with 75mm side laps and 150mm end laps. Supplement adhesion where necessary with additional membrane strips to ensure waterproof protection until application of roof assembly.

- .3 Ensure membrane is unrolled to enable membrane to relax prior to installation. Time required for relaxation will vary with weather conditions.
- .4 Torch weld all lap joints by heat softening the membrane and pressing the edge of the membrane firmly with a roofing trowel. Ensure consistent adhesion has been achieved between the substrate and base sheet membrane.

3.6 (EXPOSED) CONVENTIONAL MEMBRANE ROOFING (CMR) APPLICATION

- .1 Install insulation to meet thickness as required in scope of work and indicated on the drawings. Ensure polyethylene film on base sheet vapour barrier is completely removed prior to applying adhesives.
- .2 Stagger all joints in the boards, for all layers.
 - .1 Adhere insulation to vapour barrier using adhesive.
 - .2 Cut end pieces to suit.
 - .3 Apply adhesive in continuous 13mm ribbons at 200 mm on centre.
- .3 In the sump area around the drain, reduce base insulation by 25mm and install sloped insulation as detailed.
- .4 Cap all insulation, as detailed, with the overlay board, secured with the specified adhesives.
- .5 Unless specifically stated otherwise, strictly follow the adhesives Manufacturers printed instructions for the application of the adhesives, including spread patterns and requirements for walking over the boards.
- .6 Overlay Board: adhesive application:
 - .1 Adhere overlay board to insulation with adhesive at the rate of one 13 mm ribbon at 200 mm O.C.
 - .2 Place boards in parallel rows with end joints staggered.
 - .3 Cut ends to suit and apply adhesive in continuous ribbons at 200 mm on centre.
 - .4 Install fire tape over all joints as distributed by membrane manufacturer.
- .7 Base sheet application:
 - .1 Starting at low point of roof, perpendicular to slope, unroll base sheet, align and reroll from both ends.
 - .2 Unroll and torch base sheet onto substrate taking care not to burn membrane or its reinforcement or substrate.
 - .3 Lap sheets 75 mm minimum for side and 150 mm minimum for end laps.
 - .4 Application to be free of blisters, wrinkles and fishmouths.
- .8 Cap sheet application:
 - .1 Starting at low point on roof, perpendicular to slope, unroll cap sheet, align and

- reroll from both ends.
 - .2 Unroll and torch cap sheet onto base sheet taking care not to burn membrane or its reinforcement.
 - .3 Lap sheets 75 mm minimum for side laps and 150 mm minimum for end laps. Offset joints in cap sheet 300 mm minimum from those in base sheet.
 - .4 Application to be free of blisters, fishmouths and wrinkles.
 - .5 Do membrane application in accordance with manufacturer's recommendations.
- .9 Flashings:
- .1 Complete installation of flashing base sheet stripping prior to installing membrane cap sheet.
 - .2 Torch base and cap sheet onto substrate in 1 metre wide strips.
 - .3 Lap flashing base sheet to membrane base sheet minimum 150 mm and seal by mopping or torch welding.
 - .4 Lap flashing cap sheet to membrane cap sheet 250 mm minimum and torch weld.
 - .5 Provide 75 mm minimum side lap and seal.
 - .6 Properly secure flashings to their support, without sags, blisters, fishmouths or wrinkles.
 - .7 Do work in accordance with manufacturer's recommendations Section 07 62 00 - Sheet Metal Flashing and Trim.
 - .8 Install reinforcing gussets at all inside and outside corners as per manufacturer's recommendations.
 - .9 Granules shall be embedded for the preparation of the selvage where the membrane will overlap on the mineral surface.
 - .10 Using the propane torch, heat the back of the flashing strip until the coating flows and bonds to the roof and up to the vertical. Press in firmly for proper adhesion. Continue by bonding the upper portion to the wall, taking precautions not to stretch the membrane. Secure all membrane flashings to verticals with continuous securement strips installed along the top edge of membrane flashings and fastened at 300mm O.C. or as detailed. Lap all flashing strips to the selvage or a minimum of 75mm and seal the laps securely.
 - .11 Use a wet sponge to tamp the membranes in place at the junction of the horizontal and vertical surfaces.
 - .12 Torch application of membrane flashings shall be performed by skilled tradesmen in accordance with the manufacturer's recommendations.
- .10 Roof penetrations:
- .1 Install vent stack covers and other roof penetration flashings and seal to membrane in accordance with manufacturer's recommendations and details.

3.8 MISCELLANEOUS PENETRATIONS

- .1 Construct new composite curbs around base of posts and service lines after installation of Cap sheet membrane. Curb alignment shall be performed to ensure curbs are of consistent size and centered on the post or service line.
- .2 Adhere curb to membrane and seal all joints, prior to installing rubberized filler. Mix rubberised filler immediately before filling and cove to exterior for drainage.

3.9 SOIL VENT FLASHING

- .1 Prime aluminum flange and set into a coat of compatible mastic. Flash with one (1) ply of base sheet membrane for reinforcement, to extend a minimum of 200mm beyond flange. Complete installation with the application of the cap sheet membrane.
- .2 Install batt insulation between vent and aluminum flashing.
- .3 Caulk as detailed.

3.10 BATT INSULATION

- .1 Install mineral fibre batt insulation to fully fill stud/vent flashing cavities as required within the specification and shown on the drawings.

3.11 METAL FLASHING

- .1 Metal flashings are specified in Section 07 62 00. Co-ordinate this work with that section.

3.12 GENERAL

- .1 Remove bituminous markings from finished surfaces.
- .2 In areas where finished surfaces are soiled caused by work of this section, consult manufacturer of surfaces for cleaning advice and complying with their documented instructions.
- .3 Repair or replace defaced or disfigured finishes caused by work of this section. Patching of the cap sheet membrane shall be carried out utilizing patches with a minimum size of 450mm by 1000mm. Minimum length of cap sheet on flat run of roof shall not be less than 1000mm. Wrinkled or deformed ends of cap sheet rolls will not be tolerated and therefore must be discarded prior to application.
- .4 Following completion of new roofing, torch soften and apply a liberal application of approved bulk type mineral granules to cap sheet membrane edges where asphalt has extruded or flowed beyond clean lines and to all surface damage.
- .4 Splices in delivered rolls of membrane are to be removed. Cut back the roll 450mm on both sides of the splices and remove prior to installation.
- .5 At end of each day: Install water cut-offs and remove completely prior to continuing further roofing applications. Inspect all laps of the membrane application to ensure they are properly bonded. Repair any deficiencies prior to leaving the site for the day. Base sheet applications should not be left exposed overnight unless all seams are torch welded prior to leaving the work site.

END OF SECTION

Part 1 GENERAL

1.1 General

- .1 Provide all sheet metal and fasteners required to cover new or existing parapets curbs, vents, caps, etc. as indicated on the drawings.
- .2 All work to be performed by experienced mechanics skilled in the trade to the satisfaction of the Departmental Representative.

1.2 Warranty

- .1 For work of this section, the 12 months warranty period prescribed in subsection GC 32.2 of General Conditions "C" is extended to 24 months.

Part 2 PRODUCTS

2.1 Materials

- .1 Sheet Metal: Use one or more of the following for the particular application indicated on the drawings. [.1 Galvanized - 0.71 mm (0.028").] [.2 Copper - 0.68mm (0.027").] [.3 Aluminum 0.80mm (0.031") 35 type H.] [.4 Prefinished - as indicated on drawings.]
- .2 Fasteners: non-corrosive colour to match exposed flashings.
- .3 Unexposed: galvanized nails.
- .4 Exposed: screws with neoprene washers under the heads.
- .5 Caulking compound to CGSB 19-GP-5M colour to suit application.
- .6 Solder to ASTM B32-93 45% tin, 55% lead. .

Part 3 EXECUTION

3.1 Execution

- .1 Form sheet metal on a bending brake.
- .2 Provide flush type expansion joints at the maximum of 2400 mm (8'-0").

- .3 Back paint metal that comes in contact with other materials.
- .4 Fasten all exposed metal with non-corrosive screws c/w neoprene washers under the heads.
- .5 Caulk all joints indicated and all that are necessary to render installation watertight. Caulk around services at walls.
- .6 Extend ducts indicated on drawings with metal and gauge to match existing.
- .7 All metal flashings, reglets and parapets to be level and parallel with building lines.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 23.

1.2 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .2 Underwriter's Laboratories of Canada (ULC)
 - .1 ULC-S115-1995, Fire Tests of Fire stop Systems.

1.3 DEFINITIONS

- .1 Fire Stop Material: device intended to close off opening or penetration during fire or materials that fill openings in wall or floor assembly where penetration is by cables, cable trays, conduits, ducts and pipes and poke-through termination devices, including electrical outlet boxes along with their means of support through wall or floor openings.
- .2 Single Component Fire Stop System: fire stop material that has Listed Systems Design and is used individually without use of high temperature insulation or other materials to create fire stop system.
- .3 Multiple Component Fire Stop System: exact group of fire stop materials that are identified within Listed Systems Design to create on site fire stop system.
- .4 Tightly Fitted; (ref: NBC Part 3.1.9.1.1 and 9.10.9.6.1): penetrating items that are cast in place in buildings of non-combustible construction or have "0" annular space in buildings of combustible construction.
 - .1 Words "tightly fitted" should ensure that integrity of fire separation is such that it prevents passage of smoke and hot gases to unexposed side of fire separation.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 10 00 – General Instructions.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit two copies of WHMIS MSDS - Material Safety Data Sheets.
- .3 Shop Drawings:
 - .1 Submit shop drawings to show location, proposed material, reinforcement, anchorage, fastenings and method of installation.
 - .2 Construction details should accurately reflect actual job conditions.
- .4 Quality assurance submittals: submit following in accordance with Section 01 10 00 – General Instructions.
 - .1 Test reports: in accordance with CAN-ULC-S101 for fire endurance and CAN-ULC-S102 for surface burning characteristics.
 - .1 Submit certified test reports from approved independent testing laboratories, indicating compliance of applied fire stopping with specifications for specified performance characteristics and physical properties.

- .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.
- .4 Manufacturer's Field Reports: submit to manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

1.5 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: company specializing in fire stopping installations approved by manufacturer with 5 year documented experience.
- .2 Pre-Installation Meetings: convene pre-installation meeting one week prior to beginning work of this Section, with contractor's representative in accordance with the project schedule:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review manufacturer's installation instructions and warranty requirements.
- .3 Site Meetings: as part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits, to review Work, at stages listed.
 - .1 After delivery and storage of products, and when preparatory Work is complete, but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of Work, after cleaning is carried out.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with Section 01 10 00 – General Instructions.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
 - .3 Deliver materials to the site in undamaged condition and in original unopened containers, marked to indicate brand name, manufacturer, and ULC markings.
- .2 Storage and Protection:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Fire stopping and smoke seal systems: in accordance with CAN-ULC-S115.
 - .1 Asbestos-free materials and systems capable of maintaining effective barrier against flame, smoke and gases in compliance with requirements of CAN-ULC-S115 and not to exceed opening sizes for which they are intended and conforming to specified special requirements described in PART 3.
 - .2 Fire stop system rating: to match existing.

- .2 Service penetration assemblies: systems tested to CAN-ULC-S115.
- .3 Service penetration fire stop components: certified by test laboratory to CAN-ULC-S115.
- .4 Fire-resistance rating of installed fire stopping assembly in accordance with NBC.
- .5 Fire stopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal.
- .6 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal.
- .7 Primers: to manufacturer's recommendation for specific material, substrate, and end use.
- .8 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.
- .9 Damming and backup materials, supports and anchoring devices: to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.
- .10 Sealants for vertical joints: non-sagging.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 PREPARATION

- .1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials.
 - .1 Ensure that substrates and surfaces are clean, dry and frost free.
- .2 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.
- .3 Maintain insulation around pipes and ducts penetrating fire separation without interruption to vapour barrier.
- .4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

3.3 INSTALLATION

- .1 Install fire stopping and smoke seal material and components in accordance with manufacturer's certified tested system listing.
- .2 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.
- .3 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.
- .4 Tool or trowel exposed surfaces to neat finish.
- .5 Remove excess compound promptly as work progresses and upon completion.

3.4 SEQUENCES OF OPERATION

- .1 Proceed with installation only when submittals have been reviewed by NRC Departmental Representative.

- .2 Install floor fire stopping before interior partition erections.
- .3 Metal deck bonding: fire stopping to precede spray applied fireproofing to ensure required bonding.
- .4 Mechanical pipe insulation: certified fire stop system component.
 - .1 Ensure pipe insulation installation precedes fire stopping.

3.5 FIELD QUALITY CONTROL

- .1 Inspections: notify NRC Departmental Representative when ready for inspection and prior to concealing or enclosing fire stopping materials and service penetration assemblies.
- .2 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.6 CLEANING

- .1 Proceed in accordance with Section 01 10 00 – General Instructions.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- .3 Remove temporary dams after initial set of fire stopping and smoke seal materials.

3.7 SCHEDULE

- .1 Fire stop and smoke seal at:
 - .1 Penetrations through fire-resistance rated masonry, concrete, and gypsum board partitions and walls.
 - .2 Edge of floor slabs at curtain wall and precast concrete panels.
 - .3 Top of fire-resistance rated masonry and gypsum board partitions.
 - .4 Intersection of fire-resistance rated masonry and gypsum board partitions.
 - .5 Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.
 - .6 Penetrations through fire-resistance rated floor slabs, ceilings and roofs.
 - .7 Openings and sleeves installed for future use through fire separations.
 - .8 Around mechanical and electrical assemblies penetrating fire separations.
 - .9 Rigid ducts: greater than 129 cm²: fire stopping to consist of bead of fire stopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.

END OF SECTION

Part 1 GENERAL

1.1 General

- .1 One manufacturer's product only to be used throughout.
- .2 Sealant must be approved by Departmental Representative as acceptable product.
- .3 Exclude the following other sections of specifications; Glazing 08 80 00,
- .4 Painting 09 90 00.
- .5 Colours of all sealants to be selected by the Departmental Representative prior to proceeding.

Part 2 PRODUCTS

2.1 Materials

- .1 Multi-purpose sealant: Silicone, "Dow Corning #732" or equivalent approved by Departmental Representative.
- .2 Acoustic sealant: Synthetic Rubber Sealant, "Tremco Acoustical Sealant" or equivalent approved by Departmental Representative.
- .3 Filler of backing material: white non-absorbent, closed cell foam polyethylene. Material 30-50% wider than joint width to receive same.
- .4 Primers: sealant manufacturer's type.
- .5 Cleaners: as recommended by sealant manufacturers.

Part 3 EXECUTION

3.1 Preparation

- .1 Ensure all materials which will bear sealant on their surfaces are clean and free from foreign material which would affect bonding.
- .2 Permit concrete and mortar to cure fully before sealing.
- .3 Prime joint sides in accordance with manufacturer's directions.
- .4 Mask adjacent surfaces to prevent contamination by sealant. Remove mask immediately after joints completed.

3.2 Application

- .1 Employ a professional applicator to run continuous non varying width and depth beads of sealant on joints.
- .2 Apply sealant as per manufacturer's recommendations.
- .3 Do not apply sealant when surrounding air temperature air is below 5°C.
- .4 Immediately clean surplus compound from adjacent surfaces.

END OF SECTION

Part 1 GENERAL

1.1 Requirements of Regulatory Agencies

- .1 Steel fire rated doors and frames: labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN4 S104M-80 revised 1985 and CAN4 S105M-1985 for ratings specified or indicated, for example ULC or Warnock-Hersey.
- .2 Install labelled steel fire rated doors and frames to NFPA 80 except where specified otherwise.

1.2 Shop Drawings

- .1 Submit shop drawings in accordance with Section 01000.
- .2 Indicate each type of door, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners openings, glazed.

Part 2 PRODUCTS

2.1 Hollow Metal Doors

- .1 Steel: zinc coated .25 oz zinc per square foot content to ASTM A527.
- .2 Flat sheet: face and back skins to be 18 (1.0mm) gauge thickness.
- .3 Door Core:
 - .1 Honeycomb: structural core consisting of kraft paper having [20mm] cell size to thickness indicated.
 - .2 Hollow steel: vertically stiffened with steel ribs and all voids filled with semi-rigid fibrous insulation minimum density [24] kg/m³ [polystyrene][polyurethane].
 - .3 Bonded core: urethane or isocyanurate board insulation to CGSB 51-GP-21M-78.
- .4 Hardware reinforcement: hinges 7 (3.7mm) gauge, lock box, closer mounting, 14 (1.6mm) gauge.
- .5 Top and bottom channels closures: 14 (1.6mm) gauge.
- .6 Primer: for touch-up zinc chromate CAN/CGSB-1.132-M90.

2.2 Materials Pressed Steel Frames

- .1 Steel; zinc coated .25 oz zinc per square foot content to ASTM A527.
- .2 All components; headers, jambs, screen stiles to be 16 (1.3mm) gauge thickness.

- .3 Hardware reinforcement; minimum 7 (3.7mm) gauge for hinge plates min. 16 (1.3mm) gauge for closer mounting, panic sets, cylindrical and mortised locksets.
- .4 Glazing stops: min. 20 (0.8mm) gauge.
- .5 Temporary channel spreaders; min. 1.6mm (1/16").
- .6 Guard and dust boxes; 0.8mm (0.031") thick.
- .7 All anchors; drywall and masonry 18 (1.0mm) gauge, tube and screw 3/16" (5mm) dia. screws and 3/8" (10mm) dia. for labelled frames.
- .8 Door bumpers; pressure fit black neoprene.
- .9 Angle clips; min. 20 (0.8mm) gauge.
- .10 Primer: for touch-up zinc chromate CAN/CGSB-1.132-M90.

Part 3 EXECUTION

3.1 Fabrication

- .1 Prior to fabrication take critical measurements at site to facilitate installation and fitting of doors.
- .2 Blank, drill, reinforce and tap frames to receive templated strikes, door closers and hinges.
- .3 Cut frames, mitre accurately and form continuous invisible welds inside profile.
- .4 Grind welded corners, fill exposed surface depressions and butted joints with metallic paste filler and sand to a smooth uniform finish.
- .5 Protect strikes and hinges by guard boxes welded in place.
- .6 Reinforce door transoms and heads for openings larger than 5'-0" (1500mm) with light structural section or as indicated.
- .7 Fabricate doors as integral units, free from sag, distortion, wave or core ghosting, with slide interlocking edge seams.
- .8 Bond steel sheets to approved core material. Fill voids in stiles with polyurethane.
- .9 Exterior doors to have inverted top channel welded in place and filled with a metallic paste filler and sand to a smooth uniform finish.
- .10 Glazing stops, zinc coat steel cut to suit glass opening sizes with butted corners for doors and frame screens. Secured in place with oval headed cadmium plated machine screws 8" o.c.
- .11 Welding of door and frame components in accordance with CSA W59-M1989.
- .12 Fabricate thermally broken frames for exterior doors using steel core, separating exterior portion of frame from interior portion with polyvinyl chloride thermal breaks.

3.2 Installation

- .1 Provide each door frame with two rubber door silencers at head of each door, and three at the strike side.
- .2 Provide two channel or angle spreaders per frame to ensure proper alignment. Where frames terminate at finished floor, provide angle clips for anchorage to slab.
- .3 Provide six adjustable anchors for seven feet height of frames.
- .4 Obtain hardware templates. Cut, blank-out, reinforce and drill all members accurately to receive hardware. Provide locating clips for mortise locks.
- .5 Secure physical metal fire label, by means of pop rivets on labelled fire doors and frames. Label to carry qualifications of rating in accordance to Underwriters or Warnock-Hersey standards. Locate labels on hinge rebate of frames and hinge end of doors.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 07 95 13 Expansion Joint Assemblies: Coordination of wall and ceiling expansion joints.
- .2 Section 09 22 16 Non-Structural Metal Framing: Framing for ceiling bulkheads
- .3 Section 09 29 00 Gypsum Board: Gypsum board finish for ceiling bulkheads.
- .4 Division 22 Plumbing: Plumbing work above ceilings.
- .5 Division 23 Heating, Ventilating and Air Conditioning: HVAC work above ceilings.
- .6 Division 26 Electrical: Electrical work above ceilings; trim for recessed light fixtures; sound masking system.
- .7 Division 27 Communications: Work above ceilings; trim for recessed fixtures.

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM C423-09a, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
 - .2 ASTM C635-07, Specifications for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.
 - .3 ASTM C636-08, Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
 - .4 ASTM E1264-08, Standard Classification for Acoustical Ceiling Products.
 - .5 ASTM E1414-11a¹ Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum.
 - .6 ASTM E1477-98a(2008), Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-92.1-M89, Sound Absorptive Prefabricated Acoustical Units.
- .3 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-2007, Surface Burning Characteristics of Building Materials and Assemblies.

1.3 DESIGN REQUIREMENTS

- .1 Maximum deflection: 1/360th of span to ASTM C635 deflection test.

1.4 SEISMIC DESIGN CRITERIA

- .1 Provide seismic restraint for ceiling suspension systems in accordance with the requirements of the NBC, and in accordance with requirements of ASTM E580 and good engineering practice.
 - .1 Include provisions for all fixtures incorporated into or suspended from ceiling suspension system.
- .2 Provide ceiling suspension systems capable of withstanding effects of earthquake motions determined in accordance with NBC for site specific conditions.
 - .1 Provide connections and bracing as required to satisfy seismic criteria.

1.5 SUBMITTALS

- .1 Provide all listed submittals in accordance with submittal procedures of Section 01 00 10.
- .2 Submit triplicate 150 mm x 150 mm samples of each type of acoustical units, except as follows.
 - .1 Submit triplicate full size samples of acoustical unit type .
- .3 Submit one representative model of each type ceiling suspension system.
- .4 Submit manufacturer's product literature describing specified products, including their technical and physical properties.
 - .1 Include manufacturer's certificate of mix formulation compliance, including certification that products contain no more than 0.5% asbestos.
 - .2 Include WHMIS and Material Safety Data Sheets.

1.6 QUALITY ASSURANCE

- .1 Mock-up:
 - .1 Construct mock-ups in accordance with quality assurance requirements of Section 01 00 10.
 - .2 Construct ceiling suspension system mockup to show basic construction and assembly, treatment at walls, recessed fixtures, sound masking devices, splicing, interlocking, finishes, acoustical unit installation.
 - .3 Submit mock-up of each combination of suspension system and acoustical ceiling panel, in two typical application areas such as offices, meeting rooms, corridors, special areas.
 - .1 Construct mock-up 10 m2 minimum of each type acoustical panel ceiling including one inside corner and one outside corner where applicable.
 - .2 Construct mock-ups where directed.
 - .4 Allow 48 hours for inspection of mock-up by Departmental Representative before proceeding with ceiling work.
 - .5 When accepted, mock-up will demonstrate minimum standard for this work. Mock-up may remain as part of the finished work.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials in original unopened packaging with labels intact.

- .2 Label cartons and packages indicating contents and locations for which each item is intended.
- .3 Do not deliver panels to job site until shortly before installation.
- .4 Protect on site stored or installed absorptive material from moisture and all other forms of damage.
- .5 Remove damaged or deteriorated materials from the site.
- .6 Store extra materials required for maintenance, where directed by Owner's representative Departmental Representative.

1.8 ENVIRONMENTAL REQUIREMENTS

- .1 Permit wet work to dry before beginning to install.
- .2 Maintain uniform minimum temperature of 15 degrees C and humidity of 20- 40% before and during installation.
- .3 Store materials in work area 48 hours prior to installation.

1.9 EXTRA MATERIALS

- .1 Provide extra materials of acoustic units in accordance with closeout requirements of Section 01 00 10.
- .2 Provide acoustical units and suspension system components amounting to 2% of gross ceiling area for each pattern and type required for project.
- .3 Ensure extra materials are from same production run as installed materials.
- .4 Clearly identify each type of acoustic unit, including colour and texture.
- .5 Deliver to Departmental Representative, upon completion of the work of this section.

1.10 SEQUENCING AND SCHEDULING

- .1 Do not install acoustical panels and tiles until work above ceiling has been inspected by Departmental Representative.
- .2 Do not commence installation until mechanical and electrical work above ceiling is complete.

1.11 COORDINATION

- .1 Coordinate installation of suspended ceiling system with construction of ceiling bulkheads.
- .2 Coordinate installation of suspended ceiling system with mechanical, electrical and other work so that interference is prevented and items such as diffusers, grilles, lights, fixtures and other items are properly located and supported as indicated or as directed by Departmental Representative.

- .3 Coordinate installation of ceiling suspension system and curved trim with erection of partition framing and installation of wallboard to ensure uniform width of reveal between curved trim and partition.
 - .1 Manufacturer recommends installation of ceiling suspension system and curved trim prior to erection of adjacent partition and bulkhead framing to allow adjustment of curved partition to pre-fabricated curved trim.

Part 2 Products

2.1 SOURCE OF SUPPLY

- .1 Provide all suspension systems and acoustic panels as products of the same single manufacturer.

2.2 ACOUSTICAL SUSPENSION SYSTEM

- .1 Provide intermediate duty system to ASTM C635, as specified for each respective system.
- .2 Basic materials for suspension system: commercial quality cold rolled steel, zinc coated.
- .3 Provide acoustical suspension system specified for each respective acoustical ceiling panel, and as follows.
- .4 Exposed tee bar grid components: Components die cut. Main tee with double web, rectangular bulb and 25 mm rolled cap on exposed face, colour white. Cross tee with rectangular bulb; web extended to form positive interlock with main tee webs; lower flange extended and offset to provide flush intersection.
- .5 Hanger wire: galvanized soft annealed steel wire, 2.6 mm diameter.
- .6 Hanger inserts: purpose made drilled threaded twist-expanded sleeve anchors suitable for rod or hanger wire installation, as applicable. Do not use inserts or anchors requiring powder activated driver.
- .7 Carrying channels: 38 x 12.7 mm channel, of 3 mm thick painted galvanized steel.
- .8 Accessories: splices, clips, wire ties, retainers and wall moulding as indicated complete with pre-fabricated corners, to complement suspension system components, as recommended by system manufacturer.

2.3 ACOUSTIC CEILING PANEL (A-PNL) AND SUSPENSION

- .1 Acoustic ceiling panel for suspended ceiling system: to CAN2-92.1.
 - .1 Flame spread rating of 25 or less.
 - .2 Noise reduction coefficient (NRC) designation of 0.70 to 0.75.
 - .3 Ceiling Attenuation Class (CAC): minimum 35.
 - .4 Light reflectance range: Actual LR of 0.85.
 - .5 Edge type: square.
 - .6 Colour: white.

- .7 Standard size: 610 mm x 1 220 mm x 19 mm thick and 610 mm x 610 mm x 19 mm thick, as indicated.
- .8 Custom size: to be field cut and edge finished as required and as indicated.
- .9 Shape: flat.
- .10 Acceptable products and manufacturers:
 - .1 Armstrong Ultima;
 - .2 CGC Mars.
 - .3 Certainteed Symphony M.
- .2 Suspension Systems for Use with A-PNL:
 - .1 Acceptable products and manufacturers:
 - .1 Prelude XL as manufactured by Armstrong.
 - .2 Donn DX/DXL as manufactured by CGC Inc.,
 - .3 Classic Stab as manufactured by Certainteed

2.4 SUSPENSION SYSTEM TRIM

- .1 Suspension trim system, straight and custom curved to suit installation, as indicated and as specified:
 - .1 Acceptable product and manufacturer: Compasso Suspension Trim as manufactured by CGC.
 - .2 Acceptable alternate product and manufacturer: Axiom Perimeter Trim as manufactured by Armstrong World Industries.
 - .3 Acceptable alternate product and manufacturer: Cloud Perimeter Trim as manufactured by Certainteed.
- .2 Trim: vertical face width to suit application unless indicated otherwise, with horizontal legs to match ceiling grid, with hems formed for attachment to mounting clips, complete with all necessary manufacturer's standard trim and accessories.
- .3 Splice plate: steel finished to match trim, snap-in fit.
- .4 Attachment clips: Hot dipped galvanized and finished to match trim, snap-in fit.

2.5 SEISMIC SUPPORT COMPONENTS

- .1 Provide all necessary seismic components in accordance with approved shop drawings, including but not limited to compression posts, stainless steel aircraft cable, turnbuckles, eyebolts, clips, cross-tee connections and anchors.

Part 3 Execution

3.1 EXAMINATION

- .1 Prior to beginning ceiling installation work, examine the installation areas and identify all areas of potential interference between ceiling components and components of other trades. Report all areas so designated to the Departmental Representative Departmental Representative.

- .2 Do not commence installation work in areas of interference until interference has been resolved or accepted. Commencement of the work in areas of interference signifies acceptance of the conditions.

3.2 SUSPENSION SYSTEM INSTALLATION

- .1 Installation: in accordance with ASTM C636 except where specified otherwise.
- .2 Install suspension system to manufacturer's instructions and Certification Organizations tested design requirements.
- .3 Do not erect ceiling suspension system until work above ceiling has been inspected by Departmental Representative.
- .4 Secure hangers to overhead structure using attachment methods as indicated acceptable to Departmental Representative.
 - .1 Do not use powder actuated fastening devices at any time or place in this Work.
- .5 Install hangers spaced at maximum 1200 mm centres and within 150 mm from ends of main tees.
- .6 Lay out centre line of ceiling both ways, to provide balanced borders at room perimeter with border units not less than 50% of standard unit width system according to reflected ceiling plan.
- .7 Ensure suspension system is co-ordinated with location of related components.
- .8 Install wall moulding to provide correct ceiling height.
- .9 Completed suspension system to support super-imposed loads, such as lighting fixtures, diffusers, grilles and speakers.
- .10 Support at light fixtures and diffusers with additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.
- .11 Interlock cross member to main runner to provide rigid assembly.
- .12 Frame at openings for light fixtures, air diffusers, speakers and at changes in ceiling heights.
- .13 Finished ceiling system to be square with adjoining walls and level within 1:1000.

3.3 EXPANSION JOINTS.

- .1 Erect two main runners parallel, 50 mm apart, on building expansion joint line and where indicated.
- .2 Do not extend ceiling panels across building expansion joints.
- .3 At joint in ceiling suspension system, lay in strip of acoustic panel, 25% narrower than space between two "T" bars.

3.4 INSTALLATION OF TRIM

- .1 Install in accordance with approved shop drawings and manufacturer's instructions.
- .2 Use attachment clips to secure trim to each main tee.
- .3 Use splice plates for joining adjacent trim pieces.
- .4 Use 90 degree corner trim pieces at corners.
- .5 Finished installation to be smoothly curving line to accurate radius, free of distortion and kinks, and shall form a reveal of uniform width at partitions and bulkheads.

3.5 SEISMIC RESTRAINT

- .1 Install seismic restraint for suspended ceiling system and all associated fixtures in accordance with approved shop drawings.
- .2 Minimum seismic tension bracing for ceilings shall be installed as follows:
 - .1 At perimeter of each suspended ceiling and at the end of each grid run, install additional hanger wire splayed upward at 45 degrees and attached to structure.
 - .2 In field of ceiling, install hanger wires at points 12 feet OC in both directions splayed upward 45 degrees from each point in four directions and secured to the underside of the structure.
- .3 Tighten bracing wires without deforming the ceiling grid beyond specified tolerances.
- .4 Seismic tension bracing is not required in areas in which the maximum horizontal dimension is less than or equal to 12 feet and which are bounded on all sides by partitions anchored to floor slab and underside of structural deck with seismic anchorage.
- .5 The professional engineer responsible for the production of the shop drawings setting out the requirements for seismic restraint of the suspension systems shall provide periodic field review during construction and shall submit reports in accordance with quality assurance requirements of this specification. The cost of this field inspection shall be included in the Guaranteed Price.

3.6 ACOUSTICAL PANEL INSTALLATION

- .1 Install acoustical panels in ceiling suspension system, supported on all edges, in accordance with manufacturer's current printed instructions.
- .2 Touch up edges of panels cut to fit site conditions to conceal core and to match face.

3.7 INTERFACE WITH OTHER WORK

- .1 Co-ordinate ceiling work to accommodate components of other sections, such as light fixtures, diffusers, speakers, to be built into acoustical ceiling components.

3.8 TOUCH-UP AND CLEANING

- .1 Touch up scratches, abrasions, voids and other defects in surfaces.

- .2 Replace damaged units that cannot be touched up to satisfaction of Departmental Representative.

END OF SECTION

Part 1 GENERAL

1.1 Samples

- .1 Deliver on the Departmental Representative's request for approval, samples of materials proposed for use in the work. Make up samples 100mm wide by 300mm long (4" x 1'-0"). Finished work shall be equal to approved samples.

1.2 Qualifications

- .1 Work shall be carried out by skilled labour under the supervision of a responsible and experienced foreman.
- .2 Equipment shall be clean and in optimum working condition.

1.3 Protection

- .1 Provide protective barriers and signs to protect the work and the public from contact with paint not yet dry.
- .2 Protect surfaces likely to attract dust and insects thus liable to mar the finished surface.
- .3 Have hardware, electrical and mechanical fittings removed and replaced by appropriate trades, else protect the above and other adjacent work.

1.4 Reference Standards

- .1 Do painting and finishing to CGSB 85-GP series standards and to material manufacturer's instructions, except where specified otherwise.
- .2 Stucco and Brick: Comply with CGSB 85-GP-31M.
- .3 Concrete Floors: Comply with CGSB 85-GP-32M.
- .4 Ferrous Metal: Comply with CGSB 81-GP-10M, 11a, 12, 13 or 15 as applicable.
- .5 Galvanized Steel: 85-GP-16M.
- .6 Copper & Copper Alloys: 85-GP-20M.
- .7 Interior Plaster and Wallboard: 85-GP-33M.

1.5 WARNING

- .1 DO NOT USE SPRAY EQUIPMENT:** Only paint brush and roller will be accepted on this project

Part 2 PRODUCTS

2.1 Materials

- .1 Paint Materials: to CGSB Standards listed in Finishing Formula.
.2 Paint materials for each coating formula to be product of a single manufacturer.

2.2 Finishing Formula

- .1 Apply number of coats of specified materials to designated surfaces as follows:
.2 Interior Finishes:
- .1 Gypsum Board Walls Apply:
.1 one coat primer-sealer CAN/CGSB-1.119-M89.
.2 two finish coats, ICI Paints (or approved equal): Faithful, 09 BB,77/019, A0144, egg shell
- .2 Doors and Frames surfaces apply:
.1 One coat primer-sealer.
.2 Two finish coats, ICI Paints (or approved equal),: Aged Stucco, #70YY 46/053, semi-gloss
- .3 Existing painted concrete floors apply:
.1 one coat primer-sealer CAN/CGSB-1.188-90.
.2 One coat floor enamel low gloss finish, match existing floor colour.

Part 3 EXECUTION

3.1 Examination of Surfaces

- .1 Examine the work to be finished to determine whether the surfaces are in proper condition to receive paint work.

3.2 Preparation of Surfaces

- .1 General:

- .1 Patch defective shop prime coats. Ensure that surfaces to be painted are smooth, level, dry, free from dust and any matter liable to interfere with adhesion of paint, cause bleeding or staining.
- .2 Set all nails and screws below surface and putty flush.
- .2 Substrates: Whenever substrates required repairs not covered by this specification, suspend work on the affected portion and advise the Departmental Representative. Paint repairs at completion as part of the original work.
- .3 Ferrous Metal: Remove dirt and grease with Benzene. Remove rust and defective paint down to bare metal and touch up with red lead. Paint ferrous metals immediately upon delivery on site.
- .4 Metal:
 - .1 Unpainted: Clean down to good metal. Use appropriate metal filler to restore the original surface. Coat with CAN/CGSB-1.121-93.
 - .2 Painted: Clean paint by washing. Treat bare spots as above.

3.3 Application

- .1 Remove all paint liable to show or bleed through new finish. Prime uncoated surfaces only.
- .2 Apply two finish coats to all previously finished or primed work.
- .3 Give the Departmental Representative due notice and ample opportunity to inspect each coat and do not proceed with any coat until the last preceding coat is approved. Each coat shall be a different tint, under white a light blue.
- .4 Apply no finish nor paint to wet, frozen or rusty surfaces.
- .5 Clean castings with wire brushes.
- .6 Do not paint at temperatures under 10°C (50°F) or over 35°C (95°F) (lacquer not lower than 15°C (59°F)) nor on surfaces where condensation is likely to form.
- .7 Give additional coats to work which is unsatisfactory to the Departmental Representative after the application of the specified number of coats without extra compensation. Touch up dead or dull spots.
- .8 Brush paint wood and metal surfaces. Other surfaces may be roller painted. Do not use rollers on uneven surfaces.
- .9 Mix materials thoroughly, apply evenly, in full coats and free from sags, runs, crawls and other defects. Cut in neatly where required.
- .10 Let each coat dry perfectly and hard before a following coat is applied.
- .11 Finish ledges and surfaces above sight lines; tops, bottoms and edges of doors to match faces.
- .12 Even up stained woodwork in colour as required by the nature of the wood.
- .13 Apply all ready-mixed paint, lacquer, varnish or other finishes without cutting or admixture of any kind.
- .14 Colour filler, if required. Work well into grain of wood, and before it sets, wipe clean.
- .15 Apply material in accordance with the directions and instruction of their manufacturers.

- .16 Doors, windows: and other shop made items, shop prime. Seal and paint the bottoms and edges of all doors before hanging.
- .17 Allow a minimum of 24 hours between coats for oil based paints and 8 hours between coats of water based paints.

END OF SECTION

1 GENERAL

1.01 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 10 00 – General Instructions.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Indicate on drawings:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
 - .3 Shop drawings and product data accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify current model production.
 - .5 Certification of compliance to applicable codes.
 - .4 In addition to transmittal letter referred to in Section 01 10 00 – General Instructions: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

1.02 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 10 00 – General Instructions.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
 - .1 Operation and maintenance manual approved by, and final copies deposited with, NRC Project Manager before final inspection.
 - .2 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valves schedule and flow diagram.
 - .7 Colour coding chart.
 - .3 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
 - .4 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

- .5 Approvals:
 - .1 Submit 2 copies of draft Operation and Maintenance Manual to NRC Project Manager for approval. Submission of individual data will not be accepted unless directed by NRC Project Manager.
 - .2 Make changes as required and re-submit as directed NRC Project Manager.
- .6 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .7 Site records:
 - .1 NRC Project Manager will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
 - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection.
- .8 As-built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
 - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
 - .3 Submit to NRC Project Manager for approval and make corrections as directed.
 - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
 - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .9 Submit copies of as-built drawings for inclusion in final TAB report.

1.03 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 10 00 – General Instructions.
- .2 Furnish spare parts as follows:
 - .1 One set of packing for each pump.
 - .2 One casing joint gasket for each size pump.
 - .3 One head gasket set for each heat exchanger.
 - .4 One glass for each gauge glass.
 - .5 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
- .3 Provide one set of special tools required to service equipment as recommended by manufacturers.
- .4 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.04 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 10 00 – General Instructions and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

2 PRODUCTS

2.01 MATERIALS

- .1 HVAC and R Equipment:
 - .1 Refrigerant:
 - .1 HCFC based refrigerant.
 - .2 HFC based refrigerant.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of NRC Project Manager.
 - .2 Inform NRC Project Manager of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from NRC Project Manager.

3.02 PAINTING REPAIRS AND RESTORATION

- .1 Prime and touch up marred finished paintwork to match original.
- .2 Restore to new condition, finishes which have been damaged.

3.03 SYSTEM CLEANING

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

3.04 FIELD QUALITY CONTROL

- .1 Site Tests: conduct following tests in accordance with Section 01 10 00 – General Instructions and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .1 HVAC System.
- .2 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.05 DEMONSTRATION

- .1 NRC Project Manager will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .3 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .4 Instruction duration time requirements as specified in appropriate sections.
- .5 NRC Project Manager will record these demonstrations on video tape for future reference.

3.06 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 10 00 – General Instructions.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 10 00 – General Instructions.

3.07 PROTECTION

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

END OF SECTION

1 GENERAL

1.01 SUMMARY

- .1 Section Includes:
 - .1 Use of mechanical systems during construction.

1.02 USE OF SYSTEMS

- .1 Use of new and or existing permanent heating and or ventilating systems for supplying temporary heat or ventilation is not permitted permitted only under following conditions:
 - .1 Entire system is complete, pressure tested, cleaned, flushed out.
 - .2 Specified water treatment system has been commissioned, water treatment is being continuously monitored.
 - .3 Building has been closed in, areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.
 - .4 There is no possibility of damage.
 - .5 Supply ventilation systems are protected by 60 % filters, inspected daily, changed every week 2 weeks or more frequently as required.
 - .6 Return systems have approved filters over openings, inlets, outlets.
 - .7 Systems will be:
 - .1 Operated as per manufacturer's recommendations and instructions.
 - .2 Operated by Contractor.
 - .3 Monitored continuously by Contractor.
 - .8 Warranties and guarantees are not relaxed.
 - .9 Regular preventive and other manufacturers recommended maintenance routines are performed by Contractor at own expense and under supervision of NRC Project Manager.
 - .10 Refurbish entire system before static completion; clean internally and externally, restore to "as- new" condition, replace filters in air systems.
- .2 Filters specified in this Section are over and above those specified in other Sections of this project.
- .3 Exhaust systems are not included in approvals for temporary heating ventilation.

2 PRODUCTS

2.01 NOT USED

- .1 Not Used.

3 EXECUTION

3.01 NOT USED

- .1 Not Used.

END OF SECTION

1 GENERAL

1.01 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA B139-04, Installation Code for Oil Burning Equipment.
- .3 National Fire Code of Canada (NFCC 2005)
- .4 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1113-A2007, Architectural Coatings.
 - .2 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 10 00 – General Instructions.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheets for piping and equipment and include product characteristics, performance criteria, physical size, finish and limitations.

1.04 QUALITY ASSURANCE

- .1 Sustainability Standards Certification:
 - .1 Low-Emitting Materials: provide listing of sealants coatings used in building, comply with VOC and chemical component limits or restriction requirements.

1.05 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 10 00 – General Instructions and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

2 PRODUCTS

2.01 MATERIAL

- .1 Paint: zinc-rich to CAN/CGSB-1.181.
 - .1 Primers, Paints, and Coating: in accordance with manufacturer's recommendations for surface conditions.
 - .2 Primer: maximum VOC limit 250 g/L to Standard GS-11 to SCAQMD Rule 1113.
 - .3 Paints: maximum VOC limit 150 g/L to Standard GS-11 to SCAQMD Rule 1113.
- .2 Sealants: in accordance with Section 07 92 00 - Joint Sealants.
 - .1 Sealants: maximum VOC limit to SCAQMD Rule 1168 to GSES GS-36.
- .3 Sealants: maximum VOC limit to SCAQMD Rule 1168 to GSES GS-36.

- .4 Adhesives: maximum VOC limit to SCAQMD Rule 1168 to GSES GS-36.
- .5 Fire stopping: in accordance with Section 07 84 00 - Fire Stopping.

3 EXECUTION

3.01 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.02 CONNECTIONS TO EQUIPMENT

- .1 In accordance with manufacturer's instructions unless otherwise indicated.
- .2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.
- .3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

3.03 CLEARANCES

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer and National Fire Code of Canada CSA B139.
- .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer CSA B139 as indicated without interrupting operation of other system, equipment, and components.

3.04 DRAINS

- .1 Install piping with grade in direction of flow except as indicated.
- .2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.
- .3 Pipe each drain valve discharge separately to above floor drain.
 - .1 Discharge to be visible.
- .4 Drain valves: NPS 3/4 gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

3.05 AIR VENTS

- .1 Install manual air vents to CSA B139 at high points in piping systems.
- .2 Install isolating valve at each automatic air valve.
- .3 Install drain piping to approved location and terminate where discharge is visible.

3.06 DIELECTRIC COUPLINGS

- .1 General: compatible with system, to suit pressure rating of system.
- .2 Locations: where dissimilar metals are joined.
- .3 NPS 2 and under: isolating unions or bronze valves.

- .4 Over NPS 2: isolating flanges.

3.07 PIPEWORK INSTALLATION

- .1 Install pipework to CSA B139.
- .2 Screwed fittings jointed with Teflon tape.
- .3 Protect openings against entry of foreign material.
- .4 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .5 Assemble piping using fittings manufactured to ANSI standards.
- .6 Saddle type branch fittings may be used on mains if branch line is no larger than half size of main.
 - .1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.
- .7 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
- .8 Install concealed pipework to minimize furring space, maximize headroom, conserve space.
- .9 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .10 Install, except where indicated, to permit separate thermal insulation of each pipe.
- .11 Group piping wherever possible and as indicated.
- .12 Ream pipes, remove scale and other foreign material before assembly.
- .13 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .14 Provide for thermal expansion as indicated.
- .15 Valves:
 - .1 Install in accessible locations.
 - .2 Remove interior parts before soldering.
 - .3 Install with stems above horizontal position unless indicated.
 - .4 Valves accessible for maintenance without removing adjacent piping.
 - .5 Install globe valves in bypass around control valves.
 - .6 Use gate ball or butterfly valves at branch take-offs for isolating purposes except where specified.
 - .7 Install butterfly valves on chilled water and related condenser water systems only.
 - .8 Install butterfly valves between weld neck flanges to ensure full compression of liner.
 - .9 Install plug cocks or ball valves for glycol service.
 - .10 Use chain operators on valves NPS 2 1/2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.
- .16 Check Valves:
 - .1 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and as indicated.
 - .2 Install swing check valves in horizontal lines on discharge of pumps and as indicated.

3.08 SLEEVES

- .1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies,

and as indicated.

- .2 Material: schedule 40 black steel pipe.
- .3 Construction: use annular fins continuously welded at mid-point at foundation walls and where sleeves extend above finished floors.
- .4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.
- .5 Installation:
 - .1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.
 - .2 Other floors: terminate 25 mm above finished floor.
 - .3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.
- .6 Sealing:
 - .1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.
 - .2 Elsewhere:
 - .1 Provide space for firestopping.
 - .2 Maintain fire rating integrity.
 - .3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.
 - .4 Ensure no contact between copper pipe or tube and sleeve.

3.09 PREPARATION FOR FIRE STOPPING

- .1 Install firestopping within annular space between pipes, ducts, insulation and adjacent fire separation in accordance with Section 07 84 00 - Fire Stopping.
- .2 Uninsulated unheated pipes not subject to movement: no special preparation.
- .3 Uninsulated heated pipes subject to movement: wrap with non-combustible smooth material to permit pipe movement without damaging firestopping material or installation.
- .4 Insulated pipes and ducts: ensure integrity of insulation and vapour barriers.

3.10 FLUSHING OUT OF PIPING SYSTEMS

- .1 Flush system in accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.
- .2 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 10 00 – General Instructions supplemented as specified in relevant mechanical sections.
- .3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.11 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

- .1 Advise NRC Project Manager 48 hours minimum prior to performance of pressure tests.
- .2 Piping: test as specified in relevant sections of heating, ventilating and air conditioning work.
- .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant mechanical sections.

- .4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
- .5 Conduct tests in presence of NRC Project Manager.
- .6 Pay costs for repairs or replacement, retesting, and making good. NRC Project Manager to determine whether repair or replacement is appropriate.
- .7 Insulate or conceal work only after approval and certification of tests by NRC Project Manager.

3.12 EXISTING SYSTEMS

- .1 Connect into existing piping systems at times approved by NRC Project Manager.
- .2 Request written approval by NRC Project Manager 10 day's minimum, prior to commencement of work.
- .3 Be responsible for damage to existing plant by this work.

3.13 CLEANING

- .1 Clean in accordance with Section 01 10 00 – General Instructions.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 GENERAL

1.01 SUMMARY

- .1 Section Includes:
 - .1 Electrical motors, drives and guards for mechanical equipment and systems.
 - .2 Supplier and installer responsibility indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.
 - .3 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 22 and 23. Refer to Division 26 for quality of materials and workmanship.

1.02 REFERENCES

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 ASHRAE 90.1-01, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).
- .2 Electrical Equipment Manufacturers' Association Council (EEMAC)
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 10 00 – General Instructions.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 10 00 – General Instructions. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 10 00 – General Instructions.
 - .2 Shop Drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .3 Quality Control: in accordance with Section 01 10 00 – General Instructions.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
 - .1 NRC Project Manager will make available 1 copy of systems supplier's installation instructions.
- .4 Closeout Submittals
 - .1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 10 00 – General Instructions.

1.04 QUALITY ASSURANCE

- .1 Regulatory Requirements: work to be performed in compliance with CEPA, CEAA, TDGA, and applicable Provincial /Territorial regulations.
- .2 Health and Safety Requirements: do construction occupational health and safety in

accordance with Section 01 10 00 – General Instructions.

1.05 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 10 00 – General Instructions.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

2 PRODUCTS

2.01 GENERAL

- .1 Motors: high efficiency, in accordance with local Hydro company standards and to ASHRAE 90.1.

2.02 MOTORS

- .1 Provide motors for mechanical equipment as specified.
- .2 Motors under 1/2 HP: speed as indicated, continuous duty, built-in overload protection, and resilient mount.
- .3 Motors 1/2 HP and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40 degrees C.

2.03 TEMPORARY MOTORS

- .1 If delivery of specified motor will delay completion or commissioning work, install motor approved by NRC Project Manager for temporary use. Work will only be accepted when specified motor is installed.

2.04 BELT DRIVES

- .1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.
- .2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise indicated.
- .3 For motors under 10 HP: standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.
- .4 For motors 10 HP and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.
- .5 Correct size of sheave determined during commissioning.
- .6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- .7 Motor slide rail adjustment plates to allow for center line adjustment.
- .8 Supply one set of spare belts for each set installed in accordance with Section 01 10 00 – General Instructions.

2.05 DRIVE GUARDS

- .1 Provide guards for unprotected drives.
- .2 Guards for belt drives;
 - .1 Expanded metal screen welded to steel frame.
 - .2 Minimum 1.2 mm thick sheet metal tops and bottoms.
 - .3 38 mm dia holes on both shaft centres for insertion of tachometer.
 - .4 Removable for servicing.
- .3 Provide means to permit lubrication and use of test instruments with guards in place.
- .4 Install belt guards to allow movement of motors for adjusting belt tension. -
- .5 Guard for flexible coupling:
 - .1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.
 - .2 Securely fasten in place.
 - .3 Removable for servicing.
- .6 Unprotected fan inlets or outlets:
 - .1 Wire or expanded metal screen, galvanized, 19 mm mesh.
 - .2 Net free area of guard: not less than 80% of fan openings.
 - .3 Securely fasten in place.
 - .4 Removable for servicing.

3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.02 INSTALLATION

- .1 Fasten securely in place.
- .2 Make removable for servicing, easily returned into, and positively in position.

3.03 FIELD QUALITY CONTROL

- .1 Site Tests: conduct following tests in accordance with Section 01 10 00 – General Instructions and submit report as described in PART 1 - SUBMITTALS.
- .2 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.04 CLEANING

- .1 Proceed in accordance with Section 01 10 00 – General Instructions.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 GENERAL

1.01 REFERENCES

- .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
 - .1 ANSI/ASME B31.1-2007, Power Piping.
 - .2 ANSI/ASME B31.3-2006, Process Piping.
 - .3 ANSI/ASME Boiler and Pressure Vessel Code-2007:
 - .1 BPVC 2007 Section I: Power Boilers.
 - .2 BPVC 2007 Section V: Nondestructive Examination.
 - .3 BPVC 2007 Section IX: Welding and Brazing Qualifications.
- .2 American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - .1 ANSI/AWWA C206-03, Field Welding of Steel Water Pipe.
- .3 American Welding Society (AWS)
 - .1 AWS C1.1M/C1.1-2000(R2006), Recommended Practices for Resistance Welding.
 - .2 AWS Z49.1-2005, Safety in Welding, Cutting and Allied Process.
 - .3 AWS W1-2000, Welding Inspection Handbook.
- .5 Canadian Standards Association (CSA International)
 - .1 CSA W47.2-M1987(R2008), Certification of Companies for Fusion Welding of Aluminum.
 - .2 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.
 - .3 CSA B51-03(R2007), Boiler, Pressure Vessel and Pressure Piping Code.
 - .4 CSA-W117.2-2006, Safety in Welding, Cutting and Allied Processes.
 - .5 CSA W178.1-2008, Certification of Welding Inspection Organizations.
 - .6 CSA W178.2-2008, Certification of Welding Inspectors.

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 10 00 – General Instructions.

1.03 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Welders:
 - .1 Welding qualifications in accordance with CSA B51.
 - .2 Use qualified and licensed welders possessing certificate for each procedure performed from authority having jurisdiction.
 - .3 Submit welder's qualifications to NRC Project Manager.
 - .4 Each welder to possess identification symbol issued by authority having jurisdiction.
 - .5 Certification of companies for fusion welding of aluminum in accordance with CSA W47.2.
 - .2 Inspectors:
 - .1 Inspectors qualified to CSA W178.2.
 - .3 Certifications:
 - .1 Registration of welding procedures in accordance with CSA B51.
 - .2 Copy of welding procedures available for inspection.
 - .3 Safety in welding, cutting and allied processes in accordance with CSA-W117.2.

1.04 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 10 00 – General Instructions.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets crates padding and packaging materials in accordance with Section 01 10 00 – General Instructions.

2 PRODUCTS

2.01 ELECTRODES

- .1 Electrodes: in accordance with CSA W48 Series.

3 EXECUTION

3.01 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.02 QUALITY OF WORK

- .1 Welding: in accordance with ANSI/ASME B31.1 and/or B31.3, ANSI/ASME Boiler and Pressure Vessel Code, Sections I and IX and ANSI/AWWA C206, using procedures conforming to AWS B3.0, AWS C1.1, and special procedures specified elsewhere in Division 15 applicable requirements of provincial authority having jurisdiction.

3.03 INSTALLATION REQUIREMENTS

- .1 Identify each weld with welder's identification symbol.
- .2 Backing rings:
 - .1 Where used, fit to minimize gaps between ring and pipe bore.
 - .2 Do not install at orifice flanges.
- .3 Fittings:
 - .1 NPS 2 and smaller: install welding type sockets.
 - .2 Branch connections: install welding tees or forged branch outlet fittings.

3.04 INSPECTION AND TESTS - GENERAL REQUIREMENTS

- .1 Review weld quality requirements and defect limits of applicable codes and standards with NRC Project Manager before work is started.
- .2 Formulate "Inspection and Test Plan" in co-operation with NRC Project Manager.
- .3 Do not conceal welds until they have been inspected, tested and approved by inspector.
- .4 Provide for inspector to visually inspect welds during early stages of welding procedures in accordance with Welding Inspection Handbook. Repair or replace defects as required by codes and as specified.

3.05 SPECIALIST EXAMINATIONS AND TESTS

- .1 General:
 - .1 Perform examinations and tests by specialist qualified to CSA W178.1 and CSA W178.2 and approved by NRC Project Manager.
 - .2 To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.
 - .3 Inspect and test 15 % of welds in accordance with "Inspection and Test Plan" by non-destructive visual examination and magnetic particle (hereinafter referred to as "particle") tests and spot full gamma ray radiographic (hereinafter referred to as "radiography") tests.
- .2 Hydrostatically test welds to ANSI/ASME B31.1.
- .3 Visual examinations: include entire circumference of weld externally and wherever possible internally.
- .4 Failure of visual examinations:
 - .1 Upon failure of welds by visual examination, perform additional testing as directed by NRC Project Manager of total of up to 10% of welds, selected at random by NRC Project Manager by radiographic tests.

3.06 DEFECTS CAUSING REJECTION

- .1 As described in ANSI/ASME B31.1 and ANSI/ASME Boiler and Pressure Vessels Code.
- .2 In addition, chilled water systems:
 - .1 Undercutting greater than 0.8 mm adjacent to cover bead on outside of pipe.
 - .2 Undercutting greater than 0.8 mm adjacent to root bead on inside of pipe.
 - .3 Undercutting greater than 0.8 mm at combination of internal surface and external surface.
 - .4 Incomplete penetration and incomplete fusion greater than total length of 38 mm in 1500 mm length of weld depth of such defects being greater than 0.8 mm.
 - .5 Repair cracks and defects in excess of 0.8 mm in depth.
 - .6 Repair defects whose depth cannot be determined accurately on basis of visual examination or radiographic tests.

3.07 REPAIR OF WELDS WHICH FAILED TESTS

- .1 Re-inspect and re-test repaired or re-worked welds at Contractor's expense.

3.08 CLEANING

- .1 Clean in accordance with Section 01 10 00 – General Instructions.

END OF SECTION

1 GENERAL

1.01 SUMMARY

- .1 Section Includes:
 - .1 Materials and components for metering steam and chilled/hot water including installation.

1.02 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME Fluid Meter's Handbook: Their Theory and Application, Sixth Edition 1971.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 10 00 – General Instructions. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 10 00 – General Instructions.
- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 10 00 – General Instructions.
 - .1 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .3 Submittals to include:
 - .1 Piping configuration and sizing - straight pipe upstream and downstream, distances to first weld, protrusion, thermowell, pressure tap.
 - .2 Service conditions.
 - .3 Full details of primary element - standard of design and construction, materials, type serial number, flow rate, differential pressure, irrecoverable head loss (IHL), calculation sheets.
 - .4 Accuracy statements for each component at specified flow rates and other conditions.
 - .5 Flow and temperature ranges.
 - .6 Signal processor calibration data.
 - .7 Minimum turndown ratio.
- .4 Samples:
 - .1 Submit sample in accordance with Section 01 10 00 – General Instructions.
 - .2 Samples to include:
 - .1 Full size samples of recorder charts, integrator readings.
- .5 Quality assurance submittals: submit following in accordance with Section 01 10 00 – General Instructions.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
 - .1 NRC Project Manager will make available 1 copy of systems supplier's installation instructions.

- .6 Closeout Submittals:
 - .1 Submit maintenance data including monitoring requirements for incorporation into manuals specified in Section 01 10 00 – General Instructions.

1.04 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 10 00 – General Instructions.

1.05 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 10 00 – General Instructions.
- .2 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 10 00 – General Instructions.

2 PRODUCTS

2.01 ACCURACY

- .1 Calculate overall accuracy of each installation using following expression: Overall accuracy = $(E \text{ (accuracy of individual components of system)})^{1/2}$.
- .2 Components to include:
 - .1 Primary flow measuring elements.
 - .2 Transmitters: flow, differential pressure, pressure, temperature, temperature difference.
 - .3 RTD's.
 - .4 Signal processors, recorders.
 - .5 Calibration of signal processors: assume 0.20% per processor.
 - .6 Installation tolerances: assume 1% for concentricity of pipe, difference in height of transmitter piping.
- .3 Show in proposal overall accuracy at 100%, 70%, 10%, minimum specified design flow rate.
- .4 Indicate minimum measurable flow rate.

3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.02 PREPARATION

- .1 Before final calculations for orifice diameter, and before purchase of orifice plate, nozzle, venturi, measure:
 - .1 Internal diameter of main at the primary element to +/-0.01 mm accuracy.
 - .2 For concentricity of pipe.

3.03 INSTALLATION OF PRIMARY ELEMENT

- .1 Follow manufacturer's instructions.

3.04 INSTALLATION OF DIFFERENTIAL PRESSURE TAPS AND PIPING

- .1 Differential pressure taps horizontal and level with each other to within +/- 1.5 mm.
- .2 Tubing: straight, supported throughout its length, sloped 5%-10% upward to main for drainage and venting, without air pockets, with blowdown valves at bottom.

3.05 INSTALLATION OF TRANSMITTERS NOT FORMING INTEGRAL PART OF PRIMARY ELEMENT

- .1 Mount on pipe stand installed and located to ensure no damage by passing traffic.

3.06 INSTALLATION OF SIGNAL TRANSMISSION CABLE

- .1 Ground shielding at one point only.
- .2 Protect against RF interference.
- .3 Cross electrical cables, conduits at 90 degrees leaving at least 150 mm space between.

3.07 START-UP

- .1 Follow manufacturer's recommendations.

3.08 FIELD QUALITY CONTROL

- .1 Verification requirements in accordance with Section 01 10 00 – General Instructions: Contractor's Verification, include:
 - .1 Materials and resources.
 - .2 Storage and collection of recyclables.
 - .3 Construction waste management.
 - .4 Resource reuse.
 - .5 Recycled content.
 - .6 Local/regional materials.
 - .7 Certified wood.
 - .8 Low-emitting materials.

3.09 CLEANING

- .1 Proceed in accordance with Section 01 10 00 – General Instructions.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 GENERAL

1.01 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B40.100-2005, Pressure Gauges and Gauge Attachments.
 - .2 ASME B40.200-2008, Thermometers, Direct Reading and Remote Reading.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-14.4-M88, Thermometers, Liquid-in-Glass, Self-Indicating, Commercial/Industrial Type.
 - .2 CAN/CGSB-14.5-M88, Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.
- .3 Efficiency Valuation Organization (EVO)
 - .1 International Performance Measurement and Verification Protocol (IPMVP)
 - .1 IPMVP 2007 Version.
- .4 Green Seal Environmental Standards (GS)
 - .1 GS-11-11, Standard for Paints and Coatings.
 - .2 GS-36-11, Standard for Commercial Adhesives.

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 10 00 – General Instructions.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for thermometers and pressure gauges and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .4 Certificates:
 - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Test and Evaluation Reports:
 - .1 Submit certified test reports for thermometers and pressure gauges from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

2 PRODUCTS

2.01 GENERAL

- .1 Design point to be at mid-point of scale or range.

2.02 DIRECT READING THERMOMETERS

- .1 Industrial, variable angle type, mercury-free, liquid filled, 125 mm scale length: to CAN/CGSB-14.4 and/or ASME B40.200.
 - .1 Resistance to shock and vibration.

2.03 REMOTE READING THERMOMETERS

- .1 100 mm diameter mercury-free liquid filled activated dial type: to CAN/CGSB-14.5 ASME B40.200, accuracy within one scale division, brass movement, stainless steel capillary, stainless steel spiral armour, stainless steel bulb and polished stainless steel case for wall mounting.

2.04 THERMOMETER WELLS

- .1 Copper pipe: copper or bronze.
- .2 Steel pipe: stainless steel.

2.05 PRESSURE GAUGES

- .1 112 mm, dial type: to ASME B40.100, Grade 2A, stainless steel bourdon tube having 0.5% accuracy full scale unless otherwise specified.
- .2 Provide:
 - .1 Siphon for steam service.
 - .2 Snubber for pulsating operation.
 - .3 Diaphragm assembly for corrosive service.
 - .4 Gasketed pressure relief back with solid front.
 - .5 Bronze stop cock.
 - .6 Oil filled for high vibration applications.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of NRC Project Manager.
 - .2 Inform NRC Project Manager of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from NRC Project Manager.

3.02 GENERAL

- .1 Install thermometers and gauges so they can be easily read from floor or platform.
 - .1 If this cannot be accomplished, install remote reading units.
- .2 Install between equipment and first fitting or valve.

3.03 THERMOMETERS

- .1 Install in wells on piping. Include heat conductive material inside well.
- .2 Install in locations as indicated and on inlet and outlet of:
 - .1 Heat exchangers.
 - .2 Water heating and cooling coils.
 - .3 Water boilers.
 - .4 Chillers.
 - .5 Cooling towers.
 - .6 DHW tanks.

- .3 Install wells as indicated only for balancing purposes.
- .4 Use extensions where thermometers are installed through insulation.

3.04 PRESSURE GAUGES

- .1 Install in locations as follows:
 - .1 Suction and discharge of pumps.
 - .2 Upstream and downstream of PRV's.
 - .3 Upstream and downstream of control valves.
 - .4 Inlet and outlet of coils.
 - .5 Inlet and outlet of liquid side of heat exchangers.
 - .6 Outlet of boilers.
 - .7 In other locations as indicated.
- .2 Install gauge cocks for balancing purposes, elsewhere as indicated.
- .3 Use extensions where pressure gauges are installed through insulation.

3.05 NAMEPLATES

- .1 Install engraved lamicoïd nameplates in accordance with Section 23 05 53.01 - Mechanical Identification, identifying medium.

3.06 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 10 00 – General Instructions.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 10 00 – General Instructions.

3.07 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by thermometer and gauge installation.

END OF SECTION

1 GENERAL

1.01 REFERENCES

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
 - .1 ANSI/ASME B1.20.1-1983(R2006), Pipe Threads, General Purpose (Inch).
 - .2 ANSI/ASME B16.18-2001, Cast Copper Alloy Solder Joint Pressure Fittings.
- .2 ASTM International
 - .1 ASTM A 276-08, Standard Specification for Stainless Steel Bars and Shapes.
 - .2 ASTM B 62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .3 ASTM B 283-08a, Standard Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).
 - .4 ASTM B 505/B 505M-08a, Standard Specification for Copper-Base Alloy Continuous Castings.
- .4 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
 - .1 MSS-SP-25-1998, Standard Marking System for Valves, Fittings, Flanges and Unions.
 - .2 MSS-SP-80-2008, Bronze Gate Globe, Angle and Check Valves.
 - .3 MSS-SP-110-1996, Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 10 00 – General Instructions.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Canada.
 - .2 Submit data for valves specified in this Section.

1.03 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section 01 10 00 – General Instructions.

1.04 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials/Spare Parts:
 - .1 Furnish following spare parts:
 - .1 Valve seats: one for every 10 valves each size, minimum 1.
 - .2 Discs: one for every 10 valves, each size. Minimum 1.
 - .3 Stem packing: one for every 10 valves, each size. Minimum 1.
 - .4 Valve handles: 2 of each size.
 - .5 Gaskets for flanges: one for every 10 flanged joints.
 - .2 Tools:

- .1 Furnish special tools for maintenance of systems and equipment.
- .2 Include following:
 - .1 Lubricant gun for expansion joints.

1.05 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 10 00 – General Instructions and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

2 PRODUCTS

2.01 MATERIALS

- .1 Valves:
 - .1 Except for specialty valves, to be single manufacturer.
 - .2 Products to have CRN registration numbers.
- .2 End Connections:
 - .1 Connection into adjacent piping/tubing:
 - .1 Steel pipe systems: screwed ends to ANSI/ASME B1.20.1.
 - .2 Copper tube systems: solder ends grooved ends to ANSI/ASME B16.18.
- .3 Lockshield Keys:
 - .1 Where lockshield valves are specified, provide 10 keys of each size: malleable iron cadmium plated.
- .4 Gate Valves:
 - .1 Requirements common to gate valves, unless specified otherwise:
 - .1 Standard specification: MSS SP-80.
 - .2 Bonnet: union with hexagonal shoulders.
 - .3 Connections: screwed with hexagonal shoulders.
 - .4 Inspection and pressure testing: to MSS SP-80. Tests to be hydrostatic.
 - .5 Packing: non-asbestos.
 - .6 Handwheel: non-ferrous.
 - .7 Handwheel Nut: bronze to ASTM B 62.
 - .2 NPS 2 and under, non-rising stem, solid wedge disc, Class 125
 - .1 Body: with long disc guides, screwed bonnet with stem retaining nut.
 - .2 Operator: Handwheel.
 - .3 NPS 2 and under, non-rising stem, solid wedge disc, Class 150:
 - .1 Body: with long disc guides, screwed bonnet with stem retaining nut.
 - .2 Operator: handwheel.
 - .4 NPS 2 and under, rising stem, split wedge disc, Class 125:
 - .1 Body: with long disc guides, screwed bonnet.
 - .2 Disc: split wedge, bronze to ASTM B 283, loosely secured to stem.
 - .3 Operator: handwheel.
 - .5 NPS 2 and under, rising stem, solid wedge disc, Class 125:
 - .1 Body: with long disc guides, screwed bonnet.
 - .2 Operator: handwheel.
 - .6 NPS 2 and under, rising stem, solid wedge disc, Class 150:
 - .1 Body: with long disc guides, screwed or union bonnet.
 - .2 Operator: handwheel.

- .5 Globe Valves:
 - .1 Requirements common to globe valves, unless specified otherwise:
 - .1 Standard specification: MSS SP-80.
 - .2 Bonnet: union with hexagonal shoulders.
 - .3 Connections: screwed with hexagonal shoulders.
 - .4 Pressure testing: to MSS SP-80. Tests to be hydrostatic.
 - .5 Stuffing box: threaded to bonnet with gland follower, packing nut, high grade non-asbestos packing.
 - .6 Handwheel: non-ferrous.
 - .7 Handwheel Nut: bronze to ASTM B 62.
 - .2 NPS 2 and under, composition disc, Class 125:
 - .1 Body and bonnet: screwed bonnet.
 - .2 Disc and seat: renewable rotating PTFE disc composition to suit service conditions, regrindable bronze seat, loosely secured to bronze stem to ASTM B 505.
 - .3 Operator: handwheel.
 - .3 NPS 2 and under, composition disc, Class 150:
 - .1 Body and bonnet: union bonnet.
 - .2 Disc and seat: renewable rotating PTFE disc in easily removable disc holder, regrindable bronze seat, loosely secured to bronze stem to ASTM B 505.
 - .3 Operator: handwheel.
 - .4 NPS 2 and under, plug disc, Class 150, screwed ends:
 - .1 Body and bonnet: union bonnet.
 - .2 Disc and seat ring: tapered plug type with disc stem ring of AISI S420 stainless steel to ASTM A 276, loosely secured to stem.
 - .3 Operator: handwheel.
 - .5 Angle valve, NPS 2 and under, composition disc, Class 150:
 - .1 Body and bonnet: union bonnet.
 - .2 Disc and seat: renewable rotating PTFE disc in slip-on easily removable disc holder having integral guides, regrindable bronze seat, loosely secured to stem.
 - .3 Operator: handwheel.
- .6 Check Valves:
 - .1 Requirements common to check valves, unless specified otherwise:
 - .1 Standard specification: MSS SP-80.
 - .2 Connections: screwed with hexagonal shoulders.
 - .2 NPS 2 and under, swing type, bronze disc, Class 125:
 - .1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
 - .2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.
 - .3 NPS 2 and under, swing type, bronze disc:
 - .1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
 - .2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.
 - .4 NPS 2 and under, swing type, composition disc, Class 200:
 - .1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
 - .2 Disc: renewable rotating disc of number 6 composition to suit service conditions, bronze two-piece hinge disc construction.
 - .5 NPS 2 and under, horizontal lift type, composition disc, Class 150:
 - .1 Body: with integral seat, union bonnet ring with hex shoulders, cap.
 - .2 Disc: renewable PTFE no. 6 composition rotating disc in disc holder having guides top and bottom, of bronze to ASTM B 62.
 - .6 NPS 2 and under, vertical lift type, bronze disc, Class 125:
 - .1 Disc: rotating disc having guides top and bottom, disc guides, retaining rings.
- .7 Silent Check Valves:

- .1 NPS 2 and under:
 - .1 Body: cast high tensile bronze to ASTM B 62 with integral seat.
 - .2 Pressure rating: Class 125.
 - .3 Connections: screwed ends to ANSI B1.20.1 and with hex. Shoulders.
 - .4 Disc and seat: renewable rotating disc.
 - .5 Stainless steel spring, heavy duty.
 - .6 Seat: regrindable.

- .8 Ball Valves:
 - .1 NPS 2 and under:
 - .1 Body and cap: cast high tensile bronze to ASTM B 62.
 - .2 Pressure rating: Class125 2760-kPa CWP 4140-kPa CWP, 860 kPa steam.
 - .3 Connections: screwed ends to ANSI B1.20.1 and with hexagonal shoulders solder ends to ANSI.
 - .4 Stem: tamperproof ball drive.
 - .5 Stem packing nut: external to body.
 - .6 Ball and seat: replaceable stainless steel hard chrome solid ball and Teflon seats.
 - .7 Stem seal: TFE with external packing nut.
 - .8 Operator: removable lever handle.

- .9 Butterfly Valves:
 - .1 NPS 2 1/2 through NPS 6, 2068 kPa with grooved ends.
 - .1 Body: cast bronze, with copper-tube dimensioned grooved ends.
 - .2 Disc: elastomer coated ductile iron with integrally cast stem.
 - .3 Operator: lever or handwheel.

3 EXECUTION

3.01 INSTALLATION

- .1 Install rising stem valves in upright position with stem above horizontal.
- .2 Remove internal parts before soldering.
- .3 Install valves with unions at each piece of equipment arranged to allow servicing, maintenance, and equipment removal.

3.02 CLEANING

- .1 Clean in accordance with Section 01 10 00 – General Instructions.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 GENERAL

1.01 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.1-05, Cast Iron Pipe Flanges and Flanged Fittings.
- .2 ASTM International Inc.
 - .1 ASTM A 49-01(2006), Standard Specification for Heat-Treated Carbon Steel Joint Bars.
 - .2 ASTM A 126-04, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - .3 ASTM A 536-84(2004) e1, Standard Specification for Ductile Iron Castings.
 - .4 ASTM B 61-08, Standard Specification for Steam or Valve Bronze Castings.
 - .5 ASTM B 62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .6 ASTM B 85/B 85M-08, Standard Specification for Aluminum-Alloy Die Castings.
 - .7 ASTM B 209-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
 - .1 MSS SP-61-03, Pressure Testing of Steel Valves.
 - .2 MSS SP-70-06, Grey Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS SP-71-05, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
 - .4 MSS SP-82-1992, Valve Pressure Testing Methods.
 - .5 MSS SP-85-2002, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 10 00 – General Instructions.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheets for valves and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

1.03 CLOSEOUT SUBMITTALS

- .1 Submit maintenance data for incorporation into manual specified in Section 01 10 00 – General Instructions.

1.04 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 10 00 – General Instructions and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

1.05 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials/Spare Parts:
- .2 Furnish following spare parts:
 - .1 Valve seats: one for every 10 valves each size, minimum 1.
 - .2 Discs: one for every 10 valves, each size, and minimum 1.
 - .3 Stem packing: one for every 10 valves, each size, minimum 1.
 - .4 Valve handles: 2 of each size.
 - .5 Gaskets for flanges: one for every 10 flanged joints.
- .3 Tools:
 - .1 Furnish special tools for maintenance of systems and equipment.
 - .2 Include following:
 - .1 Lubricant gun for expansion joints.

2 PRODUCTS

2.01 MATERIAL

- .1 Valves:
 - .1 Except for specialty valves, to be of single manufacturer.
- .2 Standard specifications:
 - .1 Gate valves: MSS SP-70.
 - .2 Globe valves: MSS SP-85.
 - .3 Check valves: MSS SP-71.
- .3 Requirements common to valves, unless specified otherwise:
 - .1 Body, bonnet: cast iron to ASTM B 209 Class B or ductile iron to ASTM A 536 Grade 65-45-12.
 - .2 Connections: flanged ends plain face with 2 mm raised face with serrated finish grooved ends to ANSI B16.1.
 - .3 Inspection and pressure testing: to MSS SP-82.
 - .4 Bonnet gasket: non-asbestos.
 - .5 Stem: to have precision-machined Acme or 60 degrees V threads, top screwed for handwheel nut.
 - .6 Stuffing box: non-galling two-piece ball-jointed packing gland, gland bolts and nuts.
 - .7 Gland packing: non-asbestos.
 - .8 Handwheel: die-cast aluminum alloy to ASTM B 85/B 85M or malleable iron to ASTM A 49. Nut of bronze to ASTM B 62.
 - .9 Identification tag: with catalogue number, size, and other pertinent data.
- .4 All products to have CRN registration numbers.

2.02 GATE VALVES

- .1 NPS 2 1/2 - 8, non-rising stem, inside screw, bronze trim, solid wedge disc:
 - .1 Body and multiple-bolted bonnet: with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, Class 125.
 - .2 Disc: solid offset taper wedge, bronze to ASTM B 62.
 - .3 Seat rings: renewable bronze to ASTM B 62, screwed into body.
 - .4 Stem: bronze to ASTM B 62.
 - .5 Disc: solid offset taper wedge, cast iron to ASTM A 126 Class B, secured to wrought steel stem.
 - .6 Seat: integral with body.
 - .7 Stem: wrought steel.

- .8 Operator: handwheel.
- .9 Bypass: complete with union and NPS gate valve as Section 23 05 23.01 - Valves - Bronze.
- .2 NPS 2 1/2-8, outside screw and yoke (OS&Y), bronze iron trim, solid wedge disc:
 - .1 Body and multiple-bolted bonnet: with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, yoke, yoke hub, yoke sleeve and nut. Class 125.
 - .2 Disc: solid offset taper wedge, bronze to ASTM B 62 up to NPS 3, cast iron with bronze disc rings on other sizes, secured to stem through integral forged T-head disc-stem connection.
 - .3 Seat rings: renewable bronze screwed into body.
 - .4 Stem: nickel-plated steel manganese-bronze.
 - .5 Disc: solid offset taper all-cast iron, secured to stem through integral forged T-head disc-stem connection.
 - .6 Seat rings: integral with body.
 - .7 Stem: nickel-plated steel.
 - .8 Pressure-lubricated operating mechanism.
 - .9 Operator: manual gear.
 - .10 Bypass: complete with union.

2.03 UNDERWRITERS APPROVED GATE VALVE

- .1 NPS 2 1/2 - 14, OS&Y:
 - .1 Approvals: UL and FM approved for fire service.
 - .2 UL and FM Label: on valve yoke.
 - .3 Body, Bonnet: cast iron to ASTM A 126 Class B. Wall thicknesses to ANSI B16.1 and ULC C-262 (B) ductile iron to ASTM A 536 Grade 65-45-12.
 - .4 Bonnet bushing, yoke sleeve: bronze, to FM requirements.
 - .5 Packing gland: bronze.
 - .6 Stem: manganese bronze. Diameter to ULC C-262 (B). Brass, ASTM B 16.
 - .7 Stuffing box dimensions, gland bolt diameter: to ULC C-262 (B).
 - .8 Bosses for bypass valve, drain: on NPS 4 and over.
 - .9 Disc: solid taper wedge. Up to NPS 3: bronze. NPS 4 and over: EPDM coated cast iron with bronze disc rings.
 - .10 Disc seat ring: self-aligning, Milwood undercut on NPS 3 - 12.
 - .11 Pressure rating:
 - .1 NPS 2-1/2 - 12: 1.7 Mpa CWP.
 - .2 NPS 14-1.2: 1.2 MPa CWP.
 - .12 Operator: handwheel.
 - .13 Bypass: complete with union and gate valve as Section 23 05 23.01 - Valves - Bronze.

2.04 VALVE OPERATORS

- .1 Install valve operators as follows:
 - .1 Handwheel: on valves except as specified.
 - .2 Handwheel with chain operators: on valves installed more than 2400 mm above floor in boiler rooms and mechanical equipment rooms.

2.05 CHECK VALVES

- .1 Swing check valves, Class 125:
 - .1 Body and bolted cover: with tapped and plugged opening on each side for hinge pin. Grooved or flanged ends: plain faced with smooth finish.
 - .1 Up to NPS 16: cast iron to ASTM A 126 Class B ductile iron ASTM A 536

- Grade 65-45-12.
- .2 Ratings:
 - .1 NPS 2 1/2 - 12: 860 kPa steam; 1.4 MPa CWP.
 - .3 Disc: rotating for extended life.
 - .1 Up to NPS 6: bronze to ASTM B 62 stainless steel type 316.
 - .4 Seat rings: renewable bronze to ASTM B 62 screwed into body.
 - .5 Hinge pin, bushings: stainless steel.
 - .6 Disc: A126 Class B, secured to stem, rotating for extended life.
 - .7 Seat: cast iron, integral with body.
 - .8 Hinge pin: exelloy; bushings: malleable iron.
 - .9 Identification tag: fastened to cover.
 - .10 Hinge: stainless steel.
- .2 Swing check valves, NPS 2 1/2 - 8 Class 250:
- .1 Body and bolted cover: cast iron to ASTM A 126 Class B with tapped and plugged opening on each side for hinge pin.
 - .2 Flanged ends: 2 mm raised face with serrated finish.
 - .3 Rating: 250 psi steam; 500 psi CWP.
 - .4 Disc: rotating for extended life.
 - .1 Up to NPS 3: bronze to ASTM B 61.
 - .2 NPS 4 - 8: iron faced with ASTM B 61 bronze.
 - .5 Seat rings: renewable bronze to ASTM B 61, screwed into body.
 - .6 Hinge pin, bushings: renewable, bronze to ASTM B 61.
 - .7 Hinge: galvanized malleable iron.
 - .8 Identification tag: fastened to cover.

3 EXECUTION

3.01 INSTALLATION

- .1 Install rising stem valves in upright position with stem above horizontal.

3.02 CLEANING

- .1 Clean in accordance with Section 01 10 00 – General Instructions.
- .2 Clean installed products in accordance to manufacturer's recommendation.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 10 00 – General Instructions.

END OF SECTION

1 GENERAL

1.01 REFERENCES

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
 - .1 ASME B1.20.1-1983(R2006), Pipe Threads, General Purpose (Inch).
 - .2 ASME B16.1-05, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25,125 and 250.
 - .3 ANSI/ASME B16.5-03, Pipe Flanges and Flanged Fittings: NPS ½ through 24.
 - .4 ANSI/ASME B16.11-05, Forged Fittings, Socket-Welding and Threaded.
 - .5 ANSI/ASME B16.25-07, Buttwelding Ends.
 - .6 ANSI/ASME B16.34-04, Valves - Flanged, Threaded and Welding Ends.
- .2 American Petroleum Institute (API)
 - .1 API Std. 609-04, Butterfly Valves: Double Flanged, Lug- and Wafer-Type.
- .3 ASTM International Inc.
 - .1 ASTM A 126-04), Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - .2 ASTM A 536-84(2004)e1, Standard Specification for Ductile Iron Castings.
 - .3 ASTM B 62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .4 ASTM B 209M-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate Metric.
- .4 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
 - .1 MSS SP-67-02a, Butterfly Valves.

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 10 00 – General Instructions.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheets for valves and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit data for valves specified in this section.
- .3 Shop Drawings:
 - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

1.03 CLOSEOUT SUBMITTALS

- .1 Submit maintenance data for incorporation into manual specified in Section 01 10 00 – General Instructions.

1.04 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 10 00 – General Instructions and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

1.05 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials/Spare Parts:
- .2 Furnish following spare parts:
 - .1 Valve seats: one for every 10 valves each size, minimum 1.
 - .2 Discs: one for every 10 valves, each size, and minimum 1.
 - .3 Stem packing: one for every 10 valves, each size, minimum 1.
 - .4 Valve handles: 2 of each size.
 - .5 Gaskets for flanges: one for every 10 flanged joints.
- .3 Tools:
 - .1 Furnish special tools for maintenance of systems and equipment.
 - .2 Include following:
 - .1 Lubricant gun for expansion joints.

2 PRODUCTS

2.01 BUTTERFLY VALVES - RESILIENT SEAT - 200 PSIG

- .1 Except to specialty valves, to be of single manufacturer.
- .2 To be suitable for dead-end service.
- .3 CRN registration number required for products.
- .4 Sizes:
 - .1 Wafer Lug type: NPS 2 to 30.
 - .2 Grooved end type: NPS 2 to 12.
- .5 Pressure rating for tight shut-off at temperatures up to maximum for seat material.
 - .1 NPS 2 - 12: 200 psig.
- .6 Minimum seat temperature ratings to 121 degrees C.
- .7 Application: on-off operation.
- .9 Operators:
 - .1 NPS 2 - 6: handles capable of locking in any of ten (10) positions - 0 degrees to 90 degrees. Handle and release trigger - ductile iron. Return spring and hinge pin: carbon steel. Latch plate and mounting hardware: cadmium plated carbon steel. Standard coating: black laquer.
- .10 Designed to comply with MSS SP-67 and API 609.
- .11 Compatible with ANSI Class 125/Class 150 flanges.
- .12 Construction:
 - .1 Body iron ss bronze.
 - .2 Disc: aluminum 316SS plated iron coated ductile iron.
 - .3 Seat: EPDM Buna-N Viton EPT.
 - .4 Shaft: 316 stainless steel.
 - .5 Taper pin: 316SS Monel.
 - .6 Key: stainless.
 - .7 O-Ring: Buna-N.
 - .8 Bushings: Teflon.

2.02 MOUNTING FLANGES

- .1 Class 125 cast iron to ANSI B16.1 or Class 150 steel to B16.5 pipe flanges.

2.03 ELECTRIC ACTUATORS

- .1 Operation: designed to provide precise quarter turn electric operation.
 - .1 Torque range: up to 1.130 N-m and speed ranges from 10 seconds to 30 seconds to move from fully open to fully closed.
 - .2 Gear train within actuator to provide smooth continuous rotary power stroke for accurate automatic valve positioning. Factory-set, field adjustable cam-actuated travel limit switches to provide precise control of shaft rotation.
- .2 Construction:
 - .1 Castings: heavy duty industrial grade for rugged use.
 - .2 Actuators: continuous duty with high efficiency single phase reversing capacitor motor with thermal overload protection.
 - .3 Gears and pinions constructed from hardened steel.
 - .4 Gear train to be permanently lubricated.
 - .5 Mechanical brake to ensure that gear is locked in precise position.
- .3 Electrical:
 - .1 Standard voltage: 120 VAC. 60 Hz.
 - .2 Control options: 4-20 Ma DC.
 - .3 CSA approved.
 - .4 Electrical rating: NEMA IV.

3 EXECUTION

3.01 PREPARATION

- .1 Valve and mating flange preparation.
 - .1 Inspect adjacent pipeline, remove rust, scale, welding slag, other foreign material.
 - .2 Ensure that valve seats and pipe flange faces are free of dirt or surface irregularities which may disrupt flange seating and cause external leakage.
 - .3 Install butterfly valves with disc in almost closed position.
 - .4 Inspect valve disc seating surfaces and waterway and eliminate dirt or foreign material.

3.02 INSTALLATION OF VALVES

- .1 Install in accordance with manufacturer's instructions.
- .2 Do not use gaskets between pipe flanges and valves unless instructed otherwise by valve manufacturer.
- .3 Verify suitability of valve for application by inspection of identification tag.
- .4 Mount actuator on to valve prior to installation.
- .5 Handle valve with care so as to prevent damage to disc and seat faces.
- .6 Valves in horizontal pipe lines should be installed with stem in horizontal position to minimize liner and seal wear.
- .7 Ensure that valves are centered between bolts before bolts are tightened and then opened and closed to ensure unobstructed disc movement. If interference occurs due, for example to

pipe wall thickness, taper bore adjacent piping to remove interference.

3.03 ACTUATOR INSTALLATION

- .1 Air hoses or electrical connections to be made by actuator manufacturer.
- .2 Cycle valve operation from fully closed to fully open then back to fully closed.
- .3 At same time, check travel stop settings for proper disc alignment.

3.04 CLEANING

- .1 Clean in accordance with Section 01 10 00 – General Instructions.
- .2 Clean installed products in accordance to manufacturer's recommendation.

END OF SECTION

1 GENERAL

1.01 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B31.1-07, Power Piping.
- .2 ASTM International
 - .1 ASTM A 125-1996(2007), Standard Specification for Steel Springs, Helical, Heat-Treated.
 - .2 ASTM A 307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM A 563-07a, Standard Specification for Carbon and Alloy Steel Nuts.
- .3 Factory Mutual (FM)
- .4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
 - .1 MSS SP 58-2002, Pipe Hangers and Supports - Materials, Design and Manufacture.
 - .2 MSS SP 69-2003, Pipe Hangers and Supports - Selection and Application.
 - .3 MSS SP 89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .5 Underwriter's Laboratories of Canada (ULC)

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 10 00 – General Instructions.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Submit shop drawings for:
 - .1 Bases, hangers and supports.
 - .2 Connections to equipment and structure.
 - .3 Structural assemblies.
- .4 Certificates:
 - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Manufacturers' Instructions:
 - .1 Provide manufacturer's installation instructions.
 - .1 NRC Project Manager will make available 1 copy of systems supplier's installation instructions.

1.03 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section 01 10 00 – General Instructions.

1.04 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 10 00 – General Instructions and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

2 PRODUCTS

2.01 SYSTEM DESCRIPTION

- .1 Design Requirements:
 - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
 - .2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP 58.
 - .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
 - .4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
 - .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP 58.

2.02 GENERAL

- .1 Fabricate hangers, supports and sway braces in accordance with MSS SP 58. ANSI B31.1 and
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.03 PIPE HANGERS

- .1 Finishes:
 - .1 Pipe hangers and supports: galvanized after manufacture.
 - .2 Use hot dipped galvanizing process.
 - .3 Ensure steel hangers in contact with copper piping are epoxy coated.
- .2 Upper attachment structural: suspension from lower flange of I-Beam:
 - .1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
 - .1 Rod: 9 mm UL listed.
 - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed.
- .3 Upper attachment structural: suspension from upper flange of I-Beam:
 - .1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed FM approved to MSS SP 69.
 - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed FM approved.
- .4 Upper attachment to concrete:

- .1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
- .2 Concrete inserts: wedge shaped body with knockout protector plate UL listed FM approved to MSS SP 69.
- .6 Hanger rods: threaded rod material to MSS SP 58:
 - .1 Ensure that hanger rods are subject to tensile loading only.
 - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
 - .3 Do not use 22 mm or 28 mm rod.
- .7 Pipe attachments: material to MSS SP 58:
 - .1 Attachments for steel piping: carbon steel black galvanized.
 - .2 Attachments for copper piping: copper plated black steel.
 - .3 Use insulation shields for hot pipework.
 - .4 Oversize pipe hangers and supports.
- .8 Adjustable clevis: material to MSS SP 69 UL listed FM approved, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
 - .1 Ensure "U" has hole in bottom for riveting to insulation shields.
- .9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP 69.
- .10 U-bolts: carbon steel to MSS SP 69 with 2 nuts at each end to ASTM A 563.
 - .1 Finishes for steel pipework: black galvanized.
 - .2 Finishes for copper, glass, and brass or aluminum pipework: black galvanized, with formed portion plastic coated epoxy coated.
- .11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP 69.

2.04 RISER CLAMPS

- .1 Steel or cast iron pipe: galvanized carbon steel to MSS SP 58, type 42, UL listed.
- .2 Copper pipe: carbon steel copper plated to MSS SP 58, type 42.
- .3 Bolts: to ASTM A 307.
- .4 Nuts: to ASTM A 563.

2.05 INSULATION PROTECTION SHIELDS

- .1 Insulated cold piping:
 - .1 64 kg/m³ density insulation plus insulation protection shield to: MSS SP 69, galvanized sheet carbon steel. Length designed for maximum 3 m span.
- .2 Insulated hot piping:
 - .1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP 69.

2.06 CONSTANT SUPPORT SPRING HANGERS

- .1 Springs: alloy steel to ASTM A 125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report (CMTR).
- .2 Load adjustability: 10% minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.
- .3 Provide upper and lower factory set travel stops.

- .4 Provide load adjustment scale for field adjustments.
- .5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm minimum.
- .6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

2.07 VARIABLE SUPPORT SPRING HANGERS

- .1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.
- .2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.
- .3 Variable spring hanger complete with factory calibrated travel stops. Provide certificate of calibration for each hanger.
- .4 Steel alloy springs: to ASTM A 125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

2.08 EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05 12 23 - Structural Steel for Buildings. Submit calculations with shop drawings.

2.09 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

- .1 Provide templates to ensure accurate location of anchor bolts.

2.10 HOUSE-KEEPING PADS

- .1 Provide 100 mm high concrete housekeeping pads for base-mounted equipment; size pads 50 mm larger than equipment; chamfer pad edges.

3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.02 INSTALLATION

- .1 Install in accordance with:
 - .1 Manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
 - .1 Install on piping systems at pumps, boilers, chillers, cooling towers, and as indicated.
- .3 Clamps on riser piping:
 - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
 - .2 Bolt-tightening torques to industry standards.

- .3 Steel pipes: install below coupling or shear lugs welded to pipe.
- .4 Cast iron pipes: install below joint.
- .4 Clevis plates:
 - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
- .6 Use approved constant support type hangers where:
 - .1 Vertical movement of pipework is 13 mm or more,
 - .2 Transfer of load to adjacent hangers or connected equipment is not permitted.
- .7 Use variable support spring hangers where:
 - .1 Transfer of load to adjacent piping or to connected equipment is not critical.
 - .2 Variation in supporting effect does not exceed 25 % of total load.

3.03 HANGER SPACING

- .1 Plumbing piping: to Canadian Plumbing Code authority having jurisdiction.
- .2 Fire protection: to applicable fire code.
- .3 Gas and fuel oil piping: up to NPS 1/2: every 1.8 m.
- .4 Copper piping: up to NPS 1/2: every 1.5 m.
- .5 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.

.6 Within 300 mm of each elbow.

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.4 m	1.8 m
1-1/2	3.0 m	2.4 m
2	3.0 m	2.4 m
2-1/2	3.7 m	3.0 m
3	3.7 m	3.0 m
3-1/2	3.7 m	3.3 m
4	3.7 m	3.6 m
5	4.3 m	
6	4.3 m	
<u>12</u>	<u>4.9 m</u>	

3.04 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

3.05 HORIZONTAL MOVEMENT

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.

- .2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.06 FINAL ADJUSTMENT

- .1 Adjust hangers and supports:
 - .1 Ensure that rod is vertical under operating conditions.
 - .2 Equalize loads.
- .2 Adjustable clevis:
 - .1 Tighten hanger load nut securely to ensure proper hanger performance.
 - .2 Tighten upper nut after adjustment.
- .3 C-clamps:
 - .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4 Beam clamps:
 - .1 Hammer jaw firmly against underside of beam.

3.07 FIELD QUALITY CONTROL

- .1 Site Tests: conduct following tests in accordance with Section 01 10 00 – General Instructions and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .2 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.08 CLEANING

- .1 Clean in accordance with Section 01 10 00 – General Instructions.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 GENERAL

1.01 SUMMARY

- .1 Section Includes:
 - .1 Vibration isolation materials and components, seismic control measures and their installation.

1.02 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .2 National Fire Protection Association (NFPA)
 - .1 NFPA 13-2002, Standard for the Installation of Sprinkler Systems.
- .3 National Building Code of Canada (NBC) - 1995

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 10 00 – General Instructions.
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 10 00 – General Instructions. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 10 00 – General Instructions.
 - .2 Submit shop drawings in accordance with Section 01 10 00 – General Instructions.
 - .1 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Provide separate shop drawings for each isolated system shop drawings complete with performance and product data.
 - .3 Provide detailed drawings of seismic control measures for equipment and piping.
 - .3 Quality assurance submittals: submit following in accordance with Section 01 10 00 – General Instructions.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
 - .1 NRC Project Manager will make available 1 copy of systems supplier's installation instructions.
 - .3 Manufacturer's Field Reports: manufacturer's field reports specified.

1.04 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 10 00 – General Instructions.

1.05 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 10 00 – General Instructions.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

- .2 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 10 00 – General Instructions.

2 PRODUCTS

2.01 GENERAL

- .1 Size and shape of bases type and performance of vibration isolation as indicated.

2.02 ELASTOMERIC PADS

- .1 Type EP1 - neoprene waffle or ribbed; 9 mm minimum thick; 50 durometer; maximum loading 350 kPa.
- .2 Type EP2 - rubber waffle or ribbed; 9 mm minimum thick; 30 durometer natural rubber; maximum loading 415 kPa.
- .3 Type EP3 - neoprene-steel-neoprene; 9 mm minimum thick neoprene bonded to 1.71 mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa.
- .4 Type EP4 - rubber-steel-rubber; 9 mm minimum thick rubber bonded to 1.71 mm steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa.

2.03 ELASTOMERIC MOUNTS

- .1 Type M1 - colour coded; neoprene in shear; maximum durometer of 60; threaded insert and two bolt-down holes; ribbed top and bottom surfaces.

2.04 SPRINGS

- .1 Design stable springs: ratio of lateral to axial stiffness is equal to or greater than 1.2 times ratio of static deflection to working height. Select for 50% travel beyond rated load. Units complete with levelling devices.
- .2 Ratio of height when loaded to diameter of spring between 0.8 to 1.0.
- .3 Cadmium plate 100% relative humidity installations.
- .4 Colour code springs.

2.05 SPRING MOUNT

- .1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.
- .2 Type M2 - stable open spring: support on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad.
- .3 Type M3 - stable open spring: 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; levelling bolt for rigidly mounting to equipment.
- .4 Type M4 - restrained stable open spring: supported on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.

- .5 Type M5 - enclosed spring mounts with snubbers for isolation up to 950 kg maximum.
- .6 Performance: as indicated.

2.06 HANGERS

- .1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30 degrees arc without metal to metal contact.
- .2 Type H1 - neoprene - in-shear, moulded with rod isolation bushing which passes through hanger box.
- .3 Type H2 - stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.
- .4 Type H3 - stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.
- .5 Type H4 - stable spring, elastomeric element with pre-compression washer and nut with deflection indicator.
- .6 Performance: as indicated.

2.07 ACOUSTIC BARRIERS FOR ANCHORS AND GUIDES

- .1 Acoustic barriers: between pipe and support, consisting of 25 mm minimum thick heavy duty duck and neoprene isolation material.

2.08 HORIZONTAL THRUST RESTRAINT

- .1 Spring and elastomeric element housed in box frame; assembly complete with rods and angle brackets for equipment and ductwork attachment; provision for adjustment to limit maximum start and stop movement to 9 mm.
- .2 Arrange restraints symmetrically on either side of unit and attach at centerline of thrust.

2.09 STRUCTURAL BASES

- .1 Type B1 - Prefabricated steel base: integrally welded on sizes up to 2400 mm on smallest dimension, split for field welding on sizes over 2400 mm on smallest dimension and reinforced for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; pre-drilled holes to receive equipment anchor bolts; and complete with adjustable built-in motor slide rail where indicated.
- .2 Type B2 - Steel rail base: structural steel, positioned for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; and pre-drilled holes to receive equipment anchor bolts.
- .3 Bases to clear housekeeping pads by 25 mm minimum.

2.10 SEISMIC CONTROL MEASURES

- .1 General:
 - .1 Seismic control systems to work in every direction.
 - .2 Fasteners and attachment points to resist same maximum load as seismic restraint.
 - .3 Drilled or power driven anchors and fasteners not permitted.

- .4 No equipment, equipment supports or mounts to fail before failure of structure.
- .5 Supports of cast iron or threaded pipe not permitted.
- .6 Seismic control measures not to interfere with integrity of firestopping.
- .2 Static equipment:
 - .1 Anchor equipment to equipment supports. Anchor equipment supports to structure.
 - .2 Suspended equipment:
 - .1 Use one or more of following methods depending upon site conditions and or as indicated:
 - .1 Install tight to structure.
 - .2 Cross brace in every direction.
 - .3 Brace back to structure.
 - .4 Cable restraint system.
 - .3 Seismic restraints:
 - .1 Cushioning action gentle and steady.
 - .2 Never reach metal-like stiffness.
- .3 Vibration isolated equipment:
 - .1 Seismic control measures not to jeopardize noise and vibration isolation systems. Provide 6 to 9 mm clearance during normal operation of equipment and systems between seismic restraint and equipment.
 - .2 Incorporate seismic restraints into vibration isolation system to resist complete isolator unloading.
 - .3 As indicated.
- .4 Piping systems:
 - .1 Fire protection systems: to NFPA 13.
 - .2 Piping systems: hangers longer than 300 mm; brace at each hanger.
 - .3 Compatible with requirements for anchoring and guiding of piping systems.
- .5 Bracing methods:
 - .1 Approved by NRC Project Manager.
 - .2 Structural angles or channels.
 - .3 Cable restraint system incorporating grommets, shackles and other hardware to ensure alignment of restraints and to avoid bending of cables at connection points. Incorporate neoprene into cable connections to reduce shock loads.

3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.02 INSTALLATION

- .1 Seismic control measures to meet requirements of NBC.
- .2 Install vibration isolation equipment in accordance with manufacturer's instructions and adjust mountings to level equipment.
- .3 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.
- .4 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:

- .1 Up to NPS4: first 3 points of support. NPS5 to NPS8: first 4 points of support. NPS10 and over: first 6 points of support.
- .2 First point of support: static deflection of twice deflection of isolated equipment, but not more than 50 mm.
- .5 Where isolation is bolted to floor use vibration isolation rubber washers.
- .6 Block and shim level bases so that ductwork and piping connections can be made to rigid system at operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

3.03 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Arrange with manufacturer's representative to review work of this Section and submit written reports to verify compliance with Contract Documents.
 - .2 Manufacturer's Field Services: consisting of product use recommendations and periodic site visits to review installation, scheduled as follows:
 - .1 After delivery and storage of Products.
 - .2 After preparatory work is complete but before installation commences.
 - .3 Twice during the installation, at 25% and 60% completion stages.
 - .4 Upon completion of installation.
 - .3 Submit manufacturer's reports NRC Project Manager within 3 days of manufacturer representative's review.
 - .4 Make adjustments and corrections in accordance with written report.
- .2 Inspection and Certification:
 - .1 Experienced and competent sound and vibration testing professional engineer to take vibration measurement for HVAC systems after start up and TAB of systems to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
 - .2 Take vibration measurements for equipment as indicated and listed below.
 - .3 Provide NRC Project Manager with notice 24 h in advance of commencement of tests.
 - .4 Establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and where appropriate, remedial recommendations (including sound curves).
 - .5 Submit complete report of test results including sound curves.

3.04 CLEANING

- .1 Proceed in accordance with Section 01 10 00 – General Instructions.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 GENERAL

1.01 SUMMARY

- .1 Section Includes:
 - .1 Materials and requirements for the identification of piping systems, duct work, valves and controllers, including the installation and location of identification systems.
 - .2 Sustainable requirements for construction and verification.

1.02 REFERENCES

- .1 Canadian Gas Association (CGA)
 - .1 CSA/CGA B149.1-05, Natural Gas and Propane Installation Code.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.
 - .2 CAN/CGSB-24.3-92, Identification of Piping Systems.
- .3 National Fire Protection Association (NFPA)
 - .1 NFPA 13-2002, Standard for the Installation of Sprinkler Systems.
 - .2 NFPA 14-2003, Standard for the Installation of Standpipe and Hose Systems.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
- .2 Submittals: in accordance with Section 01 10 00 – General Instructions.
- .3 Product data to include paint colour chips, other products specified in this section.
- .4 Samples:
 - .1 Submit samples in accordance with Section 01 10 00 – General Instructions.
 - .2 Samples to include nameplates, labels, tags, lists of proposed legends.

1.04 QUALITY ASSURANCE

- .1 Quality assurance submittals: submit following in accordance with Section 01 10 00 – General Instructions.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 10 00 – General Instructions.

1.05 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 10 00 – General Instructions.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

2 PRODUCTS

2.01 MANUFACTURER'S EQUIPMENT NAMEPLATES

- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers raised or recessed.
- .3 Information to include, as appropriate:
 - .1 Equipment: manufacturer's name, model, size, serial number, capacity.
 - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.02 SYSTEM NAMEPLATES

- .1 Colours:
 - .1 Hazardous: red letters, white background.
 - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .2 Construction:
 - .1 3 mm thick laminated plastic or white anodized aluminum, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .3 Sizes:
 - .1 Conform to following table:

Size #	mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1		10 x 50	1	3
2		13 x 75	1	5
3		13 x 75	2	3
4		20 x 100	1	8
5		20 x 100	2	5
6		20 x 200	1	8
7		25 x 125	1	12
8		25 x 125	2	8
9		35 x 200	1	20
 - .2 Use maximum of 25 letters/numbers per line.
- .4 Locations:
 - .1 Terminal cabinets, control panels: use size # 5.
 - .2 Equipment in Mechanical Rooms: use size # 9.
- .5 Identification for PWGSC Preventive Maintenance Support System (PMSS):
 - .1 Use arrangement of Main identifier, Source identifier, Destination identifier.
 - .2 Equipment in Mechanical Room:
 - .1 Main identifier: size #9.
 - .2 Source and Destination identifiers: size #6.
 - .3 Terminal cabinets, control panels: size #5.
 - .3 Equipment elsewhere: sizes as appropriate.

2.03 EXISTING IDENTIFICATION SYSTEMS

- .1 Apply existing identification system to new work.
- .2 Where existing identification system does not cover for new work, use identification system

specified this section.

- .3 Before starting work, obtain written approval of identification system from NRC Project Manager.

2.04 PIPING SYSTEMS GOVERNED BY CODES

- .1 Identification:
 - .1 Natural gas: to CSA/CGA B149.1 authority having jurisdiction.
 - .2 Propane gas: to CSA/CGA B149.1 authority having jurisdiction.
 - .3 Sprinklers: to NFPA 13.
 - .4 Standpipe and hose systems: to NFPA 14.

2.05 IDENTIFICATION OF PIPING SYSTEMS

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.
- .2 Pictograms:
 - .1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.
- .3 Legend:
 - .1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.
- .4 Arrows showing direction of flow:
 - .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
 - .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
 - .3 Use double-headed arrows where flow is reversible.
- .5 Extent of background colour marking:
 - .1 To full circumference of pipe or insulation.
 - .2 Length to accommodate pictogram, full length of legend and arrows.
- .6 Materials for background colour marking, legend, arrows:
 - .1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
 - .2 Other pipes: pressure sensitive plastic-coated cloth vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.
- .7 Colours and Legends:
 - .1 Where not listed, obtain direction from NRC Project Manager.
 - .2 Colours for legends, arrows: to following table:

<u>Background colour:</u>	<u>Legend, arrows:</u>
Yellow	BLACK
Green	WHITE
Red	WHITE

.3 Background colour marking and legends for piping systems:

Contents	Background colour marking	Legend
City Water	Green	CITY WATER
Treated water	Green	TREATED WATER
Condenser water supply	Green	COND. WTR. SUPPLY
Condenser water return	Green	COND. WTR. RETURN
Chilled water supply	Green	CH. WTR. SUPPLY
Chilled water return	Green	CH. WTR. RETURN
Hot water heating supply	Yellow	HEATING SUPPLY
Hot water heating return	Yellow	HEATING RETURN
High temp HW Htg. supply	Yellow	HTHW HTG. SUPPLY++
High temp HW Htg. return	Yellow	HTHW HTG. RETURN++
Make-up water	Yellow	MAKE-UP WTR
Refrigeration suction	Yellow	REF. SUCTION
Refrigeration liquid	Yellow	REF. LIQUID
Refrigeration hot gas	Yellow	REF. HOT GAS

2.06 IDENTIFICATION DUCTWORK SYSTEMS

- .1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.
- .2 Colours: back, or co-ordinated with base colour to ensure strong contrast.

2.07 VALVES, CONTROLLERS

- .1 Brass tags with 12 mm stamped identification data filled with black paint.
- .2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

2.08 CONTROLS COMPONENTS IDENTIFICATION

- .1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.
- .2 Inscriptions to include function and (where appropriate) fail-safe position.

2.09 LANGUAGE

- .1 Identification in English.
- .2 Use one nameplate and label for each language both languages.

3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.02 TIMING

- .1 Provide identification only after painting has been completed.

3.03 INSTALLATION

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide ULC and or CSA registration plates as required by respective agency.
- .3 Identify systems, equipment to conform to PWGSC PMSS.

3.04 NAMEPLATES

- .1 Locations:
 - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Standoffs:
 - .1 Provide for nameplates on hot and/or insulated surfaces.
- .3 Protection:
 - .1 Do not paint, insulate or cover.

3.05 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

- .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping or ductwork passes.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
- .7 At beginning and end points of each run and at each piece of equipment in run.
- .8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification easily and accurately readable from usual operating areas and from access points.
 - .1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.06 VALVES, CONTROLLERS

- .1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.
- .2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass

where directed by NRC Project Manager. Provide one copy (reduced in size if required) in each operating and maintenance manual.

- .3 Number valves in each system consecutively.

3.07 CLEANING

- .1 Proceed in accordance with Section 01 10 00 – General Instructions.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 GENERAL

1.01 SUMMARY

- .1 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.
- .2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.02 QUALIFICATIONS OF TAB PERSONNEL

- .1 Submit names of personnel to perform TAB to NRC Project Manager within 90 days of award of contract.
- .2 Provide documentation confirming qualifications, successful experience.
- .3 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:
 - .1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1-2002.
 - .2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-1998.
 - .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing-2002.
- .4 Recommendations and suggested practices contained in the TAB Standard: mandatory.
- .5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.
- .6 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.
- .7 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.
- .8 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.
 - .1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.
 - .2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.03 PURPOSE OF TAB

- .1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads
- .2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.

- .3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.04 EXCEPTIONS

- .1 TAB of systems and equipment regulated by codes, standards to satisfaction of authority having jurisdiction.

1.05 CO-ORDINATION

- .1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.
- .2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.06 PRE-TAB REVIEW

- .1 Review contract documents before project construction is started and confirm in writing to NRC Project Manager Adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.
- .2 Review specified standards and report to NRC Project Manager in writing proposed procedures which vary from standard.
- .3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.07 START-UP

- .1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.
- .2 Follow special start-up procedures specified elsewhere in Division 23.

1.08 OPERATION OF SYSTEMS DURING TAB

- .1 Operate systems for length of time required for TAB and as required by NRC Project Manager for verification of TAB reports.

1.09 START OF TAB

- .1 Notify NRC Project Manager 7 days prior to start of TAB.
- .2 Start TAB when building is essentially completed, including:
- .3 Installation of ceilings, doors, windows, other construction affecting TAB.
- .4 Application of weatherstripping, sealing, and caulking.
- .5 Pressure, leakage, other tests specified elsewhere Division 23.
- .6 Provisions for TAB installed and operational.
- .7 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
 - .1 Proper thermal overload protection in place for electrical equipment.
 - .2 Air systems:
 - .1 Filters in place, clean.

- .2 Duct systems clean.
- .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
- .4 Correct fan rotation.
- .5 Fire, smoke, volume control dampers installed and open.
- .6 Coil fins combed, clean.
- .7 Access doors, installed, closed.
- .8 Outlets installed, volume control dampers open.
- .3 Liquid systems:
 - .1 Flushed, filled, vented.
 - .2 Correct pump rotation.
 - .3 Strainers in place, baskets clean.
 - .4 Isolating and balancing valves installed, open.
 - .5 Calibrated balancing valves installed, at factory settings.
 - .6 Chemical treatment systems complete, operational.

1.10 APPLICATION TOLERANCES

- .1 Do TAB to following tolerances of design values:
 - .1 Other HVAC systems: plus 5 %, minus 5 %.
 - .2 Hydronic systems: plus or minus 10 %.

1.11 ACCURACY TOLERANCES

- .1 Measured values accurate to within plus or minus 2 % of actual values.

1.12 INSTRUMENTS

- .1 Prior to TAB, submit to NRC Project Manager list of instruments used together with serial numbers.
- .2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .3 Calibrate within 3 months of TAB. Provide certificate of calibration to NRC Project Manager.

1.13 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit, prior to commencement of TAB:
- .2 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.14 PRELIMINARY TAB REPORT

- .1 Submit for checking and approval of NRC Project Manager, prior to submission of formal TAB report, sample of rough TAB sheets. Include:
 - .1 Details of instruments used.
 - .2 Details of TAB procedures employed.
 - .3 Calculations procedures.
 - .4 Summaries.

1.15 TAB REPORT

- .1 Format in accordance with referenced standard.
- .2 TAB report to show results in SI units and to include:
 - .1 Project record drawings.
 - .2 System schematics.

- .3 Submit 6 copies of TAB Report to NRC Project Manager for verification and approval, in English in D-ring binders, complete with index tabs.

1.16 VERIFICATION

- .1 Reported results subject to verification by NRC Project Manager.
- .2 Provide personnel and instrumentation to verify up to 30 % of reported results.
- .3 Number and location of verified results as directed by NRC Project Manager.
- .4 Pay costs to repeat TAB as required to satisfaction of NRC Project Manager.

1.17 SETTINGS

- .1 After TAB is completed to satisfaction of NRC Project Manager, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.
- .2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

1.18 COMPLETION OF TAB

- .1 TAB considered complete when final TAB Report received and approved by NRC Project Manager.

1.19 AIR SYSTEMS

- .1 Standard: TAB to most stringent of this section.
- .2 Do TAB of systems, equipment, components, controls specified Division 23.
- .3 Qualifications: personnel performing TAB current member in good standing of AABC or NEBB qualified to standards of AABC or NEBB.
- .4 Quality assurance: perform TAB under direction of supervisor qualified by to standards of AABC.
- .5 Measurements: to include as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.
- .6 Locations of equipment measurements: to include as appropriate:
 - .1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.
 - .2 At controllers, controlled device.
- .7 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

2 PRODUCTS

2.01 NOT USED

- .1 Not used.

3 EXECUTION

3.01 NOT USED

.1 Not used.

END OF SECTION

1 GENERAL

1.01 SUMMARY

- .1 Section Includes:
 - .1 Materials and methods for pressure testing ducts over 5 m in length, forming part of a supply, return or exhaust ductwork system directly or indirectly connected to air handling equipment.
 - .2 Sustainable requirements for construction and verification.

1.02 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .2 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
 - .1 SMACNA HVAC Air Duct Leakage Test Manual, 1985.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 10 00 – General Instructions.
- .2 Co-ordinate submittal requirements and provide submittals required by Section 01 10 00 – General Instructions: Construction.
- .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties. Include pressure test information and results as follows:
 - .1 Submit proposed report form and test report format to NRC Project Manager for approval at least three months before proposed date of first series of tests. Do not start tests until approval received in writing from NRC Project Manager.
 - .2 Prepare report of results and submit to NRC Project Manager within 24 hours of completion of tests. Include:
 - .1 Schematic of entire system.
 - .2 Schematic of section under test showing test site.
 - .3 Required and achieved static pressures.
 - .4 Orifice differential pressure at test sites.
 - .5 Permissible and actual leakage flow rate (L/s) for test sites.
 - .6 Witnessed certification of results.
 - .3 Include test reports in final TAB report.
 - .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .5 Instructions: submit manufacturer's installation instructions.
 - .6 Manufacturer's field reports specified.

1.04 QUALITY ASSURANCE

- .1 Pre-Installation Meetings:
 - .1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations in accordance with Section 01 10 00 – General Instructions.
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Coordination with other building subtrades.
 - .4 Review manufacturer's installation instructions and warranty requirements.
 - .2 Health and Safety:

- .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

2 PRODUCTS

2.01 TEST INSTRUMENTS

- .1 Test apparatus to include:
 - .1 Fan capable of producing required static pressure.
 - .2 Duct section with calibrated orifice plate mounted and accurately located pressure taps.
 - .3 Flow measuring instrument compatible with the orifice plate.
 - .4 Calibration curves for orifice plates used.
 - .5 Flexible duct for connecting to ductwork under test.
 - .6 Smoke bombs for visual inspections.
- .2 Test apparatus: accurate to within +/- 3 % of flow rate and pressure.
- .3 Submit details of test instruments to be used to NRC Project Manager at least three months before anticipated start date.
- .4 Test instruments: calibrated and certificate of calibration deposited with NRC Project Manager no more than 28 days before start of tests.
- .5 Re-calibrated every six months thereafter.

2.02 EQUIPMENT LEAKAGE TOLERANCES

- .1 Equipment and system components such as VAV boxes, duct heating leakage: 2 %.

3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.02 TEST PROCEDURES

- .1 Maximum lengths of ducts to be tested consistent with capacity of test equipment.
- .2 Section of duct to be tested to include:
 - .1 Fittings, branch ducts, tap-ins.
- .3 Repeat tests until specified pressures are attained. Bear costs for repairs and repetition to tests.
- .4 Base partial system leakage calculations on SMACNA HVAC Air Duct Leakage Test Manual.
- .5 Seal leaks that can be heard or felt, regardless of their contribution to total leakage.

3.03 SITE TOLERANCES

- .1 System leakage tolerances specified are stated as percentage of total flow rate handled by system. Pro-rate specified system leakage tolerances. Leakage for sections of duct systems: not to exceed total allowable leakage.
- .2 Leakage tests on following systems not to exceed specified leakage rates.
 - .1 Small duct systems up to 250 Pa: leakage 2%.
 - .2 VAV box and duct on downstream side of VAV box: leakage 2%.
 - .3 Large low pressure duct systems up to 500 Pa: leakage 2%.
 - .4 HP duct systems up to 1000 Pa pressure classification, including upstream side of VAV boxes: leakage 1.
- .3 Evaluation of test results to use surface area of duct and pressure in duct as basic parameters.

3.04 TESTING

- .1 Test ducts before installation of insulation or other forms of concealment.
- .2 Test after seals have cured.
- .3 Test when ambient temperature will not affect effectiveness of seals, and gaskets.
- .4 Flexible connections to VAV boxes.

3.05 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services.
 - .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.
 - .2 Manufacturer's Field Services: provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, at stages listed:
 - .1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of the Work, after cleaning is carried out.
 - .4 Obtain reports, within 3 days of review, and submit, immediately, to NRC Project Manager.
- .2 Verification requirements in accordance with Section 01 10 00 – General Instructions: Contractor's Verification, include:
 - .1 Materials and resources.
 - .2 Storage and collection of recyclables.
 - .3 Construction waste management.
 - .4 Resource reuse.
 - .5 Recycled content.
 - .6 Local/regional materials.
 - .7 Certified Wood.
 - .8 Low-emitting materials.
- .3 Performance Verification:
 - .1 NRC Project Manager to witness tests and to verify reported results.

- .2 To be certified by same TAB agency approved by NRC Project Manager to undertake TAB on this project.

3.06 CLEANING

- .1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 GENERAL

1.01 REFERENCES

- .1 Definitions:
 - .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - means "not concealed" as previously defined.
 - .3 Insulation systems - insulation material, fasteners, jackets, and other accessories.
 - .2 TIAC Codes:
 - .1 CRD: Code Round Ductwork,
 - .2 CRF: Code Rectangular Finish.
- .2 Reference Standards:
 - .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ANSI/ASHRAE/IESNA 90.1-04, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - .2 ASTM International Inc.
 - .1 ASTM B 209M-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
 - .2 ASTM C 335-05ae1, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
 - .3 ASTM C 411-05, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C 449/C 449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C 547-07e1, Standard Specification for Mineral Fiber Pipe Insulation.
 - .6 ASTM C 553-02e1, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .7 ASTM C 612-04e1, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .8 ASTM C 795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .9 ASTM C 921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
 - .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .5 Green Seal Environmental Standards (GSES)
 - .1 Standard GS-36-00, Commercial Adhesives.
 - .6 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.
 - .7 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).
 - .8 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-03, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701-05, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 10 00 – General Instructions.

- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for duct insulation, and include product characteristics, performance criteria, physical size, finish and limitations.
 - .1 Description of equipment giving manufacturer's name, type, model, year and capacity.
 - .2 Details of operation, servicing and maintenance.
 - .3 Recommended spare parts list.
- .3 Shop Drawings:
 - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .4 Samples:
 - .1 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed.
 - .2 Mount sample on 12 mm plywood board.
 - .3 Affix typewritten label beneath sample indicating service.

1.03 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, qualified to standards member of TIAC.

1.04 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 10 00 – General Instructions.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address and ULC markings.

2 PRODUCTS

2.01 FIRE AND SMOKE RATING

- .1 To CAN/ULC-S102:
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

2.02 INSULATION

- .1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C 335.
- .3 TIAC Code C-1: Rigid mineral fibre board to ASTM C 612, with without factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).
- .4 TIAC Code C-2: Mineral fibre blanket to ASTM C 553 faced with without factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: to ASTM C 553.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to ASTM C 553.

2.03 JACKETS

- .1 Canvas:
 - .1 220 gm/mi. cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.
- .2 Lagging adhesive: compatible with insulation.
 - .1 Maximum VOC limit 50 g/L to SCAQMD Rule 1168 or GSES GS-36.
- .3 Aluminum:
 - .1 To ASTM B 209 with and without moisture barrier as scheduled in PART 3 of this section.
 - .2 Thickness: 0.50 mm sheet.
 - .3 Finish: Smooth.
 - .4 Jacket banding and mechanical seals: 12 mm wide, 0.5 mm thick stainless steel.
 - .1 Stainless steel:
 - .5 Type: 316.
 - .6 Thickness: 0.25 mm sheet.
 - .7 Finish: Smooth.
 - .8 Jacket banding and mechanical seals: 12 mm wide, 0.5 mm thick stainless steel.

2.04 ACCESSORIES

- .1 Vapour retarder lap adhesive:
 - .1 Water based, fire retardant type, compatible with insulation.
 - .1 Maximum VOC limit 50 g/L to SCAQMD Rule 1168 or GSES GS-36.
- .2 Indoor Vapour Retarder Finish:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
- .3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C 449.
- .4 ULC Listed Canvas Jacket:
 - .1 220 gm/mi. cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921 untreated.
- .5 Outdoor Vapour Retarder Mastic:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
 - .2 Reinforcing fabric: Fibrous glass, untreated 305 g/mi.
- .6 Tape: self-adhesive, aluminum, plain reinforced, 50 mm wide minimum.
- .7 Contact adhesive: quick-setting
 - .1 Maximum VOC limit 50 g/L to SCAQMD Rule 1168 or GSES GS-36.
- .8 Canvas adhesive: washable.
 - .1 Maximum VOC limit 50 g/L to SCAQMD Rule 1168 or GSES GS-36.
- .9 Tie wire: 1.5 mm stainless steel.
- .10 Banding: 19 mm wide, 0.5 mm thick stainless steel.
- .11 Facing: 25 mm stainless steel hexagonal wire mesh stitched on both faces of insulation.
- .12 Fasteners: 4 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

3 EXECUTION

3.01 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.02 PRE-INSTALLATION REQUIREMENTS

- .1 Pressure test ductwork systems complete, witness and certify.
- .2 Ensure surfaces are clean, dry, and free from foreign material.

3.03 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturer's instructions and as indicated.
- .3 Use 2 layers with staggered joints when required nominal thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Ensure hangers, and supports are outside vapour retarder jacket.
- .5 Hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
 - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .6 Fasteners: install at 300 mm on centre in horizontal and vertical directions, minimum 2 rows each side.

3.04 DUCTWORK INSULATION SCHEDULE

.1 Insulation types and thicknesses: conform to following table:

	TIAC Code	Vapour Retarded	Thickness (mm)
Rectangular cold and dual temperature supply air ducts	C-1	Yes	50
Round cold and dual temperature supply air ducts	C-2	Yes	50
Rectangular warm air ducts	C-1	No	25
Round warm air ducts	C-1	No	25
Supply, return and exhaust ducts exposed in space being served			None
Outside air ducts to mixing plenum	C-1	Yes	25
Mixing plenums	C-1	Yes	25
Exhaust duct between dampers and louvres	C-1	Special	50
Rectangular ducts outside	C-1	Special	50
Round ducts, outside	C-1	Special	50
Acoustically lined ducts	None		

- .2 Exposed round ducts 600 mm and larger, smaller sizes where subject to abuse:
 - .1 Use TIAC code C-1 insulation, scored to suit diameter of duct.
 - .1 Finishes: conform to following table:

	<u>TIAC Code</u>	
	Rectangular	Round
Indoor, concealed	none	none
Indoor, exposed within mechanical room	CRF/1	CRD/2
Indoor, exposed elsewhere	CRF/2	CRD/3
Outdoor, exposed to precipitation	CRF/3	CRD/4
Outdoor, <u>elsewhere</u>	CRF/4	CRD/5

3.05 CLEANING

- .1 Clean in accordance with Section 01 10 00 – General Instructions.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 10 00 – General Instructions.

END OF SECTION

1 GENERAL

1.01 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ANSI/ASHRAE 90.1-04-SI Edition, Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 ASTM International Inc.
 - .1 ASTM C 335-05ae1, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .2 ASTM C 449/C 449M-07, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .3 ASTM C 533-07, Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
 - .4 ASTM C 547-07, Standard Specification for Mineral Fiber Pipe Insulation.
 - .5 ASTM C 553-02, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .6 ASTM C 612-04e1, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .7 ASTM C 795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .8 ASTM C 921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52MA-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .2 CAN/CGSB 51.53-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .6 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.
- .7 Thermal Insulation Association of Canada (TIAC)
 - .1 National Insulation Standards 2005.
- .8 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-07, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 10 00 – General Instructions.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for insulation and adhesives, include product characteristics, performance criteria, physical size, finish and limitations.
- .5 Manufacturer's Instructions:
 - .1 Include procedures to be used and installation standards to be achieved.

- .6 Qualifications:
 - .1 Installer to be specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, qualified to standards member of TIAC.

1.03 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 10 00 – General Instructions.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Store at temperatures and conditions recommended by manufacturer.

2 PRODUCTS

2.01 FIRE AND SMOKE RATING

- .1 Fire and smoke ratings to CAN/ULC-S102:
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

2.02 INSULATION

- .1 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C 335.
- .2 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.
 - .1 Mineral fibre: ASTM C 547.
 - .2 Maximum "k" factor: ASTM C 547.
- .3 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.
 - .1 Mineral fibre: ASTM C 547.
 - .2 Jacket: to CGSB 51-GP-52MA.
 - .3 Maximum "k" factor: ASTM C 547.
- .4 TIAC Code C-1: rigid mineral fibre board, unfaced.
 - .1 Mineral fibre: ASTM C 612.
 - .2 Maximum "k" factor: ASTM C 612.
- .5 TIAC Code C-4: rigid mineral fibre board faced with factory applied vapour retarder jacket.
 - .1 Mineral fibre: ASTM C 612.
 - .2 Jacket: to CGSB 51-GP-52MA.
 - .3 Maximum "k" factor: ASTM C 612.
- .6 TIAC Code C-2: mineral fibre blanket unfaced or faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: ASTM C 553.
 - .2 Jacket: to CGSB 51-GP-52MA.
 - .3 Maximum "k" factor: ASTM C 553.
- .7 TIAC Code A.6: flexible unicellular tubular elastomer.
 - .1 Insulation: with vapour retarder jacket.
 - .2 Jacket: to CGSB 51-GP-52MA.
 - .3 Maximum "k" factor.
 - .4 Certified by manufacturer free of potential stress corrosion cracking corrodents.

- .8 TIAC Code A-2: rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.
 - .1 Insulation: ASTM C 533.
 - .2 Maximum "k" factor: ASTM C 533.
 - .3 Design to permit periodic removal and re-installation.

2.03 CEMENT

- .1 Thermal insulating and finish
 - .1 To: ASTM C 449/C 449M.
 - .2 Hydraulic setting or Air drying on mineral wool, to ASTM C 449.

2.04 JACKETS

- .1 Polyvinyl Chloride (PVC):
 - .1 One-piece moulded type and sheet to CAN/CGSB 51.53 with pre-formed shapes as required.
 - .2 Colours: to match adjacent finish paint.
 - .3 Minimum service temperatures: -20 degrees C.
 - .4 Maximum service temperature: 65 degrees C.
 - .5 Moisture vapour transmission: 0.02 perm.
 - .7 Fastenings:
 - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Tacks.
 - .3 Pressure sensitive vinyl tape of matching colour.

2.05 INSULATION SECUREMENTS

- .1 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.
- .2 Contact adhesive: quick setting.
 - .1 Maximum VOC limit 80 g/L to SCAQMD Rule 1168 GSES GS-36.
- .4 Tie wire: 1.5 mm diameter stainless steel.
- .5 Bands: Stainless steel, 19 mm wide, 0.5 mm thick.
- .6 Facing: 25 mm galvanized steel hexagonal wire mesh on both faces of insulation.
- .7 Fasteners: 4 mm diameter pins with 35 mm diameter clips. Length of pin to suit thickness of insulation.

2.06 VAPOUR RETARDER LAP ADHESIVE

- .1 Water based, fire retardant type, compatible with insulation.
 - .1 Maximum VOC limit 80 g/L to SCAQMD Rule 1168 GSES GS-36.

2.07 INDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.

3 EXECUTION

3.01 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.02 PRE- INSTALLATION REQUIREMENTS

- .1 Pressure testing of equipment and adjacent piping systems complete, witnessed and certified.
- .2 Surfaces clean, dry, and free from foreign material.

3.03 INSTALLATION

- .1 Install in accordance with TIAC National Standards
 - .1 Hot equipment: To TIAC code 1503-H.
 - .2 Cold equipment: to TIAC code 1503-C.
- .2 Elastomeric Insulation: to remain dry. Overlaps to manufacturer's instructions. Joints tight and sealed properly.
- .3 Provide vapour retarder as recommended by manufacturer.
- .4 Apply materials in accordance with insulation and equipment manufacturer's instructions and this specification.
- .5 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- .6 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Hangers, supports outside vapour retarder jacket.
- .7 Supports, Hangers:
 - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.04 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

- .1 Application: At expansion joints, valves, primary flow measuring elements flanges and unions at equipment.
- .2 Installation to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.

3.05 FIRE SUPPRESSION EQUIPMENT INSULATION SCHEDULES

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 Cold equipment:
 - .1 TIAC C-4 with bands and 13 mm cement reinforced with one layer of reinforcing mesh.
 - .2 TIAC C-2 faced with vapour retardant jacket and with bands and 13 mm cement preceded by one layer of reinforcing mesh.
 - .3 TIAC A-6 or C-4 with bands.
 - .4 Thicknesses: chillers (except factory insulated) 50 mm.
- .3 Finishes:
 - .1 Equipment in mechanical rooms: TIAC code CEF/1 with jacket.
 - .2 Equipment elsewhere: TIAC code CEF/2 with 13 mm cement jacket.

3.06 CLEANING

- .1 Clean in accordance with Section 01 10 00 – General Instructions.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 10 00 – General Instructions.

END OF SECTION

1 GENERAL

1.01 SUMMARY

- .1 Section Includes:
 - .1 Thermal insulation for piping and piping accessories in commercial type applications.

1.02 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ASHRAE Standard 90.1-01, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM B 209M-04, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.
 - .2 ASTM C 335-04, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C 411-04, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C 449/C 449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C 533-2004, Calcium Silicate Block and Pipe Thermal Insulation.
 - .6 ASTM C 547-2003, Mineral Fiber Pipe Insulation.
 - .7 ASTM C 795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .8 ASTM C 921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .2 CAN/CGSB-51.53-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts
- .4 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
 - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
 - .3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .6 Manufacturer's Trade Associations
 - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).
- .7 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-03, Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701-01, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
 - .3 CAN/ULC-S702-1997, Thermal Insulation, Mineral Fibre, for Buildings
 - .4 CAN/ULC-S702.2-03, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.03 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - will mean "not concealed" as specified.
- .2 TIAC ss:
 - .1 CRF: Code Rectangular Finish.
 - .2 CPF: Code Piping Finish.

1.04 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 10 00 – General Instructions.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 10 00 – General Instructions. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 10 00 – General Instructions.
- .3 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 10 00 – General Instructions.
 - .1 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .4 Samples:
 - .1 Submit samples in accordance with Section 01 10 00 – General Instructions.
 - .2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix label beneath sample indicating service.
- .5 Quality assurance submittals: submit following in accordance with Section 01 10 00 – General Instructions.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
 - .1 NRC Project Manager will make available 1 copy of systems supplier's installation instructions.

1.05 QUALITY ASSURANCE

- .1 Qualifications:
- .2 Installer: specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project, member of TIAC.
- .3 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 10 00 – General Instructions.

1.06 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 10 00 – General Instructions.

- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Storage and Protection:
 - .1 Protect from weather, construction traffic.
 - .2 Protect against damage.
 - .3 Store at temperatures and conditions required by manufacturer.
- .3 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 10 00 – General Instructions.
 - .2 Place excess or unused insulation and insulation accessory materials in designated containers.
 - .3 Divert unused metal materials from landfill to metal recycling facility approved by NRC Project Manager.
 - .4 Dispose of unused adhesive material at official hazardous material collections site approved by NRC Project Manager.

2 PRODUCTS

2.01 FIRE AND SMOKE RATING

- .1 In accordance with CAN/ULC-S102.
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

2.02 INSULATION

- .1 Mineral fibre specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C 335.
- .3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.
 - .1 Mineral fibre: to CAN/ULC-S702 ASTM C 547.
 - .2 Maximum "k" factor: to CAN/ULC-S702.
- .4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.
 - .1 Mineral fibre: to CAN/ULC-S702 ASTM C 547.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to CAN/ULC-S702 ASTM C 547.
- .5 TIAC Code C-2: mineral fibre blanket faced with without factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: to CAN/ULC-S702 ASTM C 547.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to CAN/ULC-S702 ASTM C 547.

2.04 INSULATION SECUREMENT

- .1 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.
- .2 Contact adhesive: quick setting.
- .3 Canvas adhesive: washable.

- .4 Tie wire: 1.5 mm diameter stainless steel.
- .5 Bands: stainless steel, 19mm wide, 0.5 mm thick.

2.05 CEMENT

- .1 Thermal insulating and finishing cement:
 - .1 Hydraulic setting or Air drying on mineral wool, to ASTM C 449/C 449M.

2.06 VAPOUR RETARDER LAP ADHESIVE

- .1 Water based, fire retardant type, compatible with insulation.

2.07 INDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.

2.08 OUTDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.
- .2 Reinforcing fabric: fibrous glass, untreated 305 g/mi.

2.09 JACKETS

- .1 Polyvinyl Chloride (PVC):
 - .1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.
 - .2 Colours: to match adjacent finish paint by NRC Project Manager.
 - .3 Minimum service temperatures: -20 degrees C.
 - .4 Maximum service temperature: 65 degrees C.
 - .5 Moisture vapour transmission: 0.02 perm.
 - .7 Fastenings:
 - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Tacks.
 - .3 Pressure sensitive vinyl tape of matching colour.

3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.02 PRE-INSTALLATION REQUIREMENT

- .1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.
- .2 Surfaces clean, dry, and free from foreign material.

3.03 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturer's instructions and this specification.

- .3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Install hangers, supports outside vapour retarder jacket.
- .5 Supports, Hangers:
 - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.04 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

- .1 Application: at expansion joints, valves, primary flow measuring elements flanges and unions at equipment.
- .2 Design: to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.
- .3 Insulation:
 - .1 Insulation, fastenings and finishes: same as system.
 - .2 Jacket: PVC.

3.05 INSTALLATION OF ELASTOMERIC INSULATION

- .1 Insulation to remain dry. Overlaps to manufacturer's instructions. Ensure tight joints.
- .2 Provide vapour retarder as recommended by manufacturer.

3.06 PIPING INSULATION SCHEDULES

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 TIAC Code: A-1.
 - .1 Securements: SS bands at 300 mm on centre.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code 1501-H.
- .3 TIAC Code: A-3.
 - .1 Securements: SS bands at 300 mm on centre.
 - .2 Seals: VR lap seal adhesive, VR lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C.
- .5 TIAC Code: C-2 with without vapour retarder jacket.
 - .1 Insulation securements: SS bands at 300 mm on centre.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C.
- .7 Thickness of insulation as listed in following table.
 - .1 Run-outs to individual units and equipment not exceeding 4000 mm long.
 - .2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Application	Temp Degrees C	TIAC Code	Pipe Sizes (NPS) and insutlation thickness (mm)						
			Run Out	To 1	1 ¼ to 2	2 ½ to 4	5 to 6	8& over	
Chilled Water	4-13	A-3	25	25	25	25	25	25	
Chilled Water or Glycol	Below 4	A-3	25	25	38	38	38	38	
Chilled Water Pump Casing		A-3	25	25	25	25	25	25	
Domestic CWS		A-3	25	25	25	25	25	25	
Domestic CWS with Vapour Retarder		C-2	25	25	25	25	25	25	

- .8 Finishes:
- .1 Exposed indoors: PVC jacket.
 - .2 Exposed in mechanical rooms: PVC jacket.
 - .3 Concealed, indoors: canvas on valves, fittings. No further finish.
 - .4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.
 - .6 Finish attachments: SS bands, at 150 mm on centre. Seals: closed.
 - .7 Installation: to appropriate TIAC code CRF/1 through CPF/5.

3.08 CLEANING

- .1 Proceed in accordance with Section 01 10 00 – General Instructions.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 GENERAL

1.01 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM E 202-04, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

1.02 CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS

- .1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

1.03 HYDRONIC SYSTEMS - PERFORMANCE VERIFICATION (PV)

- .1 Perform hydronic systems performance verification after cleaning is completed and system is in full operation.
- .2 When systems are operational, perform following tests:
 - .1 Conduct full scale tests at maximum design flow rates, temperatures and pressures for continuous consecutive period of 48 hours to demonstrate compliance with design criteria.
 - .2 Verify performance of hydronic system circulating pumps as specified, recording system pressures, temperatures, fluctuations by simulating maximum design conditions and varying.
 - .1 Pump operation.
 - .2 Boiler and/or chiller operation.
 - .3 Pressure bypass open/closed.
 - .4 Control pressure failure.
 - .5 Maximum heating demand.
 - .6 Maximum cooling demand.
 - .7 Boiler and/or chiller failure.
 - .8 Cooling tower (and/or industrial fluid cooler) fan failure.
 - .9 Outdoor reset. Re-check heat exchanger output supply temperature at 100% and 50% reset, maximum water temperature.

1.04 HYDRONIC SYSTEM CAPACITY TEST

- .1 Perform hydronic system capacity tests after:
 - .1 TAB has been completed
 - .2 Verification of operating, limit, safety controls.
 - .3 Verification of primary and secondary pump flow rates.
 - .4 Verification of accuracy of temperature and pressure sensors and gauges.
- .2 Calculate system capacity at test conditions.
- .3 Using manufacturer's published data and calculated capacity at test conditions, extrapolate system capacity at design conditions.
- .4 When capacity test is completed, return controls and equipment status to normal operating conditions.
- .5 Submit sample of system water to approved testing agency to determine if chemical treatment is correct. Include cost.
- .6 Heating system capacity test:
 - .1 Perform capacity test when ambient temperature is within 10% of design conditions.

- Simulate design conditions by:
- .1 Increasing OA flow rates through heating coils (in this case, monitor heating coil discharge temperatures to ensure that coils are not subjected to freezing conditions) or
 - .2 Reducing space temperature by turning of heating system for sufficient period of time before starting testing.
- .2 Test procedures:
- .1 Open fully heat exchanger, heating coil and radiation control valves.
 - .2 With boilers on full firing and hot water heating supply temperature stabilized, record flow rates and supply and return temperatures simultaneously.
 - .3 Conduct flue gas analysis test on boilers at full load and at low fire conditions.
- .7 Chilled water system capacity test:
- .1 Perform capacity test when ambient temperature is within 10% of design conditions.
Simulate design conditions by:
 - .1 Adding heat from building heating system or;
 - .2 Raising space temperature by turning off cooling and air systems for sufficient period of time before starting testing and pre-heating building to summer design space temperature (occupied) or above. Set OAD and RAD for minimum outside air if OAT is near outside design temperature or to maximum recirculation if RAT is greater than OAT. RAT to be at least 23 degrees C minimum.
 - .2 Test procedures:
 - .1 Open fully cooling coil control valves.
 - .2 Set thermostats on associated AHU's for maximum cooling.
 - .3 Set AHU's for design maximum air flow rates.
 - .4 Set load or demand limiters on chillers to 100%.
 - .5 After system has stabilized, record chilled water, and condenser water flow rates and supply and return temperatures simultaneously.

1.05 CONDENSER WATER AND HUMIDIFICATION SYSTEMS

- .1 In addition to procedures specified above, perform following:
 - .1 Add chemicals once twice per week as required.
 - .2 Perform TAB as specified Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
 - .3 Set up and adjust drip feeders, timer controls, pump strokes as required to maintain required chemical feed rates.
 - .4 Inject inhibitor into cooling tower sump.

2 PRODUCTS

2.01 NOT USED

- .1 Not Used.

3 EXECUTION

3.01 NOT USED

- .1 Not Used.

END OF SECTION

1 GENERAL

1.01 SUMMARY

- .1 Section Includes:
 - .1 Procedures and cleaning solutions for cleaning mechanical piping systems.

1.02 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM E 202-00, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 10 00 – General Instructions. Include product characteristics, performance criteria, and limitations.
- .2 Quality assurance submittals: submit following in accordance with Section 01 10 00 – General Instructions.
 - .1 Instructions: submit manufacturer's installation instructions.
 - .1 NRC Project Manager will make available 1 copy of systems supplier's installation instructions.

1.04 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 10 00 – General Instructions.

1.05 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 10 00 – General Instructions.

2 PRODUCTS

2.01 CLEANING SOLUTIONS

- .1 Tri-sodium phosphate: 0.40 kg per 100 L water in system.
- .2 Sodium carbonate: 0.40 kg per 100 L water in system.
- .3 Low-foaming detergent: 0.01 kg per 100 L water in system.

3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.02 CLEANING HYDRONIC SYSTEMS

- .1 Timing: systems operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.
- .2 Cleaning Agency:
 - .1 Retain qualified water treatment specialist to perform system cleaning.
- .3 Install instrumentation such as flow meters, orifice plates, pitot tubes, and flow metering valves only after cleaning is certified as complete by water treatment specialist.
- .4 Cleaning procedures:
 - .1 Provide detailed report outlining proposed cleaning procedures at least 4 weeks prior to proposed starting date. Report to include:
 - .1 Cleaning procedures, flow rates, elapsed time.
 - .2 Chemicals and concentrations used.
 - .3 Inhibitors and concentrations.
 - .4 Specific requirements for completion of work.
 - .5 Special precautions for protecting piping system materials and components.
 - .6 Complete analysis of water used to ensure water will not damage systems or equipment.
- .5 Conditions at time of cleaning of systems:
 - .1 Systems: free from construction debris, dirt and other foreign material.
 - .2 Control valves: operational, fully open to ensure that terminal units can be cleaned properly.
 - .3 Strainers: clean prior to initial fill.
 - .4 Install temporary filters on pumps not equipped with permanent filters.
 - .5 Install pressure gauges on strainers to detect plugging.
- .6 Report on Completion of Cleaning:
 - .1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.
- .7 Hydronic Systems:
 - .1 Fill system with water, ensure air is vented from system.
 - .2 Fill expansion tanks 1/3 to 1/2 full, charge system with compressed air to at least 35 kPa (does not apply to diaphragm type expansion tanks).
 - .3 Use water metre to record volume of water in system to +/- 0.5%.
 - .4 Add chemicals under direct supervision of chemical treatment supplier.
 - .5 Closed loop systems: circulate system cleaner at 60 degrees C for at least 36 h. Drain as quickly as possible. Refill with water and inhibitors. Test concentrations and adjust to recommended levels.
 - .6 Flush velocity in system mains and branches to ensure removal of debris. System pumps may be used for circulating cleaning solution provided that velocities are adequate.
 - .7 Add chemical solution to system.
 - .8 Establish circulation, raise temperature slowly to maximum design 82 degrees C minimum. Circulate for 12 h, ensuring flow in all circuits. Remove heat, continue to circulate until temperature is below 38 degrees C. Drain as quickly as possible. Refill with clean water. Circulate for 6h at design temperature. Drain and repeat procedures

specified above. Flush through low point drains in system. Refill with clean water adding to sodium sulphite (test for residual sulphite).

3.03 START-UP OF HYDRONIC SYSTEMS

- .1 After cleaning is completed and system is filled:
 - .1 Establish circulation and expansion tank level, set pressure controls.
 - .2 Ensure air is removed.
 - .3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.
 - .4 Dismantle system pumps used for cleaning, inspect, replace worn parts, and install new gaskets and new set of seals.
 - .5 Clean out strainers repeatedly until system is clean.
 - .6 Commission water treatment systems as specified in Section 23 25 00 - HVAC Water Treatment Systems.
 - .7 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.
 - .8 Repeat with water at design temperature.
 - .9 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.
 - .10 Bring system up to design temperature and pressure slowly over a 48 hour period.
 - .11 Perform TAB as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
 - .12 Adjust pipe supports, hangers, springs as necessary.
 - .13 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.
 - .14 If sliding type expansion joints bind or if bellows type expansion joints flex incorrectly, shut down system, re-align, repeat start-up procedures.
 - .15 Re-tighten bolts using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.
 - .16 Check operation of drain valves.
 - .17 Adjust valve stem packings as systems settle down.
 - .18 Fully open balancing valves (accept those that are factory-set).
 - .19 Check operation of over-temperature protection devices on circulating pumps.
 - .20 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

3.05 CLEANING

- .1 Proceed in accordance with Section 01 10 00 – General Instructions.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 GENERAL

1.01 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 10 00 – General Instructions.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for electric and electronic control system for HVAC and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.02 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 10 00 – General Instructions and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect electric and electronic control systems from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

2 PRODUCTS

2.01 THERMOSTAT (LOW VOLTAGE)

- .1 Low voltage wall thermostat:
 - .1 For use on 24 V circuit at 1.5 A capacity.
 - .2 With heat anticipator adjustable 0.1 to 1.2 A.
 - .3 Temperature setting range: 10 degrees C to 25 degrees C.
 - .4 Without sub-base.

2.02 THERMOSTAT (REMOTE BULB)

- .1 Line voltage remote bulb type thermostat with:
 - .1 8 30 A rating on 120 V.
 - .2 3 m copper capillary tube nylon coated.
 - .3 Moisture and dust-resistant enclosure Cast weathertight box.

2.03 THERMOSTAT GUARDS

- .1 Thermostat guards: lockable, clear opaque plastic cast metal. Slots for air circulation to thermostat.

2.04 LOW LIMIT TEMPERATURE ALARM

- .1 Low limit temperature alarm with:
 - .1 Rating: 10.2 A at 120 V.

- .2 Sensing bulb and 6 m long capillary tube.
- .3 Switching action: manual.
- .4 Temperature setting range: 0 degrees C to 15 degrees C.

2.05 HIGH LIMIT TEMPERATURE ALARM

- .1 High limit temperature alarm with:
 - .1 Rating 10 A at 120 V.
 - .2 Positive lock-out.
 - .3 Manual reset only after 14 degrees C drop-in temperature.
 - .4 Cutout setting: 50 degrees C.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for electric and electronic control systems installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of NRC Project Manager.
 - .2 Inform NRC Project Manager of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from NRC Project Manager.

3.02 INSTALLATION

- .1 Install control devices.
- .2 On outside wall, mount thermostats on bracket or insulated pad 25 mm from exterior wall.
- .3 Install remote sensing device and capillary tube in metallic conduit. Conduit enclosing capillary tube must not touch heater or heating cable.

3.03 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 10 00 – General Instructions.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 10 00 – General Instructions.

END OF SECTION

1 GENERAL

1.01 REFERENCES

- .1 American National Standards Institute (ANSI)/American Welding Society (AWS)
 - .1 ANSI/AWS A5.8/A5.8M-11, AMD1 Specification Filler Metals for Brazing and Braze Welding.
- .2 ASME
 - .1 ANSI/ASME B16.4-06, Gray-Iron Threaded Fittings Classes 125 and 250.
 - .2 ANSI/ASME B16.15-11, Cast Copper Alloy Threaded Fittings Classes 125 and 250.
 - .3 ANSI B16.18-12, Cast Copper Alloy, Solder Joint Pressure Fittings.
 - .4 ANSI/ASME B16.22-12, Wrought Copper and Copper-Alloy Solder Joint Pressure Fittings.
- .3 ASTM International
 - .1 ASTM B 32-08, Standard Specification for Solder Metal.
 - .2 ASTM B 61-08, Standard Specification for Steam or Valve Bronze Castings.
 - .3 ASTM B 62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .4 ASTM B 88M-05(2011), Standard Specification for Seamless Copper Water Tube Metric.
 - .5 ASTM E 202-12, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .5 Manufacturers Standardization Society (MSS)
 - .1 MSS SP 67-2011, Butterfly Valves.
 - .2 MSS SP 70-2011, Cast Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS SP 71-2011, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
 - .4 MSS SP 80-2008, Bronze Gate, Globe, Angle and Check Valves.
 - .5 MSS SP 85-2011, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 10 00 – General Instructions.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for hydronic systems and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 10 00 – General Instructions.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Indicate on manufacturer's catalogue literature the following: valves.

1.03 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 10 00 – General Instructions.
- .2 Operation and Maintenance Data: submit operation and maintenance data for hydronic

systems for incorporation into manual.

- .3 Submit four (4) copies of operation and maintenance manual.

1.04 MAINTENANCE MATERIALS SUBMITTALS

- .1 Extra Materials:
 - .1 Furnish following spare parts:
 - .1 Valve seats: one for every ten valves, each size. Minimum one.
 - .2 Discs: one for every ten valves, each size. Minimum one.
 - .3 Stem packing: one for every ten valves, each size. Minimum one.
 - .4 Valve handles: two of each size.
 - .5 Gaskets for flanges: one for every ten flanges.

1.05 QUALITY ASSURANCE

- .1 Regulatory Requirements: ensure Work is performed in compliance with CEPA, CEAA, TDGA, and applicable Provincial /Territorial regulations.

1.06 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 10 00 – General Instructions and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect hydronic systems from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

2 PRODUCTS

2.01 TUBING

- .1 Type A or B C hard drawn copper tubing: to ASTM B 88M.

2.02 FITTINGS

- .1 Wrought copper and copper alloy solder joint pressure fittings: to ANSI/ASME B16.22.
- .2 Cast copper alloy solder joint pressure fittings: to ANSI B16.18.

2.03 FLANGES

- .1 Brass or bronze: threaded.
- .2 Orifice flanges: slip-on, raised face, 2100 kPa.

2.04 JOINTS

- .1 Solder, tin-antimony, 95:5: to ASTM B 32.
- .2 Silver solder BCUP: to ANSI/AWS A5.8.

- .3 Brazing: as indicated.

2.05 VALVES

- .1 Connections:
 - .1 NPS 2 and smaller: ends for soldering.
 - .2 NPS 2 1/2 and larger: flanged ends.
- .2 Gate Valves: application: isolating equipment, control valves, pipelines:
 - .1 NPS 2 and under:
 - .1 Mechanical Rooms: Class 125, rising stem split wedge disc, as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 Elsewhere: Class 125, non- rising stem, solid wedge disc, as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 NPS 2 1/2 and over:
 - .1 Mechanical Rooms: rising stem, split wedge disc, bronze trim, as specified Section 23 05 23.02 - Valves - Cast Iron.
 - .2 Elsewhere: Non- rising stem, solid wedge disc, bronze trim, as specified Section 23 05 23.02 - Valves - Cast Iron.
- .3 Butterfly valves: application: isolating each cell or section of multiple component equipment (i.e. multi-section coils, multi-cell cooling towers):
 - .1 NPS 2 1/2 and over: lug type: as specified Section 23 05 17 - Pipe Welding.
- .4 Globe valves: application: throttling, flow control, emergency bypass:
 - .1 NPS 2 and under:
 - .1 Mechanical Rooms: with PTFE disc, as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 Elsewhere: globe, with composition disc, as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 NPS 2 1/2 and over:
 - .1 With composition bronze disc, bronze trim, as specified Section 23 05 23.02 - Valves - Cast Iron.
- .5 Balancing, for TAB:
 - .1 Sizes: calibrated balancing valves, as specified.
 - .2 NPS 2 and under:
 - .1 Mechanical rooms: globe, with plug disc as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 Elsewhere: globe, with plug disc as specified Section 23 05 23.01 - Valves - Bronze.
- .6 Drain valves: gate, Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 23.01 - Valves - Bronze.
- .7 Bypass valves on gate globe valves NPS 8 and larger: NPS 3/4, globe, with PTFE disc as specified Section 23 05 23.01 - Valves - Bronze.
- .8 Swing check valves:
 - .1 NPS 2 and under:
 - .1 Class 125, swing, with composition disc, as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 NPS 2 1/2 and over:
 - .1 Flanged Grooved ends: as specified Section 23 05 23.02 - Valves - Cast Iron.
- .9 Silent check valves:
 - .1 NPS 2 and under:

- .1 As specified Section 23 05 23.01 - Valves - Bronze.
- .2 NPS 2 1/2 and over:
 - .1 Flanged Grooved ends: as specified Section 23 05 23.02 - Valves - Cast Iron.
- .10 Ball valves:
 - .1 NPS 2 and under: as specified Section 23 05 23.01 - Valves - Bronze.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for hydronic systems installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of NRC Project Manager.
 - .2 Inform NRC Project Manager of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from NRC Project Manager.

3.02 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.03 PIPING INSTALLATION

- .1 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.
- .2 Install concealed pipes close to building structure to keep furring space to minimum. Install to conserve headroom and space. Run exposed piping parallel to walls. Group piping where ever practical.
- .3 Slope piping in direction of drainage and for positive venting.
- .4 Use eccentric reducers at pipe size change installed to provide positive drainage or positive venting.
- .5 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.
- .6 Assemble piping using fittings manufactured to ANSI standards.

3.04 VALVE INSTALLATION

- .1 Install rising stem valves in upright position with stem above horizontal.
- .2 Install butterfly valves on chilled water and condenser water lines only.
- .3 Install gate or butterfly valves at branch take-offs and to isolate each piece of equipment, and as indicated.
- .4 Install globe valves for balancing and in by-pass around control valves as indicated.
- .5 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and as indicated.

- .6 Install swing check valves in horizontal lines on discharge of pumps and as indicated.
- .7 Install chain operators on valves NPS 2 1/2 and over where installed more than 2400 mm above floor in Boiler Rooms and Mechanical Equipment Rooms.
- .8 Install ball valves for glycol service.

3.05 CIRCUIT BALANCING VALVES

- .1 Install flow measuring stations and flow balancing valves as indicated.
- .2 Remove handwheel after installation and TAB is complete.
- .3 Tape joints in prefabricated insulation on valves installed in chilled water mains.

3.06 FLUSHING AND CLEANING

- .1 Flush and clean in presence of NRC Project Manager.
- .2 Flush after pressure test for a minimum of 4 hours.
- .3 Fill with solution of water and non-foaming, phosphate-free detergent 3% solution by weight. Circulate for minimum of 8 hours.
- .4 Refill system with clean water. Circulate for at least 4 hours. Clean out strainer screens/baskets regularly. Then drain.
- .5 Refill system with clean water. Circulate for at least 2 hours. Clean out strainer screens/baskets regularly. Then drain.
- .6 Drainage to include drain valves, dirt pockets, strainers, low points in system.
- .7 Re-install strainer screens/baskets only after obtaining NRC Project Manager Approval.

3.07 FILLING OF SYSTEM

- .1 Refill system with clean water adding water treatment as specified glycol.

3.08 FIELD QUALITY CONTROL

- .1 Testing:
 - .1 Test system in accordance with Section 21 05 01 - Common Work Results for Mechanical.
 - .2 For glycol systems, retest with ethylene glycol to ASTM E 202, inhibited, for use in building system after cleaning. Repair leaking joints, fittings or valves.
- .2 Balancing:
 - .1 Balance water systems to within plus or minus 5% of design output.
 - .2 Refer to Section 23 08 01 – Performance Verification Mechanical Piping Systems for applicable procedures.
- .3 Glycol Charging:
 - .1 Provide mixing tank and positive displacement pump for glycol charging.
 - .2 Retest for concentration to ASTM E 202 after cleaning.
 - .3 Provide report to NRC Project Manager.

3.09 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 10 00 – General Instructions.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 10 00 – General Instructions.

END OF SECTION

1 GENERAL

1.01 REFERENCES

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - .1 ANSI/AWWA C111/A21.11-06, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .2 American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.1-10, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
 - .2 ASME B16.3-06, Malleable Iron Threaded Fittings: Classes 150 and 300.
 - .3 ASME B16.5-09, Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch Standard.
 - .4 ASME B16.9-07, Factory-Made Wrought Butt Welding Fittings.
 - .5 ASME B18.2.1-10, Square Hex, Heavy Hex and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Loded Head and Lag Screws (Inch Series).
 - .6 ASME B18.2.2-10, Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series).
- .3 ASTM International
 - .1 ASTM A 47/A 47M-99(2009), Standard Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A 53/A 53M-10, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
 - .3 ASTM A 536-84(2009), Standard Specification for Ductile Iron Castings.
 - .4 ASTM B 61-08, Standard Specification for Steam or Valve Bronze Castings.
 - .5 ASTM B 62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .6 ASTM E 202-10, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.
- .4 CSA International
 - .1 CSA B242-05(R2011), Groove and Shoulder Type Mechanical Pipe Couplings.
 - .2 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.
- .5 Manufacturer's Standardization of the Valve and Fittings Industry (MSS)
 - .1 MSS-SP-67-2002a, Butterfly Valves.
 - .2 MSS-SP-70-06, Gray Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS-SP-71-05, Gray Iron Swing Check Valves Flanged and Threaded Ends.
 - .4 MSS-SP-80-08, Bronze Gate, Globe, Angle and Check Valves.
 - .5 MSS-SP-85-02, Gray Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 10 00 – General Instructions.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for hydronic systems and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Indicate on drawings:

- .1 Components and accessories.

1.03 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 10 00 – General Instructions.
- .2 Operation and Maintenance Data: submit operation and maintenance data for hydronic systems for incorporation into manual.
 - .1 Include special servicing requirements.

1.04 EXTRA STOCK MATERIALS

- .1 Supply spare parts as follows:
 - .1 Valve seats: 1 minimum for every ten valves, each size. Minimum one.
 - .2 Discs: 1 minimum for every ten valves, each size. Minimum one.
 - .3 Stem packing: 1 minimum for every ten valves, each size. Minimum one.
 - .4 Valve handles: 2 minimum of each size.
 - .5 Gaskets for flanges: 1 minimum for every ten flanges.

1.05 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 10 00 – General Instructions and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect hydronic systems from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

2 PRODUCTS

2.01 PIPE

- .1 Steel pipe: to ASTM A 53/A 53M, Grade B, as follows:
 - .1 To NPS 6: Schedule 40.
 - .2 NPS 8 and over, 10.
 - .3 NPS 12 and over, 10 mm wall thickness.

2.02 PIPE JOINTS

- .1 NPS 2 and under: screwed fittings with PTFE tape or lead-free pipe dope.
- .2 NPS 2-1/2 and over: welding fittings and flanges to CSA W48.
- .3 Flanges: plain or raised face, slip-on weld neck to ANSI/AWWA C111/ A21.11.
- .4 Orifice flanges: slip-on raised face, 2100 kPa.
- .5 Flange gaskets: to ANSI/AWWA C111/ A21.11.
- .6 Pipe thread: taper.
- .7 Bolts and nuts: to ASME B18.2.1 and ASME B18.2.2.

2.03 FITTINGS

- .1 Screwed fittings: malleable iron, to ASME B16.3, Class 150.
- .2 Pipe flanges and flanged fittings:
 - .1 Cast iron: to ASME B16.1, Class 125.
 - .2 Steel: to ASME B16.5.
- .3 Butt-welding fittings: steel, to ASME B16.9.
- .4 Unions: malleable iron, to ASTM A 47/A 47M and ASME B16.3.

2.04 VALVES

- .1 Connections:
 - .1 NPS 2 and smaller: screwed ends.
 - .2 NPS 2-1/2 and larger: flanged ends.
- .2 Gate valves: to MSS-SP-70 to MSS-SP-80 application: isolating equipment, control valves, pipelines:
 - .1 NPS 2 and under:
 - .1 Mechanical Rooms: Class 125, rising stem, split wedge disc, as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 Elsewhere: Class 125, non- rising stem, solid wedge disc, as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 NPS 2-1/2 and over:
 - .1 Mechanical Rooms: rising stem, split wedge disc, lead free bronze trim, as specified Section 23 05 23.02 - Valves - Cast Iron.
 - .1 Operators: gear.
 - .2 Elsewhere: non- rising stem, solid wedge disc, lead free bronze trim, as specified Section 23 05 23.02 - Valves - Cast Iron.
 - .1 Gear.
- .3 Butterfly valves: to MSS-SP-67 application: isolating cells or section of multiple component equipment (i.e. multi-section coils, multi-cell cooling towers):
 - .1 NPS 2-1/2 and over: lug type: as specified Section 23 05 17 - Pipe Welding.
- .4 Globe valves: to MSS-SP- 80 85 application: throttling, flow control, emergency bypass:
 - .1 NPS 2 and under:
 - .1 Mechanical Rooms: with PTFE disc, as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 Elsewhere: globe, with composition disc, as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 NPS 2-1/2 and over:
 - .1 With composition lead free bronze disc, lead free bronze trim, as specified Section 23 05 23.02 - Valves - Cast Iron.
- .5 Balancing, for TAB:
 - .1 Sizes: calibrated balancing valves, as specified this section.
 - .2 NPS 2 and under:
 - .1 Mechanical Rooms: globe, with plug disc as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 Elsewhere: globe, with plug disc as specified Section 23 05 23.01 - Valves - Bronze.
- .6 Drain valves: Gate, Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 23.01 - Valves - Bronze.

- .7 Bypass valves on gate valves NPS 8 and larger: NPS 3/4, Globe, with PTFE disc as specified Section 23 05 23.01 - Valves - Bronze.
- .8 Swing check valves: to MSS-SP-71.
 - .1 NPS 2 and under:
 - .1 Class 125, swing, with composition disc, as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 NPS 2-1/2 and over:
 - .1 Flanged ends: as specified Section 23 05 23.02 - Valves - Cast Iron.
- .9 Silent check valves:
 - .1 NPS 2 and under:
 - .1 As specified Section 23 05 23.01 - Valves - Bronze.
 - .2 NPS 2-1/2 and over:
 - .1 Flanged ends: as specified Section 23 05 23.02 - Valves - Cast Iron.
- .10 Ball valves:
 - .1 NPS 2 and under: as specified Section 23 05 23.01 - Valves - Bronze.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for hydronic systems installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of NRC Project Manager.
 - .2 Inform NRC Project Manager of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from NRC Project Manager.

3.02 PIPING INSTALLATION

- .1 Install pipework in accordance with Section 23 05 05 - Installation of Pipe Work.

3.03 CIRCUIT BALANCING VALVES

- .1 Install flow measuring stations and flow balancing valves as indicated.
- .2 Remove handwheel after installation and when TAB is complete.
- .3 Tape joints in prefabricated insulation on valves installed in chilled water mains.

3.04 CLEANING, FLUSHING AND START-UP

- .1 In accordance with Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems.

3.05 TESTING

- .1 Test system in accordance with Section 21 05 01 - Common Work Results for Mechanical.
- .2 For glycol systems, retest with ethylene propylene glycol to ASTM E 202, inhibited, for use in building system after cleaning. Repair leaking joints, fittings or valves.

3.06 BALANCING

- .1 Balance water systems to within plus or minus 5 % of design output.

- .2 In accordance with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures.

3.07 GLYCOL CHARGING

- .1 Include mixing tank and positive displacement pump for glycol charging.
- .2 Retest for concentration to ASTM E 202 after cleaning.

3.08 PERFORMANCE VERIFICATION

- .1 In accordance with Section 23 08 01 - Performance Verification Mechanical Piping Systems.

3.09 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 10 00 – General Instructions.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 10 00 – General Instructions.

3.10 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by hydronic systems installation.

END OF SECTION

1 GENERAL

1.01 REFERENCES

- .1 ASME
 - .1 ASME Boiler and Pressure Vessel Code (BPVC), Section VII-2013.
- .2 ASTM International
 - .1 ASTM A 47/A 47M-99(2009), Standard Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A 278/A 278M-01(2011), Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F (350 degrees C).
 - .3 ASTM A 516/A 516M-10, Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.
 - .4 ASTM A 536-84(2009), Standard Specification for Ductile Iron Castings.
 - .5 ASTM B 62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .3 CSA Group
 - .1 CSA B51-09, Boiler, Pressure Vessel, and Pressure Piping Code.

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 10 00 – General Instructions.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for expansion tanks, air vents, separators, valves, and strainers and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

1.03 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 10 00 – General Instructions.
- .2 Operation and Maintenance Data: submit operation and maintenance data for hydronic specialties for incorporation into manual.
- .3 Submit four (4) copies of operation and maintenance manual.

1.04 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 10 00 – General Instructions and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect hydronic specialties from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

2 PRODUCTS

2.01 AUTOMATIC AIR VENT

- .1 Standard float vent: brass body and NPS 1/8 connection and rated at 690 kPa working pressure.
- .3 Float: solid material suitable for 115 degrees C working temperature.

2.02 AIR SEPARATOR - IN-LINE

- .1 Working pressure: 860 kPa.
- .2 Size: NPS 1 1/2 as indicated.

2.03 COMBINATION SEPARATORS/ STRAINERS

- .1 Steel, tested and stamped in accordance with ASME BPVC, for 860 kPa operating pressure, with galvanized steel integral strainer with 5 mm perforations, tangential inlet and outlet connections, and internal stainless steel air collector tube.

2.04 COMBINATION LOW PRESSURE RELIEF AND REDUCING VALVE

- .1 Adjustable pressure setting: 206 kPa relief, 55 to 172 kPa reducing.
- .2 Low inlet pressure check valve.
- .3 Removable strainer.

2.05 PIPE LINE STRAINER

- .1 NPS 1/2 to 2: bronze body to ASTM B 62, solder end or screwed connections, Y pattern.
- .2 NPS 2 1/2 to 12: cast steel body to ASTM A 278/A 278M, Class 30, cast iron body to ASTM A 278/A 278M, Class 30 flanged connections.
- .3 NPS 2 to 12: T type with ductile iron body to ASTM A 536 malleable iron body to ASTM A 47M, flanged.
- .4 Blowdown connection: NPS 1.
- .5 Screen: stainless steel with 1.19 mm perforations.
- .6 Working pressure: 860 kPa.

2.6 SUCTION DIFFUSER

- .1 Body: cast iron with screwed connections.
- .2 Strainer: with built-in, disposable 1.19 mm mesh, low pressure drop screen and NPS 1 blowdown connection.
- .3 Permanent magnet particle trap.
- .4 Full length straightening vanes.
- .5 Pressure gauge tappings.
- .6 Adjustable support leg.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for hydronic specialties installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of NRC Project Manager.
 - .2 Inform NRC Project Manager of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from NRC Project Manager.

3.02 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and data sheets.

3.03 GENERAL

- .1 Run drain lines and blow off connections to terminate above nearest drain.
- .2 Maintain adequate clearance to permit service and maintenance.
- .3 Should deviations beyond allowable clearances arise, request and follow NRC Project Manager Directive.
- .4 Check shop drawings for conformance of tapings for ancillaries and for equipment operating weights.

3.04 STRAINERS

- .1 Install in horizontal or down flow lines.
- .2 Ensure clearance for removal of basket.
- .3 Install ahead of each pump.
- .4 Install ahead of each automatic control valve larger than NPS 1 and radiation except at radiation and as indicated.

3.05 AIR VENTS

- .1 Install at high points of systems.
- .2 Install gate valve on automatic air vent inlet. Run discharge to nearest drain or service sink.

3.06 EXPANSION TANKS

- .1 Adjust expansion tank pressure as indicated to suit design criteria.
- .2 Install lockshield type valve at inlet to tank.

3.07 PRESSURE SAFETY RELIEF VALVES

- .1 Run discharge pipe to terminate above nearest drain.

3.08 SUCTION DIFFUSERS

- .1 Install on inlet to pumps having suction size greater than 50.

3.09 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 10 00 – General Instructions.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 10 00 – General Instructions.

END OF SECTION

1 GENERAL

1.01 REFERENCES

- .1 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 ANSI/ASHRAE/IES Standard 90.1-2010, Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 CSA Group
 - .1 CAN/CSA-B214-12, Installation Code for Hydronic Heating Systems.
- .3 Electrical Equipment Manufacturers Association of Canada (EEMAC)
- .4 National Electrical Manufacturers' Association (NEMA)
 - .1 NEMA MG 1-2011, Motors and Generators.

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 10 00 – General Instructions.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for pump, circulator, and equipment and include product characteristics, performance criteria, physical size, finish and limitations indicate point of operation, and final location in field assembly.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.

1.03 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 10 00 – General Instructions.
- .2 Operation and Maintenance Data: submit operation and maintenance data for hydronic pumps for incorporation into manual.
- .3 Submit four (4) copies of operation and maintenance manual.

1.04 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 10 00 – General Instructions and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect hydronic pumps from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

2 PRODUCTS

2.01 EQUIPMENT

- .1 Size and select components to: CAN/CSA-B214.

2.02 VERTICAL IN-LINE CIRCULATORS

- .1 Volute: cast iron radially split, with tapped openings for venting, draining and gauge connections, with screwed or flanged suction and discharge connections.
- .2 Impeller: Bronze.
- .3 Shaft: stainless steel with bronze sleeve bearing, integral thrust collar.
- .4 Seal assembly: mechanical for service to 135 degrees C.
- .5 Coupling: flexible rigid self-aligning.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for hydronic pump installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of NRC Project Manager.
 - .2 Inform NRC Project Manager of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from NRC Project Manager.

3.02 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and data sheets.

3.03 INSTALLATION

- .1 Install hydronic pumps to: CAN/CSA-B214.
- .2 In line circulators: install as indicated by flow arrows.
 - .1 Support at inlet and outlet flanges or unions.
 - .2 Install with bearing lubrication points accessible.
- .3 Base mounted type: supply templates for anchor bolt placement.
 - .1 Include anchor bolts with sleeves. Place level, shim unit and grout.
 - .2 Align coupling in accordance with manufacturers recommended tolerance.
 - .3 Check oil level and lubricate. After run-in, tighten glands.
- .4 Ensure that pump body does not support piping or equipment.
 - .1 Provide stanchions or hangers for this purpose.
 - .2 Refer to manufacturer's installation instructions for details.
- .5 Pipe drain tapping to floor drain.
- .6 Install volute venting pet cock in accessible location.

- .7 Check rotation prior to start-up.
- .8 Install pressure gauge test cocks.

3.04 START-UP

- .1 General:
 - .1 In accordance with manufacturer's recommendations.
- .2 Procedures:
 - .1 Before starting pump, check that cooling water system over-temperature and other protective devices are installed and operative.
 - .2 After starting pump, check for proper, safe operation.
 - .3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.
 - .4 Check base for free-floating, no obstructions under base.
 - .5 Run-in pumps for 12 continuous hours minimum.
 - .6 Verify operation of over-temperature and other protective devices under low- and no-flow condition.
 - .7 Eliminate air from scroll casing.
 - .8 Adjust water flow rate through water-cooled bearings.
 - .9 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.
 - .10 Adjust alignment of piping and conduit to ensure true flexibility.
 - .11 Eliminate cavitation, flashing and air entrainment.
 - .12 Adjust pump shaft seals, stuffing boxes, glands.
 - .13 Measure pressure drop across strainer when clean and with flow rates as finally set.
 - .14 Replace seals if pump used to degrease system or if pump used for temporary heat.
 - .15 Verify lubricating oil levels.

3.05 PERFORMANCE VERIFICATION (PV)

- .1 Verify that manufacturer's performance curves are accurate.
- .2 Ensure valves on pump suction and discharge provide tight shut-off.
- .3 Net Positive Suction Head (NPSH):
 - .1 Application: measure NPSH for pumps which operate on open systems and with water at elevated temperatures.
 - .2 Measure using procedures prescribed.
 - .3 Where procedures do not exist, discontinue PV, report to NRC Project Manager and await instructions.
- .4 Multiple Pump Installations - Series and Parallel:
 - .1 Repeat PV procedures specified above for pump performance and pump BHP for combinations of pump operations.
- .5 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.

3.06 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 10 00 – General Instructions.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 10 00 – General Instructions.

END OF SECTION

1 GENERAL

1.01 REFERENCES

- .1 ASME
 - .1 ASME Boiler and Pressure Vessel Code (BPVC), Section VII-[2013].
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 10 00 – General Instructions.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for [HVAC water treatment systems] and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit 2 copies of WHMIS MSDS. Indicate VOC's for adhesive and solvents during application and curing.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.03 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 10 00 – General Instructions.
- .2 Operation and Maintenance Data: submit operation and maintenance data for HVAC water treatment systems for incorporation into manual.
- .3 Include following:
 - .1 Log sheets as recommended NRC Project Manager.

1.05 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect HVAC water treatment systems from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

2 PRODUCTS

2.01 MANUFACTURER

- .1 Equipment, chemicals, and service provided by one supplier.

2.02 POT FEEDER

- .1 Welded steel, pressure rating 690 kPa. Temperature rating: 90 degrees C.

2.03 CHEMICAL FEED PIPING

- .1 Resistant to chemicals employed. Pressure rating: 690 kPa.

2.04 CHEMICAL FEED PUMPS

- .1 Electronic metering diaphragm type: flow range 0-100%, adjustable, plus or minus 1.0% accuracy (repetitive), on-off operation, with pressure relief valve, check valve, foot valve, injection fitting.
- .2 Piston type: flow range 0-100%, adjustable, plus or minus 1.0% accuracy (repetitive), on-off operation, with stainless steel piston, pressure relief valve, double ball and check valves.

2.05 CONDUCTIVITY CONTROLLER

- .1 Fully transistorized, suitable for wall or flush panel mounting, linear over full measuring range of 0-5000 microhms.
- .2 Insensitive to phase angle shifts, capable of operating on 95-130 Volts without affecting accuracy, power, bleedoff status lights.

2.06 CONDUCTIVITY PROBES

- .1 Dual carbon elements in PVC holder, quick disconnect, self-locking connection.

2.07 WATER TREATMENT FOR HYDRONIC SYSTEMS

- .1 Chilled water system: pot feeder, [25] L, operating pressure 690 kPa.
- .2 Micron filter for each pot feeder:
 - .1 Capacity 2% of pump recirculating rate at operating pressure.
 - .2 Six (6) sets of filter cartridges for each type, size of micron filter.

2.08 WATER TREATMENT FOR CONDENSER WATER SYSTEMS, SPRAY WATER SIDE OF CLOSED CIRCUIT COOLERS

- .1 Bleed-off solenoid and throttling valves.
- .2 Panel: EEMAC type 5 enclosure with enamel finish, pre-wired, following features:
 - .1 Internal wiring harness, colour-coded, identified, brought to central terminal board.
 - .2 Grounded AC receptacles for feed pumps and utility.
 - .3 Main power switch, indicating light, legend nameplate.
 - .4 Manual-auto selector switches, indicating lights for bleed-off control, chemical feed, with legend plates.
 - .5 Timers pulsed from water metre with contacting register to operate feed pumps.
 - .6 Conductivity controller with indicating metre to control bleed-off.
- .3 Flow assembly: consisting of conductivity probe mounted in flow-tee complete with isolating

valves.

- .4 Automatic flow switch: to shut down and re-start water treatment system on interruption of water flow.
- .5 Make-up water metre:
 - .1 .2 Size: NPS 12mm.
 - .3 Bronze, capacity to meet requirements, non-reset electric cumulative totalizer, electric contacting register.
- .6 Pot feeder:
 - .1 For addition of biocides.
 - .2 Capacity 7.5 L minimum, 1200 kPa max. WP.

2.09 CHEMICALS

- .1 Provide 1 years supply.
- .2 Obtain chemicals from manufacturer with existing valid contract.

2.10 TEST EQUIPMENT

- .1 Provide one set of test equipment for each system to verify performance.
- .2 Complete with carrying case, reagents for chemicals, specialized or supplementary equipment.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for HVAC water treatment systems installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of NRC Project Manager.
 - .2 Inform NRC Project Manager of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied [and after receipt of written approval to proceed from NRC Project Manager.

3.02 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.03 INSTALLATION

- .1 Install HVAC water treatment systems in accordance with ASME Boiler and Pressure Code Section VII, and requirements and standards of authorities having jurisdiction, except where specified otherwise.
- .2 Ensure adequate clearances to permit performance of servicing and maintenance of equipment.

3.04 CHEMICAL FEED PIPING

- .1 Install crosses at changes in direction. Install plugs in unused connections.

3.05 CLEANING OF MECHANICAL SYSTEM

- .1 Provide copy of recommended cleaning procedures and chemicals for approval by NRC Project Manager.
- .2 Flush mechanical systems and equipment with approved cleaning chemicals designed to remove deposition from construction such as pipe dope, oils, loose mill scale and other extraneous materials. Use chemicals to inhibit corrosion of various system materials that are safe to handle and use.
- .3 Examine and clean filters and screens, periodically during circulation of cleaning solution, and monitor changes in pressure drop across equipment.
- .4 Drain and flush system[s] until alkalinity of rinse water is equal to make-up water. Refill with clean water treated to prevent scale and corrosion during system operation.
- .5 Disposal of cleaning solutions approved by authority having jurisdiction.

3.06 FIELD QUALITY CONTROL

- .1 Start-up:
 - .1 Startup water treatment systems in accordance with manufacturer's instructions.
- .2 Commissioning:
 - .1 Commissioning Agency: to be holder of service contract.
 - .2 Timing:
 - .1 After start-up deficiencies rectified.
 - .2 After start-up and before TAB of connected systems.
 - .3 Pre-commissioning Inspections: verify:
 - .1 Presence of test equipment, reagents, chemicals, details of specific tests performed, and operating instructions.
 - .2 Suitability of log book.
 - .3 Currency and accuracy of [initial] water analysis.
 - .4 Required quality of treated water.
 - .4 Commissioning procedures - applicable to Water Treatment Systems:
 - .1 Establish, adjust as necessary and record automatic controls and chemical feed rates.
 - .2 Monitor performance continuously during commissioning of connected systems and until acceptance of project.
 - .3 Establish test intervals, regeneration intervals.
 - .4 Record on approved report forms commissioning procedures, test procedures, dates, times, quantities of chemicals added, raw water analysis, treated water analysis, test results, instrument readings, adjustments made, results obtained.
 - .5 Establish, monitor and adjust automatic controls and chemical feed rates as necessary.
 - .6 Visit project at specified intervals after commissioning is satisfactorily completed to verify that performance remains as set during commissioning (more often as required until system stabilizes at required level of performance).
 - .7 Advise NRC Project Manager in writing on matters regarding installed water treatment systems.
 - .5 Commissioning procedures - Water side of closed circuit coolers, Cooling Tower Systems:
 - .1 Verify operation of bleed-off system.
 - .2 Establish bleed-off flow rate.
 - .3 Establish rate of chemical feed - continual and periodic.
 - .4 Test system water for chlorides, TDS, suspended solids, algae, slime,

- inhibitor level, pH, alkalinity, hardness, other impurities and microbiological organisms.
- .5 Compare with readings of total dissolved and suspended solids metre.
- .6 Read make-up water metre, compare with chiller load summation (ton-hours).
- .7 Test make-up water for chlorides, hardness.
- .8 Compare test results with readings from TDS metre.
- .9 Record quantity of make-up water, compare with summation of chiller load (in ton-hours).
- .10 Record types, quantities of chemicals applied.
- .6 Commissioning procedures - Closed Circuit Hydronic Systems:
 - .1 Analyze water in system.
 - .2 Based upon an assumed rate of loss approved by NRC Project Manager, establish rate of chemical feed.
 - .3 Record types, quantities of chemicals applied.
- .7 Training:
 - .1 Commission systems, perform tests in presence of, and using assistance of, assigned O&M personnel.
 - .2 Train O&M personnel in softener regeneration procedures.
- .8 Certificates:
 - .1 Upon completion, furnish certificates confirming satisfactory installation and performance.
- .9 Commissioning Reports:
 - .1 To include system schematics, test results, test certificates, raw and treated water analyses, design criteria, other data required by NRC Project Manager.
- .11 Commissioning activities during Warranty Period:
 - .1 Check out water treatment systems on regular basis and submit written report to NRC Project Manager].

3.07 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 10 00 – General Instructions.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 10 00 – General Instructions.

END OF SECTION

1 GENERAL

1.01 REFERENCES

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
- .2 ASTM International
 - .1 ASTM A 480/A 480M-12, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - .2 ASTM A 635/A 635M-09b, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for.
 - .3 ASTM A 653/A 653M-11, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 Green Seal Environmental Standards (GS)
 - .1 GS-36-11, Standard for Adhesives for Commercial Use.
- .4 National Fire Protection Association (NFPA)
 - .1 NFPA 90A-12, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - .2 NFPA 90B-12, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
 - .3 NFPA 96-11, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .5 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2005.
 - .2 SMACNA HVAC Air Duct Leakage Test Manual, 2012.
 - .3 IAQ Guideline for Occupied Buildings Under Construction 2007.
- .6 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 10 00 – General Instructions.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for metal ducts and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .4 Test and Evaluation Reports:
 - .1 Certification of Ratings:
 - .1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

1.03 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect metal ducts from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan in accordance with Section 01 10 00 – General Instructions.

2 PRODUCTS

2.01 SEAL CLASSIFICATION

- .1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
500	C
250	C
125	C
125	Unsealed
- .2 Seal classification:
 - .1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.
 - .2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant tape or combination thereof.
 - .3 Class C: transverse joints and connections made air tight with gaskets sealant tape or combination thereof. Longitudinal seams unsealed.
 - .4 Unsealed seams and joints.

2.02 SEALANT

- .1 Sustainability Characteristics:
 - .1 Adhesives and sealants: VOC limit 30 g/L maximum to SCAQMD Rule 1168 GS-36.
- .2 Sealant: oil resistant, water borne, polymer type flame resistant duct sealant. Temperature range of minus 30 degrees C to plus 93 degrees C.

2.03 TAPE

- .1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.

2.04 DUCT LEAKAGE

- .1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual.

2.05 FITTINGS

- .1 Fabrication: to SMACNA.

- .2 Radiused elbows:
 - .1 Rectangular: standard radius, centreline radius: 1.5 times width of duct.
 - .2 Round: five piece, centreline radius: 1.5 times diameter.
- .3 Mitred elbows, rectangular:
 - .1 To 400 mm: with double thickness turning vanes.
 - .2 Over 400 mm: with double thickness turning vanes.
- .4 Branches:
 - .1 Rectangular main and branch: with radius on branch 1.5 times width of duct 45 degrees entry on branch.
 - .2 Round main and branch: enter main duct at 45 degrees with conical connection.
 - .3 Provide volume control damper in branch duct near connection to main duct.
 - .4 Main duct branches: with splitter damper.
- .5 Transitions:
 - .1 Diverging: 20 degrees maximum included angle.
 - .2 Converging: 30 degrees maximum included angle.
- .6 Offsets:
 - .1 Full radiused elbows as indicated.
- .7 Obstruction deflectors: maintain full cross-sectional area.
 - .1 Maximum included angles: as for transitions.

2.06 FIRE STOPPING

- .1 Retaining angles around duct, on both sides of fire separation in accordance with Section 07 84 00 - Fire Stopping.
- .2 Fire stopping material and installation must not distort duct.

2.07 GALVANIZED STEEL

- .1 Lock forming quality: to ASTM A 653/A 653M, Z90 zinc coating.
- .2 Thickness, fabrication and reinforcement: to ASHRAE and SMACNA.
- .3 Joints: to ASHRAE and SMACNA proprietary manufactured duct joint. Proprietary manufactured flanged duct joint to be considered to be a class A seal.

2.08 HANGERS AND SUPPORTS

- .1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
 - .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.
 - .1 Maximum size duct supported by strap hanger: 500.
 - .2 Hanger configuration: to ASHRAE and SMACNA.
 - .3 Hangers: galvanized steel angle with galvanized steel rods to ASHRAE and SMACNA following table:

<u>Duct Size</u> (mm)	<u>Angle Size</u> (mm)	<u>Rod Size</u> (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
<u>2401 and over</u>	<u>50 x 50 x 6</u>	<u>10</u>

- .4 Upper hanger attachments:
 - .1 For concrete: manufactured concrete inserts.
 - .2 For steel joist: manufactured joist clamp.
 - .3 For steel beams: manufactured beam clamps:

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for metal duct installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of NRC Project Manager.
 - .2 Inform NRC Project Manager of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from NRC Project Manager.

3.02 GENERAL

- .1 Do work in accordance with NFPA 90A, ASHRAE and SMACNA as indicated.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
 - .1 Insulate strap hangers 100 mm beyond insulated duct. Ensure diffuser is fully seated.
- .3 Support risers in accordance with ASHRAE and SMACNA as indicated.
- .4 Install breakaway joints in ductwork on sides of fire separation.
- .5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.
- .6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.

3.03 HANGERS

- .1 Strap hangers: install in accordance with SMACNA.
- .2 Angle hangers: complete with locking nuts and washers.
- .3 Hanger spacing: in accordance with ASHRAE and SMACNA as follows:

<u>Duct Size</u> (mm)	<u>Spacing</u> (mm)
to 1500	3000
<u>1501 and over</u>	<u>2500</u>

3.04 WATERTIGHT DUCT

- .1 Provide watertight duct for:
 - .1 Fresh air intake.
 - .2 Minimum 3000 mm from duct mounted humidifier in all directions.
 - .3 As indicated.
- .2 Form bottom of horizontal duct without longitudinal seams.
 - .1 Solder joints of bottom and side sheets.
 - .2 Seal other joints with duct sealer.
- .3 Slope horizontal branch ductwork down towards fume hoods served.
 - .1 Slope header ducts down toward risers.
- .4 Fit base of riser with 150 mm deep drain sump and 32 mm drain connected, with deep seal trap and valve trap primer and discharging to open funnel drain as indicated.

3.05 SEALING AND TAPING

- .1 Apply sealant in accordance with SMACNA and to manufacturer's recommendations.
- .2 Bed tape in sealant and recoat with minimum of 1 coat of sealant to manufacturers recommendations.

3.06 LEAKAGE TESTS

- .1 Refer to Section 23 05 94 - Pressure Testing of Ducted Air Systems.
- .2 In accordance with SMACNA HVAC Duct Leakage Test Manual.
- .3 Do leakage tests in sections.
- .4 Make trial leakage tests as instructed to demonstrate workmanship.
- .5 Do not install additional ductwork until trial test has been passed.
- .6 Test section minimum of 30 m long with not less than three branch takeoffs and two 90 degrees elbows.
- .7 Complete test before performance insulation or concealment Work.

3.07 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 10 00 – General Instructions.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 10 00 – General Instructions.

END OF SECTION

1 GENERAL

1.01 REFERENCES

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 2005.

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 10 00 – General Instructions.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for air duct accessories and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Indicate:
 - .1 Flexible connections.
 - .2 Duct access doors.
 - .3 Turning vanes.
 - .4 Instrument test ports.

1.03 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 10 00 – General Instructions and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect air duct accessories from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

2 PRODUCTS

2.01 GENERAL

- .1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.02 FLEXIBLE CONNECTIONS

- .1 Frame: galvanized sheet metal frame with fabric clenched by means of double locked seams.
- .2 Material:
 - .1 Fire resistant, self-extinguishing, neoprene coated glass fabric, temperature rated at minus 40 degrees C to plus 90 degrees C, density of 1.3 kg/mi.

2.03 ACCESS DOORS IN DUCTS

- .1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
- .2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness

heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.

- .3 Gaskets: neoprene.
- .4 Hardware:
 - .1 Up to 300 x 300 mm: two sash locks complete with safety chain.
 - .2 301 to 450 mm: four sash locks complete with safety chain.
 - .3 451 to 1000 mm: piano hinge and minimum two sash locks.
 - .4 Doors over 1000 mm: piano hinge and two handles operable from both sides.
 - .5 Hold open devices.
 - .6 300 x 300 mm glass viewing panels.

2.04 TURNING VANES

- .1 Factory or shop fabricated double thickness with trailing edge, to recommendations of SMACNA and as indicated.

2.05 INSTRUMENT TEST

- .1 1.6 mm thick steel zinc plated after manufacture.
- .2 Cam lock handles with neoprene expansion plug and handle chain.
- .3 28 mm minimum inside diameter. Length to suit insulation thickness.
- .4 Neoprene mounting gasket.

2.06 SPIN-IN COLLARS

- .1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.
- .2 Sheet metal thickness to co-responding round duct standards.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for air duct accessories installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of NRC Project Manager.
 - .2 Inform NRC Project Manager of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from NRC Project Manager.

3.02 INSTALLATION

- .1 Flexible Connections:
 - .1 Install in following locations:
 - .1 Inlets and outlets to supply air units and fans.
 - .2 Inlets and outlets of exhaust and return air fans.
 - .3 As indicated.
 - .2 Length of connection: 100 mm.
 - .3 Minimum distance between metal parts when system in operation: 75 mm.
 - .4 Install in accordance with recommendations of SMACNA.
 - .5 When fan is running:

- .1 Ducting on sides of flexible connection to be in alignment.
- .2 Ensure slack material in flexible connection.
- .2 Access Doors and Viewing Panels:
 - .1 Size:
 - .2 Locations:
 - .1 Fire and smoke dampers.
 - .2 Control dampers.
 - .3 Devices requiring maintenance.
 - .4 Required by code.
 - .5 Reheat coils.
 - .6 Elsewhere as indicated.
- .3 Instrument Test Ports:
 - .1 General:
 - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
 - .2 Locate to permit easy manipulation of instruments.
 - .3 Install insulation port extensions as required.
 - .4 Locations:
 - .1 For traverse readings:
 - .1 Ducted inlets to roof and wall exhausters.
 - .2 Inlets and outlets of other fan systems.
 - .3 Main and sub-main ducts.
 - .4 And as indicated.
 - .2 For temperature readings:
 - .1 At outside air intakes.
 - .2 In mixed air applications in locations as approved by NRC Project Manager.
 - .3 At inlet and outlet of coils.
 - .4 Downstream of junctions of two converging air streams of different temperatures.
 - .5 And as indicated.
- .4 Turning Vanes:
 - .1 Install in accordance with recommendations of SMACNA and as indicated.

3.03 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 10 00 – General Instructions.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 10 00 – General Instructions.

END OF SECTION

1 GENERAL

1.01 REFERENCES

- .1 Sheet Metal and Air Conditioning National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible-2013.

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 10 00 – General Instructions.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for dampers and include product characteristics, performance criteria, physical size, finish and limitations.

1.03 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 10 00 – General Instructions.
- .2 Operation and Maintenance Data: submit operation and maintenance data for dampers for incorporation into manual.

1.05 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 10 00 – General Instructions and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

2 PRODUCTS

2.01 GENERAL

- .1 Manufacture to SMACNA standards.

2.02 SPLITTER DAMPERS

- .1 Fabricate from same material as duct but one sheet metal thickness heavier, with appropriate stiffening.
- .2 Double thickness construction.
- .3 Control rod with locking device and position indicator.
- .4 Rod configuration to prevent end from entering duct.
- .5 Pivot: piano hinge.
- .6 Folded leading edge.

2.03 SINGLE BLADE DAMPERS

- .1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove

stiffened.

- .2 Size and configuration to recommendations of SMACNA, except maximum height 100 mm.
- .3 Locking quadrant with shaft extension to accommodate insulation thickness.
- .4 Inside and outside nylon end bearings.
- .5 Channel frame of same material as adjacent duct, complete with angle stop.

2.04 MULTI-BLADED DAMPERS

- .1 Factory manufactured of material compatible with duct.
- .2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.
- .3 Maximum blade height: 100 mm.
- .4 Bearings: self-lubricating nylon.
- .5 Linkage: shaft extension with locking quadrant.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for damper installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of NRC Project Manager.
 - .2 Inform NRC Project Manager of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from NRC Project Manager.

3.02 INSTALLATION

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .3 Locate balancing dampers in each branch duct, for supply, return and exhaust systems.
- .4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.
- .5 Dampers: vibration free.
- .6 Ensure damper operators are observable and accessible.
- .7 Corrections and adjustments conducted by NRC Project Manager.

3.03 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 10 00 – General Instructions.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 10 00 – General Instructions.

END OF SECTION

1 GENERAL

1.01 REFERENCES

- .1 ASTM International
 - .1 ASTM A 653/A 653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 10 00 – General Instructions.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for dampers and include product characteristics, performance criteria, physical size, finish and limitations.

1.03 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 10 00 – General Instructions.
- .2 Operation and Maintenance Data: submit operation and maintenance data for dampers for incorporation into manual.

1.04 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 10 00 – General Instructions and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect dampers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

2 PRODUCTS

2.01 MULTI-LEAF DAMPERS

- .1 Opposed blade type as indicated.
- .2 Structurally formed steel or extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, structurally formed and welded galvanized steel or extruded aluminum frame.
- .3 Pressure fit self-lubricated bronze bearings.
- .4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.
- .6 Performance:
 - .1 Leakage: in closed position less than 2% of rated air flow at 500 Pa differential across

damper.

- .7 Insulated aluminum dampers:
 - .1 Frames: insulated with extruded polystyrene foam with RSI 0.88.
 - .2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, RSI 0.88.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for damper installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of NRC Project Manager.
 - .2 Inform NRC Project Manager of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from NRC Project Manager.

3.02 INSTALLATION

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.
- .3 Seal multiple damper modules with silicon sealant.
- .4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.
- .5 Ensure dampers are observable and accessible.

3.03 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 10 00 – General Instructions.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 10 00 – General Instructions.

END OF SECTION

1 GENERAL

1.01 REFERENCES

- .1 National Fire Protection Association (NFPA)
 - .1 NFPA 90A-12, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .2 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S112-10, Standard Test Method of Fire Test of Fire Damper Assemblies.
 - .2 CAN/ULC-S112.2-07, Standard Method of Fire Test of Ceiling Fire Stop Flap Assemblies.
 - .3 ULC-S505-1974, Standard for Fusible Links for Fire Protection Service.

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 10 00 – General Instructions.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for fire and smoke dampers and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Indicate the following:
 - .1 Fire dampers.
 - .2 Smoke dampers.
 - .3 Fire stop flaps.
 - .4 Operators.
 - .5 Fusible links.
 - .6 Design details of break-away joints.
- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.03 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 10 00 – General Instructions.
- .2 Operation and Maintenance Data: submit operation and maintenance data for fire and smoke dampers for incorporation into manual.

1.04 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
 - .1 Submit maintenance materials in accordance with Section 01 10 00 – General Instructions.
 - .2 Provide:
 - .1 6 fusible links of each type.

1.05 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 10 00 – General Instructions and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect fire and smoke dampers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

2 PRODUCTS

2.01 FIRE DAMPERS

- .1 Fire dampers: arrangement Type A, B and C, listed and bear label of ULC, meet requirements of provincial fire authority Fire Commissioner of Canada (FCC) CFFM and NFPA 90A authorities having jurisdiction. Fire damper assemblies' fire tested in accordance with CAN/ULC-S112.
- .2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
 - .1 Fire dampers: 1-1/2 hour fire rated unless otherwise indicated.
 - .2 Fire dampers: automatic operating type and have dynamic rating suitable for maximum air velocity and pressure differential to which it will be subjected.
- .3 Top hinged: offset single damper, round or square; multi-blade hinged or interlocking type; roll door type; guillotine type; sized to maintain full duct cross section as indicated.
- .4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.
- .5 40 x 40 x 3 mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.
- .6 Equip fire dampers with steel sleeve or frame installed disruption ductwork or impair damper operation.
- .7 Equip sleeves or frames with perimeter mounting angles attached on both sides of wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform to ULC.
- .8 Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.
- .9 Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition of floor slab depth or thickness.
- .10 Unless otherwise indicated, the installation details given in SMACNA Install Fire Damp HVAC and in manufacturer's instructions for fire dampers shall be followed.

2.02 FIRE STOP FLAPS

- .1 Fire smoke flaps: ULC listed and labelled and fire tested in accordance with CAN/ULC-S112.2.
- .2 Construct of minimum 1.5 mm thick sheet steel with 1.6 mm thick non-asbestos ULC listed insulation and corrosion-resistant pins and hinges.
- .3 Flaps held open with fusible link conforming to ULC-S505 and close at 74 degrees C or as indicated.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for fire and smoke damper installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of NRC Project Manager.
 - .2 Inform NRC Project Manager of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from NRC Project Manager.

3.02 INSTALLATION

- .1 Install in accordance with NFPA 90A and in accordance with conditions of ULC listing.
- .2 Maintain integrity of fire separation.
- .3 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.
- .4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.
- .5 Co-ordinate with installer of fire stopping.
- .6 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.
- .7 Install break-away joints of approved design on each side of fire separation.

3.03 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 10 00 – General Instructions.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 10 00 – General Instructions.

END OF SECTION

1 GENERAL

1.01 REFERENCES

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE)
- .2 National Fire Protection Association (NFPA)
 - .1 NFPA 90A-12, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - .2 NFPA 90B-12, Standard for Installation of Warm Air Heating and Air-Conditioning Systems.
- .3 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2005.
 - .2 SMACNA IAQ Guideline for Occupied Buildings under Construction, 2005.
- .4 Underwriters' Laboratories (UL)
 - .1 UL 181-2005, Standard for Factory-Made Air Ducts and Air Connectors.
- .5 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S110-2007, Standard Methods of Tests for Air Ducts.

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 10 00 – General Instructions.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for flexible ducts and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Indicate:
 - .1 Thermal properties.
 - .2 Friction loss.
 - .3 Acoustical loss.
 - .4 Leakage.
 - .5 Fire rating.
- .3 Test and Evaluation Reports:
 - .1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

1.03 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 10 00 – General Instructions and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect flexible ducts from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

2 PRODUCTS

2.01 GENERAL

- .1 Factory fabricated to CAN/ULC-S110.
- .2 Pressure drop coefficients listed below are based on relative sheet metal duct pressure drop coefficient of 1.00.
- .3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

2.02 METALLIC - UNINSULATED

- .1 Type 1: spiral wound flexible aluminum, as indicated.
- .2 Performance:
 - .1 Factory tested to 2.5 kPa without leakage.
 - .2 Maximum relative pressure drop coefficient: 3.

2.03 METALLIC - INSULATED

- .1 Type 2: spiral wound flexible aluminum with factory applied, 37 mm thick flexible glass fibre thermal insulation with vapour barrier and aluminum jacket, as indicated.
- .2 Performance:
 - .1 Factory tested to 2.5 kPa without leakage.
 - .2 Maximum relative pressure drop coefficient: 3.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for flexible ducts installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of NRC Project Manager.
 - .2 Inform NRC Project Manager of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from NRC Project Manager.

3.02 DUCT INSTALLATION

- .1 Install in accordance with: CAN/ULC-S110, UL 181, NFPA 90A, NFPA 90B and SMACNA.

3.03 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 10 00 – General Instructions.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 10 00 – General Instructions.

END OF SECTION

1 GENERAL

1.01 REFERENCES

- .1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)
 - .1 ANSI/AMCA Standard 99-2010, Standards Handbook.
 - .2 ANSI/AMCA Standard 210-2007/(ANSI/ASHRAE 51-07), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
 - .3 ANSI/AMCA Standard 300-2008, Reverberant Room Method for Sound Testing of Fans.
 - .4 ANSI/AMCA Standard 301-1990, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .2 The Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual - current edition.
 - .1 MPI #18, Primer, Zinc Rich, Organic.

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 10 00 – General Instructions.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for HVAC fans and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Provide:
 - .1 Fan performance curves showing point of operation, bhp kW and efficiency.
 - .2 Sound rating data at point of operation.
 - .3 Indicate:
 - .1 Motors, sheaves, bearings, shaft details.
 - .2 Minimum performance achievable with variable speed controllers.

1.03 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
 - .1 Submit in accordance with Section 01 10 00 – General Instructions.
 - .1 Provide:
 - .1 Matched sets of belts.
 - .2 Furnish list of individual manufacturer's recommended spare parts for equipment, include:
 - .1 Bearings and seals.
 - .2 Addresses of suppliers.
 - .3 List of specialized tools necessary for adjusting, repairing or replacing.

1.04 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 10 00 – General Instructions and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging,

labelled with manufacturer's name and address.

- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect HVAC fans from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

2 PRODUCTS

2.01 SYSTEM DESCRIPTION

- .1 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.
 - .2 Capacity: flow rate, total static pressure, bhp W, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.
 - .3 Fans: statically and dynamically balanced, constructed in conformity with ANSI/AMCA Standard 99.
 - .4 Sound ratings: comply with ANSI/AMCA Standard 301, tested to ANSI/AMCA Standard 300. Supply unit with ANSI/AMCA certified sound rating seal.
 - .5 Performance ratings: based on tests performed in accordance with ANSI/AMCA Standard 210. Supply unit with ANSI/AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.

2.02 FANS GENERAL

- .1 Motors:
 - .1 In accordance with Section 23 05 13 - Common Motors Requirements for HVAC Equipment -supplemented as specified herein.
 - .2 For use with variable speed controllers.
 - .3 Sizes as indicated.
- .2 Accessories and hardware: matched sets of V-belt drives, adjustable slide rail motor bases, belt guards, coupling guards fan inlet and outlet safety screens as indicated and as specified in Section 23 05 13 - Common Motor Requirements for HVAC Equipment, inlet outlet dampers and vanes and as indicated.
- .3 Factory primed before assembly in colour standard to manufacturer.
- .4 Scroll casing drains: as indicated.
- .5 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.
- .6 Vibration isolation: to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- .7 Flexible connections: to Section 23 33 00 - Air Duct Accessories.

2.07 IN-LINE CENTRIFUGAL FANS

- .1 Characteristics and construction: as for centrifugal fan wheels, with axial flow construction and belt drive.
- .2 Provide AMCA arrangements 1 or 9 as indicated with stiffened flanges, smooth rounded inlets,

and stationary guide vanes.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for HVAC fans installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of NRC Project Manager.
 - .2 Inform NRC Project Manager of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from NRC Project Manager.

3.02 FAN INSTALLATION

- .1 Install fans as indicated, complete with resilient mountings specified in Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment, flexible electrical leads and flexible connections in accordance with Section 23 33 00 - Air Duct Accessories.
- .2 Provide sheaves and belts required for final air balance.
- .3 Bearings and extension tubes to be easily accessible.
- .4 Access doors and access panels to be easily accessible.

3.03 ANCHOR BOLTS AND TEMPLATES

- .1 Size anchor bolts to withstand seismic acceleration and velocity forces as specified.

3.04 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 10 00 – General Instructions.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 10 00 – General Instructions.

END OF SECTION

1 GENERAL

1.01 REFERENCES

- .1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)
 - .1 ANSI/AMCA Standard 210-2007/(ANSI/ASHRAE 51-07), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .2 International Organization of Standardization (ISO)
 - .1 ISO 3741-2010, Acoustics-Determination of Sound Power Levels of Noise Sources Using Sound Pressure - Precision Methods for Reverberation Rooms.
- .3 National Fire Protection Association (NFPA)
 - .1 NFPA 90A-12, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .4 Underwriter's Laboratories (UL)
 - .1 UL 181-2005(R2008), Factory-Made Air Ducts and Air Connectors.

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 10 00 – General Instructions.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for air terminal units and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Indicate the following:
 - .1 Capacity.
 - .2 Pressure drop.
 - .3 Noise rating.
 - .4 Leakage.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Test and Evaluation Reports:
 - .1 Test data: to ANSI/AMCA Standard 210.
 - .1 Submit published test data on DIN (Direct Internal Noise), in accordance with ISO 3741 made by independent testing agency for 0, 2.5 and 6 m/s branch velocity or inlet velocity.
 - .2 Sound power level with minimum inlet pressure of 0.5 kPa in accordance with ISO 3741 for 2nd through 7th octave band, also made by independent testing agency.
 - .3 Pressure loss through silencer shall not exceed 60% of inlet velocity pressure maximum.

1.03 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 10 00 – General Instructions.
- .2 Operation and Maintenance Data: submit operation and maintenance data for air terminal

units for incorporation into manual.

1.04 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 10 00 – General Instructions and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect air terminal units from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

2 PRODUCTS

2.01 SYSTEM DESCRIPTION

- .1 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from certified ADC (Air Diffusion Council) testing agency signifying adherence to codes and standards.

2.02 MANUFACTURED UNITS

- .1 Terminal units of the same type to be product of one manufacturer.

2.04 ELECTRONIC VARIABLE AIR VOLUME BOXES

- .1 Pressure independent, reset to air flow between zero and maximum air volume.
- .2 At inlet velocity of 10 m/s, differential static pressure for unit with attenuator section not to exceed 25 Pa.
- .3 Sound ratings of assembly not to exceed 35 NC at 375 Pa.
- .4 Air velocity sensor resistance wire or pitot rack as standard to manufacturer.
- .5 Signals between temperature sensing device, velocity controller, velocity sensor and damper actuator digital as indicated. Shielded or twisted wire requirements is not acceptable.
- .6 Electronic thermostat furnished by terminal unit manufacturer and have set points and velocity adjustments located in thermostat. Heating and cooling set point range 13 to 30 degrees C. Set points not overlapping.
- .7 Electronic control package factory calibrated and set at factory. Features to accommodate field calibration and readjustment of air volume settings to include:
 - .1 Metre taps for balancing with digital DC voltmeter.
 - .2 Adjustable flow settings at thermostat.
- .8 Factory installed 20 VA transformer, 115 V to 24 V. Power consumption of terminal not to exceed 15 VA.
- .9 Terminal unit to be CSA certified.

- .10 Casing: 22 ga galvanized steel, internally lined with 25 mm. 0.7 kg density fibrous glass, to UL 181 and NFPA 90A. Mount control components inside protective metal shroud.
- .11 Peripheral gasket and self-lubricating bearings. Air leakage past closed damper not to exceed 2% of nominal rating at 750 Pa inlet static pressure, in accordance with Air Diffusion Council test procedure.
- .12 Sizes and capacity: as indicated.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for air terminal unit's installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of NRC Project Manager.
 - .2 Inform NRC Project Manager of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from NRC Project Manager.

3.02 INSTALLATION

- .1 Install in accordance with manufacturers recommendations.
- .2 Support independently of ductwork.
- .3 Install with at least 1000 mm of flexible inlet ducting and minimum of four duct diameters of straight inlet duct, same size as inlet.
- .4 Locate controls, dampers and access panels for easy access.

3.03 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 10 00 – General Instructions.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 10 00 – General Instructions.

END OF SECTION

1 GENERAL

1.01 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 10 00 – General Instructions.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for diffusers, registers and grilles and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Indicate following:
 - .1 Capacity.
 - .2 Throw and terminal velocity.
 - .3 Noise criteria.
 - .4 Pressure drop.
 - .5 Neck velocity.

1.03 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 10 00 – General Instructions and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect diffuser, registers and grilles from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

2 PRODUCTS

2.01 SYSTEM DESCRIPTION

- .1 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

2.02 GENERAL

- .1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.
- .2 Frames:
 - .1 Full perimeter gaskets.
 - .2 Plaster frames where set into plaster or gypsum board and as specified.
 - .3 Concealed fasteners.
- .3 Concealed manual volume control damper operators.
- .4 Colour: standard.

2.03 MANUFACTURED UNITS

- .1 Grilles, registers and diffusers of same generic type, products of one manufacturer.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for diffuser, register and grille installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of NRC Project Manager.
 - .2 Inform NRC Project Manager of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from NRC Project Manager.

3.02 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
- .2 Install with flat head oval head stainless steel cadmium plated screws in countersunk holes where fastenings are visible.
- .3 Bolt grilles, registers and diffusers, in place, in gymnasium and similar game rooms.
- .4 Provide concealed safety chain on each grille, register and diffuser in gymnasium and similar game rooms and elsewhere as indicated.

3.03 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 10 00 – General Instructions.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 10 00 – General Instructions.

END OF SECTION

1 GENERAL

1.01 REFERENCES

- .1 ASTM International
 - .1 ASTM E 90-09, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .2 National Fire Protection Association (NFPA)
 - .1 NFPA 96-11, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
- .4 Society of Automotive Engineers (SAE)

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 10 00 – General Instructions.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for louvers, intakes and vents and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Indicate following:
 - .1 Pressure drop.
 - .2 Face area.
 - .3 Free area.
- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Test Reports: submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E 90.

1.03 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 10 00 – General Instructions and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect louvers, intakes and vents from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

2 PRODUCTS

2.01 SYSTEM DESCRIPTION

- .1 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried

out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

2.02 FIXED LOUVRES - ALUMINUM

- .1 Louver frames shall be extruded mill finish aluminum (6063-T5).
 - .1 Louvers with 4" (101.6mm) frames shall not be less than 0.072" (1.83mm) in thickness.
- .2 Louvers frame style shall be Channel (U-frame) type or Exterior Flange (L-frame) style. (Specify one.)
- .3 Louver blades shall be extruded mill finish aluminum (6063-T5) and shall be fixed at a 45° angle. Intake louvers shall have a center baffle (K type) blade to resist water intake. Exhaust louvers shall have a flat (J type) blade for lower pressure drop.
 - .1 4" (101.6mm) blade profiles and shall not be less than .071" (1.80mm) in thickness.
- .4 Louvers shall be mullion style or continuous blade style, as indicated on the plans.
- .5 Screens to be constructed as follows: (Specify one.)
 - .1 Standard bird screen shall be .5" x .5" x .032" (12.7mm x 12.7mm x .81mm) galvanized steel wire mesh, complete with frame and installed by the manufacturer.
- .6 Louvers shall be made to size required.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for louvres, intakes and vents installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of NRC Project Manager.
 - .2 Inform NRC Project Manager of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from NRC Project Manager.

3.02 INSTALLATION

- .1 In accordance with manufacturer's and SMACNA recommendations.
- .2 Reinforce and brace as indicated.
- .3 Anchor securely into opening. Seal with caulking to ensure weather tightness.

3.03 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 10 00 – General Instructions.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 10 00 – General Instructions.

END OF SECTION

1 GENERAL

1.01 REFERENCES

- .1 American National Standard Institute (ANSI)/American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
 - .1 ANSI/ASHRAE 52.2-12, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particulate Size (ANSI approved).
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-115.10-M90, Disposable Air Filters for the Removal of Particulate Matter from Ventilating Systems.
 - .2 CAN/CGSB-115.11-M85, Filters, Air, High Efficiency, Disposable, Bag Type.
 - .3 CAN/CGSB-115.12-M85, Filters, Air, Medium Efficiency, Disposable, Bag Type.
 - .4 CAN/CGSB-115.13-85, Filter Media, Automatic Roll.
 - .5 CAN/CGSB-115.14-M91, High Efficiency Cartridge Type Supported Air Filters for the Removal of Particulate Matter from Ventilating Systems.
 - .6 CAN/CGSB-115.15-M91, High Efficiency Rigid Type Air Filters for Removal of Particulate Matter from Ventilating Systems.
 - .7 CAN/CGSB-115.16-M82, Activated Carbon for Odor Removal from Ventilating Systems.
 - .8 CAN/CGSB-115.18-M85, Filter, Air, Extended Area Panel Type, Medium Efficiency.
 - .9 CAN/CGSB-115.20-95, Polarized Media Air Filter.
- .3 International Organization of Standardization (ISO)
 - .1 ISO 14644-1-99, Clean Rooms and Associated Controlled Environments - Part 1: Classification of Air Cleanliness.
- .4 National Fire Protection Association (NFPA)
 - .1 NFPA 96-11, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .5 Underwriters' Laboratories of Canada (ULC)
 - .1 ULC -S111-07, Standard Method of Fire Tests for Air Filter Units.
 - .2 ULC-S646-06, Exhaust Hoods and Related Controls for Commercial and Institutional Kitchens.
- .6 US Department of Defense - Test Method Standard
 - .1 MIL-STS-282-95, Filter Units, Protective Clothing, Gas-Mask Components and Related Products; Performance Test Methods.

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 10 00 – General Instructions.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for HVAC filters and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.03 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 10 00 – General Instructions.
 - .2 Furnish list of individual manufacturer's recommended spare parts for equipment such as frames and filters, addresses of suppliers, list of specialized tools necessary for adjusting, repairing or replacing for inclusion in operating manual.
 - .3 Spare filters: in addition to filters installed immediately prior to acceptance by NRC Project Manager, supply 1 complete set of filters for each.

1.04 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 10 00 – General Instructions and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect HVAC filters from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

2 PRODUCTS

2.01 GENERAL

- .1 Media: suitable for air at 100% RH and air temperatures between -40 and 50 degrees C.
- .2 Number of units, size and thickness of panels, overall dimensions of filter bank, configuration and capacities: as indicated.
- .3 Pressure drop when clean and dirty, sizes and thickness: as indicated on schedule.

2.02 ACCESSORIES

- .1 Holding frames: permanent "T" section or channel section construction of galvanized steel or extruded aluminum same material as casing/hood, 1.6 mm thick, except where specified.
- .2 Seals: to ensure leakproof operation.
- .3 Blank-off plates: as required, to fit all openings and of same material as holding frames.
- .4 Access and servicing: through doors/panels on each side and/or from upstream downstream face of filter bank.

2.03 CARTRIDGE TYPE FILTERS 95% EFFICIENCY

- .1 Media: disposable, high efficiency, according to DWG Schedule.
- .2 Holding frame: galvanized steel with bracing.
- .3 Media support: welded wire grid.
- .4 Performance: average atmospheric dust spot efficiency 95% to ANSI/ASHRAE 52.2.

- .5 Fire rated: to ULC-S111.

2.04 FILTER GAUGES - DIAL TYPE

- .1 Diaphragm actuated, direct reading.
- .2 Range: 0 to 2 times initial pressure 0 to 250 Pa.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for filter installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of NRC Project Manager.
 - .2 Inform NRC Project Manager of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from NRC Project Manager.

3.02 INSTALLATION GENERAL

- .1 Install in accordance with manufacturer's recommendations and with adequate space for access, maintenance and replacement.

3.03 REPLACEMENT MEDIA

- .1 Replace media with new upon acceptance.
- .2 Filter media new and clean, as indicated by pressure gauge, at time of acceptance.

3.04 FILTER GAUGES

- .1 Install type as indicated across each filter bank (pre-filter and final filter) in approved and easy readable location.
- .2 Mark each filter gauge with value of pressure drop for clean condition and manufacturer's recommended replacement (dirty) value.

3.05 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 10 00 – General Instructions.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 10 00 – General Instructions.

END OF SECTION

1 GENERAL

1.01 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME Boiler and Pressure Vessel Code, 2010.
- .2 CSA International
 - .1 CSA B51-09, Boiler, Pressure Vessel, and Pressure Piping Code.

1.02 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Meetings:
 - .1 Convene pre-installation meeting 1 week prior to beginning work of this Section and on-site installation, with NRC Project Manager in accordance with Section 01 10 00 – General Instructions to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review manufacturer's written installation instructions and warranty requirements.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit submittals in accordance with Section 01 10 00 – General Instructions.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for heat exchangers and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Shop drawings to indicate project layout, including layout and dimensions of heat exchangers and system.
 - .1 Indicate manufacturer's recommended clearances for tube withdrawal and manipulation of tube cleaning tools.
- .4 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .5 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .6 Manufacturer's Instructions: submit manufacturer's installation instructions.
- .7 Manufacturers Reports:
 - .1 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

1.04 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 10 00 – General Instructions.

- .2 Operation and Maintenance Data: submit operation and maintenance data for heat exchangers for incorporation into manual.

1.06 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 10 00 – General Instructions and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect heat exchangers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

2 PRODUCTS

2.01 EQUIPMENT

- .1 Plate Heat Exchanger:
 - .1 Water to water.
 - .1 Designed, constructed and tested in with accordance ASME Boiler and Pressure Vessel Code CSA B51 and provincial pressure vessel regulations.
 - .2 Frames: carbon steel with baked epoxy enamel paint, stainless steel side bolts and shroud.
 - .3 Plates: type 304 stainless steel.
 - .4 Gaskets: as recommended by manufacturer to suit fluid temperature nitrile rubber.
 - .5 Nozzles: ASA rubber rated flange type.
 - .6 Supports: as indicated.
 - .7 Piping connections: as indicated.
 - .8 Capacity: as indicated.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for heat exchanger installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of NRC Project Manager.
 - .2 Inform NRC Project Manager of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from NRC Project Manager.

3.02 INSTALLATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- .2 General: install level and firmly anchored to supports as indicated in accordance with manufacturer's recommendations.

- .3 Plate exchangers: install in accordance with manufacturer's recommendations.

3.03 APPURTENANCES

- .1 Install with vacuum breaker and hose bib drain valve.
- .2 Install thermometer wells with thermometers on inlet and outlet of primary and secondary side.
- .3 Install pressure gauge on steam inlet.

3.04 FIELD QUALITY CONTROL

- .1 Site Tests and Inspections:
 - .1 Perform tests as directed by NRC Project Manager to ensure heat exchangers are functional.
 - .2 Obtain reports within 3 days of review and submit immediately to NRC Project Manager.
- .2 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product.
- .3 Manufacturer's Field Services:
 - .1 Submit manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .2 Ensure manufacturer's representative is present before and during critical periods of installation construction of field joints and testing.
 - .3 Schedule site visits:
 - .1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.

3.05 SYSTEM START-UP

- .1 Check heater for cleanliness on primary and secondary sides.
- .2 Check water treatment system is complete, operational and correct treatment is being applied.
- .3 Check installation, settings, operation of relief valves and safety valves.
- .4 Check installation, location, settings and operation of operating, limit and safety controls.
- .5 Check supports, seismic restraint systems.
- .6 Timing: only after TAB of hydronic systems have been successfully completed.
- .7 Primary side:
 - .1 Measure flow rate, pressure drop, and water temperature at inlet and outlet.
 - .1 Verify operation of steam traps. Measure temperature of condensate return at trap outlet.
 - .2 Secondary side:
 - .1 Measure flow rate, pressure drop and water temperature inlet and outlet.
 - .2 Verify installation and operation of air elimination devices.
 - .3 Calculate heat transfer from primary and secondary sides.
 - .4 Simulate heating water temperature schedule and repeat above procedures.
 - .5 Verify settings, operation, safe discharge from safety valves and relief valves.
 - .6 Verify settings, operation of operating, limit and safety controls and alarms.

3.06 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 10 00 – General Instructions.
 - .1 Leave Work area clean at end of each day.
 - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 10 00 – General Instructions.

3.08 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by heat exchanger installation.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Air-Conditioning and Refrigeration Institute (ARI)
 - .1 ARI-550/590-98, Standard for Water Chilling Packages Using the Vapor Compression Cycle.
- .2 ASTM International Inc.
 - .1 ASTM C547-07e1, Standard Specification for Mineral Fiber Pipe Insulation.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA B52-05 SMART, Mechanical Refrigeration Code.
- .4 Environment Canada, EC/Environmental Protection Services (EPS)
 - .1 EPS 1/RA/2-1996, Environmental Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 23 05 01 Common Work Results - Mechanical.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for chillers, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Indicate:
 - .1 Equipment including connections, piping and fittings, valves, strainers, control assemblies and ancillaries, identifying factory and field assembled.
 - .2 Wiring as assembled and schematically.
 - .3 Dimensions, construction details, recommended installation and support, mounting bolt hole sizes and locations and point loads.
 - .4 Type of refrigerant used.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 23 05 01 Common Work Results - Mechanical.
- .2 Data to include:
 - .1 Description of equipment giving manufacturers name, model type and year, capacity and serial numbers.
 - .2 Provide part load performance curves.
 - .3 Details on operation, servicing and maintenance.
 - .4 Recommended spare parts list.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 23 05 01 Common Work Results – Mechanical.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

Part 2 Products

2.1 GENERAL

- .1 Provide complete water cooled scroll compressor chiller package including: compressors; evaporator; condenser, motor and motor starter; controls; control centre; piping; wiring; refrigeration and oil charge; ready for connection to chilled water circuit and condenser water circuit interlocks, and electric power source, installed in welded steel frame with heavy gauge panels and access doors finished to manufacturers standard.

2.2 CAPACITY

- .1 Certified ratings based on ARI 550/590: Capacity as indicated in drawing schedule.

2.3 COMPRESSOR

- .1 The compressors shall be sealed hermetic scroll type with crankcase oil heater and suction strainer. The compressor motor shall be refrigerant gas cooled, high torque, hermetic induction type, and two-pole, with inherent thermal protection on all three phases and shall be mounted on RIS vibration isolator pads.
- .2 Capacity control is achieved by compressor cycling with a minimum of 4 stages of control. Compressors will automatically pump refrigerant down at the end of each cycle.
 - .1 Lead/lag automatically by compressor number of starts.
 - .2 Each refrigerant circuit to have a manual refrigerant pump down switch.
- .3 Factory mounted hot gas bypass should allow chiller operation down to 10% of full load capacity, and includes a hot gas bypass valve, solenoid valve and manual shutoff valve.
- .4 Compressor to include suction and discharge shut-off valves; oil sight glass; separate circuit crankcase heater; and cylinder unloading device.
- .5 Provide nameplate to show capacity at design temperature, type of refrigerant used and total weight in system.

2.4 EVAPORATOR

- .1 The evaporator shall be direct expansion type with stainless steel plates brazed together. It shall be insulated with 3/4 inch (19mm) closed cell polyurethane insulation and have 653 psi (4500 kPa) water side working pressure.

2.5 CONDENSER

- .1 Horizontal shell and finned tube type with steel shell and integral finned copper tubes rolled into steel tube sheets. The chiller shall be equipped with intermediate tube supports. Construct condenser in accordance with the requirements of ASME Section VIII Unfired Pressure Vessel Code and ANSI B9.1 Safety Code. It shall be designed for 232 psi (1599 kPa) water side working pressure and 450 psig (3104 kPa) refrigerant side pressure and be provided with ASME, ANSI B9.1 pressure relief valves.
- .2 Water regulating valve: sensing condensing or head pressure to control water flow.

2.6 REFRIGERANT CIRCUIT

- .1 Refrigerant Circuit: Each refrigerant circuit shall include a liquid line shutoff valve, replaceable core or sealed filter-drier, sight glass with moisture indicator, liquid line solenoid valve, thermal expansion valve, and insulated suction line.

2.7 CONTROL CENTRE

- .1 The control panel shall contain a microprocessor controller providing operating and equipment protection controls plus motor starting equipment, factory wired, operationally tested, and ready for operation. Standard components shall include a control transformer with primary and secondary fusing, microprocessor transformers with integral fusing, compressor contactors, circuit breakers, single-point wiring arrangement and switches for each circuit pumpdown and unit control power.
- .2 The control panel shall have a hinged tool-locked door.
- .3 The control system shall stage the compressors based on the leaving water temperature. Equipment protection devices controlled by the microprocessor include motor protection, high pressure, loss of refrigerant, loss of water flow, freeze protection, and low refrigerant pressure. Controls shall include auto/stop switch, chilled water setpoint adjustment, anti-recycle timer, and digital display with water temperature and setpoint, operating temperatures and pressures, and diagnostic messages.
- .4 The following features and functions shall be included:
 - .1 The LCD-type display shall have a minimum of 20 characters with all messages in plain English. Coded messages are not acceptable.
 - .2 Critical parameters shall have their own section of control and shall be password protected.
 - .3 Resetting chilled water temperature by a remote 4-20mA DC signal.
 - .4 A soft load function to prevent the system from operating at full load during the chilled water pulldown period.
 - .5 An electronic time clock to allow programming of a yearly schedule accommodating weekends and holidays.
 - .6 Auto restart after a power failure, not requiring external battery backup or auxiliary power for maintaining program memory.
 - .7 Shutdowns shall be date and time stamped with system temperatures and pressures recorded. A minimum of six previous occurrences shall be kept in a revolving memory.
 - .8 Start-to-start and stop-to-start timers to provide minimum compressor off-time with maximum motor protection.
 - .9 Capability of communication with a PC or remote monitoring through a twisted pair RS-232 interface.
 - .10 Lead/lag manually or automatically by compressor number of starts.
 - .11 Continuous diagnostic checks of unit to provide a pre-alarm signal in advance of a shutdown allowing time for remedial action to be taken.
- .5 The controller shall contain the following features as a minimum:
 - .1 Unit Enable Selection - Enables unit operation from local keypad, digital input, or BAS
 - .2 Unit Mode Selection - Selects standard cooling, ice, glycol, or test operation mode
 - .3 Analog Inputs - Reset of leaving water temperature, 4-20 mA
 - .4 Digital Inputs
 - .1 Unit off switch
 - .2 Remote start/stop
 - .3 Flow switch
 - .4 Ice mode, converts operation and setpoints for ice production
 - .5 Motor protection
 - .5 Digital Outputs
 - .1 Shutdown alarm; field wired, activates on an alarm condition, off when alarm is cleared

- .2 Evaporator pump; field wired, starts pump when unit is set to start
- .6 Limit Alarms
 - .1 Condenser pressure stage down, unloads unit at high discharge pressures
 - .2 Low ambient lockout, shuts off unit at low ambient temperatures
 - .3 Low evaporator pressure hold, holds stage #1 until pressure rises
 - .4 Low evaporator pressure unload, shuts off one compressor
- .7 Shutdown Alarms
 - .1 No evaporator water flow
 - .2 Low evaporator pressure
 - .3 High condenser pressure
 - .4 Motor protection system
 - .5 Phase voltage protection (Optional)
 - .6 Outside ambient temperature
 - .7 Evaporator freeze protection
 - .8 Sensor failures
- .8 Equipment Protection - The unit shall be protected in two ways: (1) by alarms that shut the unit down and require manual reset to restore unit operation and (2) by limit alarms that reduce unit operation in response to some out-of-limit condition. Shut down alarms shall activate an alarm signal.
- .6 Optional Building Automation System (BAS) Interface -
 - .1 The unit shall be equipped with an optional factory-installed BAS communication module. Factory mounted DDC controller(s) shall support operation on a BACnet®, Modbus® network via one of the data link / physical layers listed below as specified by the successful Building Automation System (BAS) supplier. The information communicated between the BAS and the factory mounted unit controllers shall include the reading and writing of data to allow unit monitoring, control and alarm notification as specified in the unit sequence of operation and the unit points list.
 - .1 BACnet MS/TP master (Clause 9)
 - .2 BACnet IP, (Annex J)
 - .3 BACnet ISO 8802-3, (Ethernet)

Part 3 Execution

3.1 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 GENERAL

- .1 Provide appropriate protection apparatus.
- .2 Ensure adequate clearances for servicing and maintenance.

3.3 INSTALLATION

- .1 Install in strict accordance with manufacturer's requirements, shop drawings, and Contract Documents. Chiller manufacturer must approve the refrigerant piping design.
- .2 Adjust and level chiller in alignment on supports.
- .3 Coordinate electrical installation with electrical contractor.
- .4 Coordinate controls with control contractor.

- .5 Provide all appurtenances required to ensure a fully operational and functional chiller. Wye strainer, to be installed at the evaporator inlet and sized for the design flow rate, with perforation diameter of 0.063" (for Brazed Plate evaporators) or 0.125" (for Shell-and-Tube evaporators) with blowdown valve and Victaulic couplings (factory mounted or field installed)

3.4 START-UP

- .1 Ensure proper charge of refrigerant and oil.
- .2 Provide testing, and starting of machine, and instruct the Owner in its proper operation and maintenance.
 - .1 Include 3 days per unit.

END OF SECTION

1 GENERAL

1.01 PRODUCTS SUPPLIED BUT NOT INSTALLED UNDER THIS SECTION

- .1 Anchor bolts: size anchor bolts to withstand seismic acceleration and velocity forces as defined in Section 23 05 49.01 - Seismic Restraint Systems (SRS) - Type P2 Buildings 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

1.02 REFERENCES

- .1 ASTM International
 - .1 ASTM A 48/A 48M-03(2012), Standard Specification for Gray Iron Castings.
 - .2 ASTM A 123/A/123M-2012, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .3 ASTM A 153/A 153M-09, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - .4 ASTM B 117-11, Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - .5 ASTM C 67-12, Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
 - .6 ASTM D 520-00(2011), Standard Specification for Zinc Dust Pigment.
- .2 CSA Group
 - .1 CSA B52-05, Mechanical Refrigeration Code.
 - .2 CAN/CSA-Z809-08, Sustainable Forest Management.
- .3 Cooling Technology Institute (CTI)
 - .1 CTI-ATC-105-00, Acceptance Test Code.
 - .2 CTI-STD-201-11, Standard for the Certification of Commercial Water Cooling Tower Thermal Performance.
- .4 Forest Stewardship Council (FSC)
 - .1 FSC-STD-01-001-2004, FSC Principle and Criteria for Forest Stewardship.
- .5 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA MG 1-2011, Motors and Generators.
- .6 Sustainable Forestry Initiative (SFI)
 - .1 SFI-2010-2014 Standard.
- .7 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102.2-10, Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies.

1.04 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 10 00 – General Instructions.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for condensers, coolers and cooling towers and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 10 00 – General Instructions.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed

- in Province of Ontario, Canada.
- .2 Indicate on drawings:
 - .1 Connections, piping, fittings, valves, strainers, control assemblies and ancillaries, identifying factory and field assembled.
 - .2 Wiring as assembled and schematically.
 - .3 Dimensions, construction details, recommended installation and support, mounting bolt hole sizes and locations and point loads.
 - .4 Vibration and seismic control measures.
 - .5 Manufacturers recommended clearances.
 - .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .5 Test reports:
 - .1 Submit certified test reports for cooling towers closed circuit coolers evaporative condensers from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
 - .6 Manufacturer's Field Reports:
 - .1 Submit manufacturer's field reports specified.

1.05 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 10 00 – General Instructions.
- .2 Operation and Maintenance Data: submit operation and maintenance data for condensers, coolers and cooling towers for incorporation into manual.
- .3 Include:
 - .1 Description of equipment giving manufacturers name, type, model year, capacity.
 - .2 Start-up and commissioning procedures.
 - .3 Details of operation, servicing and maintenance.
 - .4 Recommended spare parts list.

1.06 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: company or person specializing in cooling towers evaporative condensers installations with 5 years documented experience approved by manufacturer.
- .2 Regulatory Requirements: work to be performed in compliance with CEPA, TDGA, and applicable Provincial/Territorial regulations.

1.07 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 10 00 – General Instructions and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect condensers and cooling equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- .1 Performance certified in accordance with CTI-STD-201; as indicated on drawings.

2.02 GENERAL

- .1 Factory assembled forced draft counter flow vertical discharge cooling tower.
- .2 Ensure major equipment including cooling towers, cooling tower gear drive assemblies, fans, and motors have manufacturer's name, address, style, model serial number, on plate secured to item of equipment.
- .3 Plates: durable and legible throughout equipment life and made of stainless steel.
- .4 Fix plates in prominent locations with nonferrous screws or bolts.

2.04 MATERIALS

- .1 Steel: components fabricated of zinc-coated steel not lighter than 1.5 mm thick steel, protected against corrosion by zinc coating.
 - .1 Zinc coating: to ASTM A 153/A 153M and ASTM A 123/A 123M, with extra heavy coating of not less than 0.76 kg per square meter of surface.
 - .2 Coat galvanized surfaces damaged due to welding with zinc rich coating conforming to ASTM D 520, Type 1.
- .2 Fibre glass reinforced plastic, (FRP) components: inert, corrosion resistant, and fire-retardant with thickness of 3.66 kg/square meter.
- .3 Polyvinyl chloride, (PVC) with flame spread rating of 10, smoke developed of 25, to CAN/ULC-S102.2.
- .4 Wood: pressure treated fir.
 - .1 Treat and saturate wood exposed from notching, cutting, or drilling with preservative.
 - .2 Certified Wood: submit listing of wood products and materials used in accordance with CAN/CSA-Z809 or FSC or SFI.
- .5 Stainless steel: type 304.
- .6 Plastic: polypropylene.
- .8 Hardware: Type 304 stainless steel.
 - .1 Bolts: provided with neoprene and cadmium-plated steel washers under heads.
 - .2 Nails: stainless steel.
 - .3 Hardware: meet salt-spray fog test as defined by ASTM B 117.

2.05 CASING AND FRAMEWORK

- .1 Materials: galvanized steel sheet, angles and channels.
- .2 Structure: designed for wind loads of 1.45 kN/mi. on projected area and transmission of loads to anchorage.
 - .1 Include 15% increased loading for ice or snow load.
- .3 Access doors and panels: on inside end walls for servicing and maintenance.
- .4 Access to spray nozzles: permanent galvanized steel ladder and access platforms.

2.06 COLD WATER BASIN

- .1 Construct basin watertight from Type 304 stainless steel.
- .2 Construct and install basin to ensure that air will not entrained in outlets when operating and no water will overflow on shutdown.
- .3 Provide individual sump with individual outlet.
- .4 Equip outlets with 12.7 mm mesh, zinc-coated steel wire securely mounted to prevent trash from entering outlet.
- .5 Equip basins with:
 - .1 Overflow and valved drain connections.
 - .2 Float-controlled, makeup water valve as indicated.
- .6 Makeup water: discharge not less than 50 mm or two pipe diameters, whichever is greater, above top of basin.
- .7 Pour basin floor slab as one continuous pour.
- .8 Locate continuous water-stop stripping of 150 mm molded polyvinyl plastic on centerline position of basin wall and at other cold pour joints.
- .9 Construct basin wall sections in second continuous pour, reinforced in accordance with manufacturer's requirements, to interlock with water-stop seal in floor slab, forming completely waterproof basin.

2.07 HOT WATER DISTRIBUTION

- .1 Water distribution: gravity-flow pressurized-flow type system which distributes waters evenly over entire fill surface.
- .2 Design tower cells so that water flow of 140 % capacity will not cause overflowing or splashing.
- .3 Include with distribution system for each cell, adjustable flow control valves.
- .4 Ensure distribution system is self-draining and non-clogging.
- .5 Piping: cast iron, ductile iron, threaded-glass-fiber reinforced epoxy pipe, polypropylene, PVC, Schedule 80 black steel.
- .6 Gravity-Flow System: provided with open basins which include splash box baffles to minimize splashing of incoming hot water and holes that evenly distribute water over entire decking area.
 - .1 Equip water basin holes with ceramic plastic orifice inserts.
- .7 Pressurized-Flow System: includes piping, fittings, branches, and spray nozzles.
 - .1 Spray nozzles: stainless steel, bronze, polypropylene, high-impact plastic.
 - .2 Nozzles: cleanable, non-clogging, removable, and spaced for even distribution.
- .9 Recirculating pump: close-coupled bronze fitted centrifugal with mechanical seal.
- .10 Size and capacity: selected by manufacturer refer to Section 23 21 23 - Hydronic Pumps.
- .11 Provide hot water distribution basins with tower manufacturer's standard removable, wood zinc-coated steel stainless steel FRP, covers to prevent airborne debris from entering basin.

2.09 FILL, ELIMINATORS AND LOUVRES

- .1 Tower fill: splash or film, type.
 - .1 Fill material: free to expand or contract without warping or cracking
 - .2 Do not use plasticized wood cellulose for fill material.
 - .3 Ensure fill is removable or otherwise made accessible for cleaning.
 - .4 Space supports: corrosion resistant, designed to prevent warping, sagging, misalignment, or vibration of fill material.
 - .5 Design fill material and supports to provide for even mixing of air and water.
 - .6 Construct fill material of aluminum stainless steel tile of multi-cell design, set without mortar PVC formed sheets, zinc-coated steel, and lumber in pattern, and of sufficient height to meet performance specifications.
 - .7 Tile fill: vitreous, with low water absorption that will pass freeze-thaw test conducted in accordance with ASTM C 67.
 - .8 Tile fill: minimum crushing strength of 13.8 MPa over gross area of tile when load is applied parallel to cells as tested in accordance with ASTM C 67.
 - .9 Cast iron tee section lintels supporting tile fill: to ASTM A 48M, Class 25, 3.2 mm additional thickness for corrosion.
 - .10 Design lintels with safety factor of 2 minimum.
- .2 Provide eliminators in tower outlet to limit drift loss to not over 0.02 % of circulating water rate.
 - .1 Construct eliminators of minimum 10 mm polyvinyl chloride (PVC).
 - .2 Eliminators: multi-pass zigzag type, assembled into sections making strong, stable unit.
 - .3 Support eliminators sections on FRP tee sections. Suspend Tee sections with 6.35 mm brass rods connected to stainless steel clips embedded in bottom side of roof deck at time of casting.
 - .4 Supply stainless steel clips for installation at time of roof deck pour.
 - .5 Support eliminators stainless steel suspension rods from fan deck.
- .3 Provide air inlets for each cooling tower with individually removable louvers arranged to prevent escape of water. Louvers: Type 304 stainless steel.
 - .1 Provide compatible materials casings and louvers.
 - .2 One material not to produce stains on other materials.
 - .3 Construct lumber louvers, thickness to withstand alternate wetting and drying without cracking or splitting.
 - .4 Provide air intakes with 25 mm zinc-coated steel mesh.

2.10 FAN

- .1 Fan: forward curved, centrifugal type, statically and dynamically balanced. Housing: inlet ring and four sided discharge cowl extended into pan.
- .2 Fan drive: V-belt designed for minimum 150% of motor nameplate ratings.
- .3 Motor: variable speed, totally enclosed, insulation Class B, continuous-rated type which conforms to NEMA MG 1.
 - .1 Fan motors: open drip proof totally enclosed enclosures; locate outside discharge airstream.
 - .2 Mount motors in accordance with manufacturer's recommendations.
 - .3 Two-speed motors: single winding with variable torque characteristics.
- .4 Drives, fans, and moving parts: protected by galvanized wire guards.

2.11 ACCESSORIES

- .1 Immersion heaters: in pan suitable to maintain temperature of water at 5 degrees C, when outside temperature is minus 17 degrees C and wind velocity is 25 kph.

- .2 Immersion thermostat and float control to operate heaters on low temperature when pan is filled.
- .3 Temperature controller: in pan, set at 60 degrees C with sensor to cycle fans.
- .4 Time delay relay: to limit fan motor starts to not more than 6 /h.
- .5 Capacity control: scroll damper and modulating electronic damper motor, controlled by temperature controller. Sensor in pan set at 60 degrees C.

2.12 VIBRATION ISOLATORS

- .1 To Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for condensers, coolers and cooling tower installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of NRC Project Manager.
 - .2 Inform NRC Project Manager of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from NRC Project Manager.

3.02 GENERAL

- .1 Mount on structural supports and vibration isolators as indicated and to manufacturer's recommendations.
- .2 Ensure clearance for servicing and maintenance as recommended by manufacturer.
- .3 Manufacturers field service representative to approve installation, to supervise start up and to instruct operators.

3.03 FIELD QUALITY CONTROL

- .1 Site Tests:
 - .1 Test under actual operating conditions in accordance with CTI-ATC-105 to verify specified performance.
- .2 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.04 ADJUSTING

- .1 Lubricate bearings with oil or grease as recommended by manufacturer.
- .2 Tighten belts to manufacturers specified tension.

3.05 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 10 00 – General Instructions.
 - .1 Leave Work area clean at end of each day.
- .2 Wipe equipment clean, and remove traces of oil, dust, dirt, or paint spots.
- .3 Maintain system in clean condition until final acceptance.
- .4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 10 00 – General Instructions.

END OF SECTION

1 GENERAL

1.01 REFERENCES

- .1 Definitions:
 - .1 Catalogued or published ratings: ratings obtained from tests carried out by manufacturer or manufacturer's designated independent testing agency which signify adherence to codes and standards in force.
- .2 Reference Standards:
 - .1 American National Standards Institute/American Society of Heating, Refrigeration and Air Condition Engineers/Illuminating Engineering Society (ANSI/ASHRAE/IES)
 - .1 ANSI/ASHRAE 52.2-2012, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
 - .2 ANSI/ASHRAE/IES 90.1-2010, Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - .3 Green Seal (GS)
 - .1 GS-11-11, Standard for Paints and Coatings.
 - .4 Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual - current edition.
 - .1 MPI #18.
 - .5 National Fire Protection Association (NFPA)
 - .1 NFPA 90A-12, Standard for the Installation of Air Conditioning and Ventilating Systems.
 - .6 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA)
 - .7 South Coast Air Quality Management District (SCAQMD)
 - .1 SCAQMD Rule 1113-11, Architectural Coatings.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 10 00 – General Instructions.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for refrigerant, insulation, filters, and paints and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Indicate on drawings:
 - .1 Actual cooling and heating fluid entering and leaving conditions for stated air side requirements.

1.04 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 10 00 – General Instructions.
- .2 Operation and Maintenance Data: submit operation and maintenance data for air handling equipment for incorporation into manual.

1.05 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 10 00 – General Instructions.
- .2 Furnish list of individual manufacturer's recommended spare parts for equipment such as

bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

1.06 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 10 00 – General Instructions and with manufacturer's written instructions
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect air handling equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

2 PRODUCTS

2.01 GENERAL

- .1 Factory assembled components to form unit supplying air at design conditions as indicated. Allow for field re-assembly as required to accommodate installation into the existing penthouse space.

2.02 FANS

- .1 In accordance with Section 23 34 00 - HVAC Fans

2.03 CASING

- .1 General:
 - .1 Factory manufactured galvanized steel casing thickness of 1.3 mm thick steel reinforced and braced for rigidity and flanged for bolted sub- assemblies, to withstand a pressure differential as indicated.
 - .2 Provide walk-in access doors to allow access to internal parts and component removal.
 - .1 Walk-in access doors: insulated sandwich panel construction of same material and thickness as casing, of sizes as indicated and complete with 3 hinges, two-way latches, neoprene gaskets and 300 x 300 mm Georgian wire glass ports as indicated. Hinge doors to open against air pressure complete with hold open devices.
 - .2 Removable panels: insulated sandwich panel construction of same material and thickness as casing, of sizes as indicated and complete with hex head bolts, nuts welded to rear of frame, two handles and neoprene gaskets.
 - .3 Inspection doors: insulated factory manufactured complete with latches, two handles and neoprene gaskets of sizes as indicated. Hinge doors to open against air pressure complete with hold open devices.
 - .3 Paint over steel, where steel is not galvanized, or where galvanized steel sheet is cut, with corrosion resistant paint to MPI #18.
 - .1 Primer: maximum VOC limit 250 g/L to GS-11 to SCAQMD Rule 1113.
 - .2 Enamel Finish: maximum VOC limit 250 g/L to GS-11 to SCAQMD Rule 1113.
 - .4 Internally insulate casing with 25 mm thick, 72 kg/mi. density, neoprene coated rigid acoustic duct liner with metal nosings at edges, pinned and cement in place.
 - .1 Ensure expanded polystyrene and polyurethane insulation materials are not produced using ozone depleting substances.

- .6 Openings and bolted sections gasketed.
- .7 Provide duplex receptacle and vapour tight marine lights complete with gaskets and cast aluminum guards in each section in accordance with Division 26.
- .2 Acoustic panels:
 - .1 Factory manufactured with Sound Transmission Coefficients and Acoustical Absorption Coefficients as indicated.
 - .2 Cut and frame openings or panel penetrations greater than 150 mm (diameter or length and width) at factory. Openings or penetrations less than 150 mm (pipe, conduit and instrument holes) may be field cut. Installer to provide filler sheets between equipment and casing.

2.04 COILS

- .1 General:
 - .1 Cleanable tube type: steel or cast iron headers and straight tubes.
 - .2 Plate fin type: tubes mechanically bonded to fins.
 - .3 Spiral wound fin type: mechanically bonded to tubes.
 - .4 Non-ferrous tubes and headers: brazed assembly.
 - .5 Maximum tube length: 3.6 m unless specified otherwise.
 - .6 Factory tested with air under water.
- .2 Capacities: as indicated.
- .3 Ratings: AHRI Certified. Submit with shop drawings actual cooling and heating fluid entering and leaving conditions for stated air side requirements.
- .4 Do not use removable headers at working gauge pressures above 0.7 MPa.
 - .1 Unless indicated, dehumidifying coils rated for 2.5 m/s face velocity.
 - .2 Unless indicated, preheat coils rated for 3.5 m/s.
 - .3 Pressure drop through heating coils: 30 kPa maximum.
 - .4 Pressure drop through cooling coils: 60 kPa maximum.
 - .5 Water velocity: 1.2 m/s maximum. Under 0.6 m/s, turbulators may be used if manufacturer's standard practice.
- .5 Coil casings:
 - .1 Mounting: designed for bolting to other sections.
 - .2 Steel: die formed 1.6 mm thick galvanized steel sheet.
 - .3 Copper at spray washers: 1.6 mm thick cornice temper copper.
 - .4 Tube supports: allow for expansion and contraction.
 - .5 Supports: steel channel or double angle frames or other approved support. Provide brass supports for copper coils.
 - .6 Blank-off plates: of similar material as casing to prevent air bypass. Seal openings where pipes pass through casing using methods recommended by SMACNA.
 - .4 Pressure tests: 1.7 MPa.
- .6 Hot and Chilled water coils: cleanable fins.
 - .1 Tubes: copper or steel.
 - .2 Fins: aluminum spiral wound.
 - .3 Headers: cast iron or steel.
 - .4 Pressure tests: 1.7 MPa.

2.05 DRAIN PANS

- .1 Construction: stainless steel. Rounded corners.
- .2 Insulation: external foam type, minimum 13 mm thick.

- .3 Drain connection: in bottom at low point.
- .4 Installation: sloped in two directions without sag minimum 1% to ensure no standing water.
- .5 Dimensions: minimum 75 mm from upstream face of coil to 150 mm beyond downstream face of coil or eliminator and to include return bends and headers.

2.06 MIXING BOX

- .1 Provide as indicated.
- .2 Material: to match casing.
- .3 Design: provide motorized dampers at the exterior of the unit for the return air, the outdoor air and the exhaust air connections, complete with actuators to produce mixed air temperature to within plus or minus 3 degrees C of design across face of outlet.
- .4 Factory manufactured assembly to include frame, dampers, operating linkages, drive shafts of minimum 12 mm diameter carbon steel and access door on each side.
- .5 Dampers for mixing boxes: Section 23 33 15 - Dampers - Operating.

2.07 FILTER BOX

- .1 Material to match casing complete with flat type filter arrangement as indicated using disposable permanent cleanable type filters. Provide access to filter through hinged door suitable hardware on removable panels.
- .2 Filters: in accordance with Section 23 44 00 - HVAC Air Filtration.
 - .1 Minimum Efficiency Reporting Value (MERV) value 8 filtration media to ANSI/ASHRAE 52.2, to be used on return air section of air handling unit.
 - .2 Immediately prior to occupancy, replace filtration media with new filtration media with Minimum Efficiency Reporting Value (MERV) of 13 in accordance with ANSI/ASHRAE 52.2.
- .3 Provide blank off plates around filters.

2.8 VIBRATION ISOLATION

- .1 Flexible connections in accordance with Section 23 33 00 - Air Duct Accessories.
- .2 Vibration isolators on each fan section in accordance with Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for air handling equipment installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of NRC Project Manager.
 - .2 Inform NRC Project Manager of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from NRC Project Manager.

3.02 INSTALLATION

- .1 Provide appropriate protection apparatus.
- .2 Fabricate to provide smooth air flow through components.
 - .1 Limit air leakage to 1% of rated air flow at 2.5 kPa suction pressure.
- .3 Apply sealer into seams prior to assembly.
 - .1 Secure toe angles on 300 mm centres for full length of casing continuous along entire length of assembly.
- .4 Paint inside casing surfaces with corrosion resistant paint to MPI #18, 0.075 mm minimum thickness when dry. Prime coat outside surfaces.

3.03 FANS

- .1 Provide sheaves and belts required for final air balance.
- .2 Suspension for hung units: install four part hanger type, ceiling flange, top hanger, and bottom hanger and vibration isolator with takeup for levelling.
- .3 Install flexible connections at fan inlets and outlets as indicated.
 - .1 Ensure metal bands of connectors are parallel and not touching.
 - .2 Ensure that fan outlet and duct are aligned when fan is running.

3.04 DRIP PAN

- .1 Install deep deal P trap and trap seal primer on drain lines.
 - .1 Depth of water seal to be 1.5 minimum times static pressure at this point.

3.05 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 10 00 – General Instructions.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 10 00 – General Instructions.

END OF SECTION

1 GENERAL

1.01 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 10 00 – General Instructions.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for fan coil units and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Product data to include:
 - .1 Filters, fan accessibility.
 - .2 Anchoring of cabinet.
 - .3 Thermostat, transformer, controls where integral.
 - .4 kW rating, voltage, phase.
 - .5 Cabinet material thicknesses.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.02 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 10 00 – General Instructions and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect fan coil units from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

2.01 FAN COIL UNITS

- .1 Cabinet: steel, 1.2 mm thick, ceiling mounting, recessed surface.
- .2 Elements: stainless steel sheathed with corrosion protected steel fins covering full length of element.
- .3 Built-in thermostat with integral relay. Wall mounted thermostats: type to match with BAS.
- .4 Fan delay switch.
- .5 On-Off switch (for wall mount unit only).
- .6 Two position selector switch (for wall mount unit only).
- .7 Fresh air duct adapter.
- .8 Filter: replaceable washable and reusable.

- .9 Trim for semi-recessed installation.
- .10 Assembly fully wired to one outlet location.
- .11 Multiple knockouts for up to 1 ½" up to 38 mm diameter conduit.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for fan coil units installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of NRC Project Manager.
 - .2 Inform NRC Project Manager of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from NRC Project Manager.

3.02 INSTALLATION

- .1 Hang units.
- .2 Make electrical and control connections.
- .3 Co-ordinate ducting of fresh air with Division 23.

3.04 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 10 00 – General Instructions.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 10 00 – General Instructions.

END OF SECTION

1 GENERAL

1.01 SUMMARY

- .1 Section Includes.
 - .1 Methods and procedures for start-up, verification and commissioning, for building Energy Monitoring and Control System (EMCS) and includes:
 - .1 Start-up testing and verification of systems.
 - .2 Check out demonstration or proper operation of components.
 - .3 On-site operational tests.

1.02 DEFINITIONS

- .1 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.
- .2 AEL: ratio between total test periods less any system downtime accumulated within that period and test period.
- .3 Downtime: results whenever EMCS is unable to fulfill required functions due to malfunction of equipment defined under responsibility of EMCS contractor. Downtime is measured by duration, in time, between time that Contractor is notified of failure and time system is restored to proper operating condition. Downtime not to include following:
 - .1 Outage of main power supply in excess of back-up power sources, provided that:
 - .1 Automatic initiation of back-up was accomplished.
 - .2 Automatic shut-down and re-start of components was as specified.
 - .2 Failure of communications link, provided that:
 - .1 Controller automatically and correctly operated in stand-alone mode.
 - .2 Failure was not due to failure of any specified EMCS equipment.
 - .3 Functional failure resulting from individual sensor inputs or output devices, provided that:
 - .1 System recorded said fault.
 - .2 Equipment defaulted to fail-safe mode.
 - .3 AEL of total of all input sensors and output devices is at least 99 % during test period.

1.03 DESIGN REQUIREMENTS

- .1 Confirm with NRC Project Manager that Design Criteria and Design Intents are still applicable.
- .2 Commissioning personnel to be fully aware of and qualified to interpret Design Criteria and Design Intents.

1.04 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 10 00 – General Instructions.
- .2 Final Report: submit report to NRC Project Manager.
 - .1 Include measurements, final settings and certified test results.
 - .2 Bear signature of commissioning technician and supervisor
 - .3 Report format to be approved by NRC Project Manager before commissioning is started.
 - .4 Revise "as-built" documentation, commissioning reports to reflect changes, adjustments and modifications to EMCS as set during commissioning and submit to NRC Project Manager in accordance with Section 01 10 00 – General Instructions.

- .5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

1.05 CLOSEOUT SUBMITTALS

- .1 Provide documentation, O&M Manuals, and training of O&M personnel for review of NRC Project Manager before interim acceptance in accordance with Section 01 10 00 – General Instructions.

1.06 COMMISSIONING

- .1 Carry out commissioning under direction NRC Project Manager and in presence of NRC Project Manager.
- .2 Inform, and obtain approval from, NRC Project Manager in writing at least 14 days prior to commissioning or each test. Indicate:
 - .1 Location and part of system to be tested or commissioned.
 - .2 Testing/commissioning procedures, anticipated results.
 - .3 Names of testing/commissioning personnel.
- .3 Correct deficiencies, re-test in presence of NRC Project Manager until satisfactory performance is obtained.
- .4 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.
- .5 Load system with project software.
- .6 Perform tests as required.

1.07 COMPLETION OF COMMISSIONING

- .1 Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed by NRC Project Manager.

1.08 ISSUANCE OF FINAL CERTIFICATE OF COMPLETION

- .1 Final Certificate of Completion will not be issued until receipt of written approval indicating successful completion of specified commissioning activities including receipt of commissioning documentation.

2 PRODUCTS

2.01 EQUIPMENT

- .1 Provide sufficient instrumentation to verify and commission the installed system. Provide two-way radios.
- .2 Instrumentation accuracy tolerances: higher order of magnitude than equipment or system being tested.
- .3 Independent testing laboratory to certify test equipment as accurate to within approved tolerances no more than 2 months prior to tests.
- .4 Locations to be approved, readily accessible and readable.
- .5 Application: to conform to normal industry standards.

3 EXECUTION

3.01 PROCEDURES

- .1 Test each system independently and then in unison with other related systems.
- .2 Commission each system using procedures prescribed by the NRC Project Manager.
- .3 Commission integrated systems using procedures prescribed by NRC Project Manager.
- .4 Debug system software.
- .5 Optimize operation and performance of systems by fine-tuning PID values and modifying CDLs as required.
- .6 Test full scale emergency evacuation and life safety procedures including operation and integrity of smoke management systems under normal and emergency power conditions as applicable.

3.02 FIELD QUALITY CONTROL

- .1 Pre-Installation Testing.
 - .1 General: consists of field tests of equipment just prior to installation.
 - .2 Testing may be on site or at Contractor's premises as approved by NRC Project Manager.
 - .3 Configure major components to be tested in same architecture as designed system. Include BECC equipment and 2 sets of Building Controller's including MCU's, LCU's, and TCU's.
 - .4 Equip each Building Controller with sensor and controlled device of each type (AI, AO, DI, DO).
 - .5 Additional instruments to include:
 - .1 DP transmitters.
 - .2 VAV supply duct SP transmitters.
 - .3 DP switches used for dirty filter indication and fan status.
 - .6 In addition to test equipment, provide inclined manometer, digital micro-manometer, milli-amp meter, source of air pressure infinitely adjustable between 0 and 500 Pa, to hold steady at any setting and with direct output to milli-amp meter at source and to BECC.
 - .7 After setting, test zero and span in 10 % increments through entire range while both increasing and decreasing pressure.
 - .8 NRC Project Manager to mark instruments tracking within 0.5 % in both directions as "approved for installation".
 - .9 Transmitters above 0.5% error will be rejected.
 - .10 DP switches to open and close within 2% of setpoint.
- .2 Completion Testing.
 - .1 General: test after installation of each part of system and after completion of mechanical and electrical hook-ups, to verify correct installation and functioning.
 - .2 Include following activities:
 - .1 Test and calibrate field hardware including stand-alone capability of each controller.
 - .2 Verify each A-to-D convertor.
 - .3 Test and calibrate each AI using calibrated digital instruments.
 - .4 Test each DI to ensure proper settings and switching contacts.
 - .5 Test each DO to ensure proper operation and lag time.
 - .6 Test each AO to ensure proper operation of controlled devices. Verify tight closure and signals.
 - .7 Test operating software.

- .8 Test application software and provide samples of logs and commands.
- .9 Verify each CDL including energy optimization programs.
- .10 Debug software.
- .11 Blow out flow measuring and static pressure stations with high pressure air at 700 kPa.
- .12 Provide point verification list in table format including point identifier, point identifier expansion, point type and address, low and high limits and engineering units. Include space on commissioning technician and NRC Project Manager. This document will be used in final startup testing.
- .3 Final Startup Testing: Upon satisfactory completion of tests, perform point-by-point test of entire system under direction of NRC Project Manager and provide:
 - .1 2 technical personnel capable of re-calibrating field hardware and modifying software.
 - .2 Detailed daily schedule showing items to be tested and personnel available.
 - .3 NRC Project Manager Acceptance signature to be on executive and applications programs.
 - .4 Commissioning to commence during final startup testing.
 - .5 O&M personnel to assist in commissioning procedures as part of training.
 - .6 Commissioning to be supervised by qualified supervisory personnel and NRC Project Manager.
 - .7 Commission systems considered as life safety systems before affected parts of the facility are occupied.
 - .8 Operate systems as long as necessary to commission entire project.
 - .9 Monitor progress and keep detailed records of activities and results.
- .4 Final Operational Testing: to demonstrate that EMCS functions in accordance with contract requirements.
 - .1 Prior to beginning of 30 day test demonstrate that operating parameters (set points, alarm limits, operating control software, sequences of operation, trends, graphics and CDL's) have been implemented to ensure proper operation and operator notification in event of off-normal operation.
 - .1 Repetitive alarm conditions to be resolved to minimize reporting of nuisance conditions.
 - .2 Test to last at least 30 consecutive 24 hour days.
 - .3 Tests to include:
 - .1 Demonstration of correct operation of monitored and controlled points.
 - .2 Operation and capabilities of sequences, reports, special control algorithms, diagnostics, software.
 - .4 System will be accepted when:
 - .1 EMCS equipment operates to meet overall performance requirements. Downtime as defined in this Section must not exceed allowable time calculated for this site.
 - .2 Requirements of Contract have been met.
 - .5 In event of failure to attain specified AEL during test period, extend test period on day-to-day basis until specified AEL is attained for test period.
 - .6 Correct defects when they occur and before resuming tests.
- .5 NRC Project Manager to verify reported results.

3.03 ADJUSTING

- .1 Final adjusting: upon completion of commissioning as reviewed by NRC Project Manager, set and lock devices in final position and permanently mark settings.

3.04 DEMONSTRATION

- .1 Demonstrate to NRC Project Manager Operation of systems including sequence of operations in regular and emergency modes, under normal and emergency conditions, start-up, shut-down interlocks and lock-outs in accordance with Section 01 10 00 – General Instructions.

END OF SECTION

1 GENERAL

1.01 SUMMARY

- .1 Section Includes.
 - .1 Requirements and procedures for training program, instructors and training materials, for building Energy Monitoring and Control System (EMCS) Work.

1.02 DEFINITIONS

- .1 CDL - Control Description Logic.
- .2 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 10 00 – General Instructions, supplemented and modified by requirements of this Section.
- .2 Submit training proposal complete with hour-by-hour schedule including brief overview of content of each segment to NRC Project Manager 30 days prior to anticipated date of beginning of training.
 - .1 List name of trainer, and type of visual and audio aids to be used.
 - .2 Show coordinated interface with other EMCS mechanical and electrical training programs.
- .3 Submit reports within one week after completion of Phase 1 and Phase 2 training program that training has been satisfactorily completed.

1.04 QUALITY ASSURANCE

- .1 Provide bilingual, competent instructors thoroughly familiar with aspects of EMCS installed in facility.
- .2 NRC Project Manager reserves right to approve instructors.

1.05 INSTRUCTIONS

- .1 Provide instruction to designated personnel in adjustment, operation, maintenance and pertinent safety requirements of EMCS installed.
- .2 Training to be project-specific.

1.06 TIME FOR TRAINING

- .1 Number of days of instruction to be as specified in this section (1 day = 8 hours including two 15 minute breaks and excluding lunch time).

1.07 TRAINING MATERIALS

- .1 Provide equipment, visual and audio aids, and materials for classroom training.
- .2 Supply manual for each trainee, describing in detail data included in each training program.
 - .1 Review contents of manual in detail to explain aspects of operation and maintenance (O&M).

1.08 TRAINING PROGRAM

- .1 To be in 2 phases over 6 month period.
- .2 Phase 1: 2 day program to begin before 30 day test period at time mutually agreeable to Contractor, NRC Project Manager.
 - .1 Train O&M personnel in functional operations and procedures to be employed for system operation.
 - .2 Supplement with on-the-job training during 30 day test period.
 - .3 Include overview of system architecture, communications, operation of computer and peripherals, report generation.
 - .4 Include detailed training on operator interface functions for control of mechanical systems, CDL's for each system, and elementary preventive maintenance.
- .3 Phase 2: 5 day program to begin 8 weeks after acceptance for operators, equipment maintenance personnel and programmers.
 - .1 Provide multiple instructors on pre-arranged schedule. Include at least following:
 - .1 Operator training: provide operating personnel, maintenance personnel and programmers with condensed version of Phase 1 training.
 - .2 Equipment maintenance training: provide personnel with 2 days training within 5 day period in maintenance of EMCS equipment, including general equipment layout, trouble shooting and preventive maintenance of EMCS components, maintenance and calibration of sensors and controls.
 - .3 Programmers: provide personnel with 2 days training within 5 day period in following subjects in approximate percentages of total course shown:

Software and architecture: 10%

Logiciel et architecture : 10 %

Application programs: 15% Programmes
d'application : 15 %

Controller programming: 50%

Programmation du contrôleur : 50 %

Trouble shooting and debugging: 10%

Dépannage et mise au point : 10 %

Colour graphic generation: 15%

Génération de graphiques en couleur:

15 %

1.09 ADDITIONAL TRAINING

- .1 List courses offered by name, duration and approximate cost per person per week. Note courses recommended for training supervisory personnel.

1.10 MONITORING OF TRAINING

- .1 NRC Project Manager to monitor training program and may modify schedule and content.

2 PRODUCTS

2.01 NOT USED

- .1 Not Used.

3 EXECUTION

3.01 NOT USED

.1 Not Used.

END OF SECTION

1 GENERAL

1.01 SUMMARY

- .1 Section Includes:
 - .1 General requirements for building Energy Monitoring and Control System (EMCS) that are common to NMS EMCS Sections.

1.02 REFERENCES

- .1 American National Standards Institute (ANSI)/The Instrumentation, Systems and Automation Society (ISA).
 - .1 ANSI/ISA 5.5-1985, Graphic Symbols for Process Displays.
- .2 American National Standards Institute (ANSI)/ Institute of Electrical and Electronics Engineers (IEEE).
 - .1 ANSI/IEEE 260.1-1993, American National Standard Letter Symbols Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units).
- .3 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
 - .1 ASHRAE STD 135-R2001, BACNET - Data Communication Protocol for Building Automation and Control Network.
- .4 Canadian Standards Association (CSA International).
 - .1 CAN/CSA-Z234.1-89(R1995), Canadian Metric Practice Guide.
- .5 Consumer Electronics Association (CEA).
 - .1 CEA-709.1-B-2002, Control Network Protocol Specification.
- .6 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
 - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
- .7 Electrical and Electronic Manufacturers Association (EEMAC).
 - .1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.
- .8 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .9 Transport Canada (TC).
 - .1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

1.03 ACRONYMS AND ABBREVIATIONS

- .1 Acronyms used in EMCS:
 - .1 AEL - Average Effectiveness Level.
 - .2 AI - Analog Input.
 - .3 AIT - Agreement on International Trade.
 - .4 AO - Analog Output.
 - .5 BACnet - Building Automation and Control Network.
 - .6 BC(s) - Building Controller(s).
 - .7 BECC - Building Environmental Control Center.
 - .8 CAD - Computer Aided Design.
 - .9 CDL - Control Description Logic.
 - .10 CDS - Control Design Schematic.
 - .11 COSV - Change of State or Value.

- .12 CPU - Central Processing Unit.
- .13 DI - Digital Input.
- .14 DO - Digital Output.
- .15 DP - Differential Pressure.
- .16 ECU - Equipment Control Unit.
- .17 EMCS - Energy Monitoring and Control System.
- .18 HVAC - Heating, Ventilation, Air Conditioning.
- .19 IDE - Interface Device Equipment.
- .20 I/O - Input/Output.
- .21 ISA - Industry Standard Architecture.
- .22 LAN - Local Area Network.
- .23 LCU - Local Control Unit.
- .24 MCU - Master Control Unit.
- .25 NAFTA - North American Free Trade Agreement.
- .26 NC - Normally Closed.
- .27 NO - Normally Open.
- .28 OS - Operating System.
- .29 O&M - Operation and Maintenance.
- .30 OWS - Operator Work Station.
- .31 PC - Personal Computer.
- .32 PCI - Peripheral Control Interface.
- .33 PCMCIA - Personal Computer Micro-Card Interface Adapter.
- .34 PID - Proportional, Integral and Derivative.
- .35 RAM - Random Access Memory.
- .36 SP - Static Pressure.
- .37 ROM - Read Only Memory.
- .38 TCU - Terminal Control Unit.
- .39 USB - Universal Serial Bus.
- .40 UPS - Uninterruptible Power Supply.
- .41 VAV - Variable Air Volume.

1.04 DEFINITIONS

- .1 Point: may be logical or physical.
 - .1 Logical points: values calculated by system such as setpoints, totals, counts, derived corrections and may include, but not limited to result of and statements in CDL's.
 - .2 Physical points: inputs or outputs which have hardware wired to controllers which are measuring physical properties, or providing status conditions of contacts or relays which provide interaction with related equipment (stop, start) and valve or damper actuators.
- .2 Point Name: composed of two parts, point identifier and point expansion.
 - .1 Point identifier: comprised of three descriptors, "area" descriptor, "system" descriptor and "point" descriptor, for which database to provide 25 character field for each point identifier. "System" is system that point is located on.
 - .1 Area descriptor: building or part of building where point is located.
 - .2 System descriptor: system that point is located on.
 - .3 Point descriptor: physical or logical point description. For point identifier "area", "system" and "point" will be shortforms or acronyms. Database must provide 25 character field for each point identifier.
 - .2 Point expansion: comprised of three fields, one for each descriptor. Expanded form of shortform or acronym used in "area", "system" and "point" descriptors is placed into appropriate point expansion field. Database must provide 32 character field for each point expansion.
 - .3 Bilingual systems to include additional point identifier expansion fields of equal capacity for each point name for second language.
 - .1 System to support use of numbers and readable characters including blanks,

periods or underscores to enhance user readability for each of the above strings.

- .3 Point Object Type: points fall into following object types:
 - .1 AI (analog input).
 - .2 AO (analog output).
 - .3 DI (digital input).
 - .4 DO (digital output).
 - .5 Pulse inputs.
- .4 Symbols and engineering unit abbreviations utilized in displays: to ANSI/ISA S5.5.
 - .1 Printouts: to ANSI/IEEE 260.1.
 - .2 Refer also to Section 25 05 54 - EMCS: Identification.

1.05 SYSTEM DESCRIPTION

- .1 Refer to control schematics and for system architecture.
- .2 Work covered by sections referred to above consist of fully operational EMCS, including, but not limited to, following:
 - .1 Building Controllers.
 - .2 Control devices as listed in I/O point summary tables.
 - .3 OWS(s).
 - .4 Data communications equipment necessary to effect EMCS data transmission system.
 - .5 Field control devices.
 - .6 Software/Hardware complete with full documentation.
 - .7 Complete operating and maintenance manuals.
 - .8 Training of personnel.
 - .9 Acceptance tests, technical support during commissioning, full documentation.
 - .10 Wiring interface co-ordination of equipment supplied by others.
 - .11 Miscellaneous work as specified in these sections and as indicated.
- .3 Design Requirements:
 - .1 Design and provide conduit and wiring linking elements of system.
 - .2 Supply sufficient programmable controllers of types to meet project requirements. Quantity and points contents as reviewed by NRC Project Manager prior to installation.
 - .3 Location of controllers as reviewed by NRC Project Manager prior to installation.
 - .4 Provide utility power to EMCS and emergency power to EMCS as indicated.
 - .5 Metric references: in accordance with CAN/CSA Z234.1.
- .4 Language Operating Requirements:
 - .1 Provide English operator selectable access codes.
 - .2 Use non-linguistic symbols for displays on graphic terminals wherever possible. Other information to be in English.
 - .3 Operating system executive: provide primary hardware-to-software interface specified as part of hardware purchase with associated documentation to be in English and or French.
 - .4 System manager software: include in English system definition point database, additions, deletions or modifications, control loop statements, use of high level programming languages, report generator utility and other OS utilities used for maintaining optimal operating efficiency.
 - .5 Include, in English:
 - .1 Input and output commands and messages from operator-initiated functions and field related changes and alarms as defined in CDL's or assigned limits (i.e. commands relating to day-to-day operating functions and not related to

- .1 system modifications, additions, or logic re-definitions).
- .2 Graphic "display" functions, point commands to turn systems on or off, manually override automatic control of specified hardware points. To be in French and English at specified OWS and to be able to operate one terminal in English and second in French. Point name expansions in both languages.
- .3 Reporting function such as trend log, trend graphics, alarm report logs, energy report logs, maintenance generated logs.

1.06 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 10 00 – General Instructions and 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
- .2 Co-ordinate submittal requirements and provide submittals required by Section 01 10 00 – General Instructions: Construction.
- .3 Quality Control:
 - .1 Provide equipment and material from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.
 - .2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.
 - .3 Submit proof of compliance to specified standards with shop drawings and product data in accordance with Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process. Label or listing of specified organization is acceptable evidence.
 - .4 In lieu of such evidence, submit certificate from testing organization, approved by NRC Project Manager, certifying that item was tested in accordance with their test methods and that item conforms to their standard/code.
 - .5 For materials whose compliance with organizational standards/codes/specifications is not regulated by organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.
 - .6 Permits and fees: in accordance with general conditions of contract.
 - .7 Submit certificate of acceptance from authority having jurisdiction to NRC Project Manager.
 - .8 Existing devices intended for re-use: submit test report.

1.07 QUALITY ASSURANCE

- .1 Have local office within 50 km of project staffed by trained personnel capable of providing instruction, routine maintenance and emergency service on systems,
- .2 Provide record of successful previous installations submitting tender showing experience with similar installations utilizing computer-based systems.
- .3 Have access to local supplies of essential parts and provide 7 year guarantee of availability of spare parts after obsolescence.
- .4 Ensure qualified supervisory personnel continuously direct and monitor Work and attend site meetings.
- .5 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 10 00 – General Instructions.

1.08 DELIVERY, STORAGE AND HANDLING

- .1 Material Delivery Schedule: provide NRC Project Manager with schedule within 2 weeks after award of Contract.

1.09 EXISTING- CONTROL COMPONENTS

- .1 Utilize existing control wiring and piping as indicated.
- .2 Re-use field control devices that are usable in their original configuration provided that they conform to applicable codes, standards specifications.
 - .1 Do not modify original design of existing devices without written permission from NRC Project Manager.
 - .2 Provide for new, properly designed device where re-usability of components is uncertain.
- .3 Inspect and test existing devices intended for re-use within 30 days of award of contract, and prior to installation of new devices.
 - .1 Furnish test report within 40 days of award of contract listing each component to be re-used and indicating whether it is in good order or requires repair by NRC Project Manager.
 - .2 Failure to produce test report will constitute acceptance of existing devices by contractor.
- .4 Non-functioning items:
 - .1 Provide with report specification sheets or written functional requirements to support findings.
 - .2 NRC Project Manager will repair or replace existing items judged defective yet deemed necessary for EMCS.
- .5 Submit written request for permission to disconnect controls and to obtain equipment downtime before proceeding with Work.
- .6 Assume responsibility for controls to be incorporated into EMCS after written receipt of approval from NRC Project Manager.
 - .1 Be responsible for items repaired or replaced by NRC Project Manager.
 - .2 Be responsible for repair costs due to negligence or abuse of equipment.
 - .3 Responsibility for existing devices terminates upon final acceptance of EMCS applicable portions of EMCS as approved NRC Project Manager.
- .7 Remove existing controls not re-used or not required. Place in approved storage for disposition as directed.

2 PRODUCTS

2.01 EQUIPMENT

- .1 Control Network Protocol and Data Communication Protocol: to CEA 709.1 ASHRAE STD 135.
- .2 Complete list of equipment and materials to be used on project and forming part of bid tender documents by adding manufacturer's name, model number and details of materials, and submit for approval.

2.02 ADAPTORS

- .1 Provide adaptors between metric and imperial components.

3 EXECUTION

3.01 MANUFACTURER'S RECOMMENDATIONS

- .1 Installation: to manufacturer's recommendations.

END OF SECTION

1 GENERAL

1.01 SUMMARY

- .1 Section Includes.
 - .1 Methods and procedures for shop drawings submittals, preliminary and detailed review process including review meetings, for building Energy Monitoring and Control System (EMCS).

1.02 DEFINITIONS

- .1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.03 DESIGN REQUIREMENTS

- .1 Preliminary Design Review: to contain following contractor and systems information.
 - .1 Location of local office.
 - .2 Description and location of installing and servicing technical staff.
 - .3 Location and qualifications of programming design and programming support staff.
 - .4 List of spare parts.
 - .5 Location of spare parts stock.
 - .6 Names of sub-contractors and site-specific key personnel.
 - .7 Sketch of site-specific system architecture.
 - .8 Specification sheets for each item including memory provided, programming language, speed, type of data transmission.
 - .9 Descriptive brochures.
 - .10 Sample CDL and graphics (systems schematics).
 - .11 Response time for each type of command and report.
 - .12 Item-by-item statement of compliance.
 - .13 Proof of demonstrated ability of system to communicate utilizing Proprietary Communications Protocol BACnet Lontalk.

1.04 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 10 00 – General Instructions and coordinate with requirements in this Section.
- .2 Submit preliminary design document within 5 working days after tender closing and before contract award, for review by NRC Project Manager.
- .3 Shop Drawings to consist of 3 hard copies and 1 soft copy of design documents, shop drawings, product data and software.
- .4 Hard copy to be completely indexed and coordinated package to assure compliance with contract requirements and arranged in same sequence as specification and cross-referenced to specification section and paragraph number.
- .5 Soft copy to be in Autocad - latest version and WordPerfect latest version Microsoft Word latest version format, structured using menu format for easy loading and retrieval on OWS.

1.05 PRELIMINARY SHOP DRAWING REVIEW

- .1 Submit preliminary shop drawings within 30 working days of award of contract and include following:
 - .1 Specification sheets for each item. To include manufacturer's descriptive literature, manufacturer's installation recommendations, specifications, drawings, diagrams,

- performance and characteristic curves, catalogue cuts, manufacturer's name, trade name, catalogue or model number, nameplate data, size, layout, dimensions, capacity, other data to establish compliance.
- .2 Detailed system architecture showing all points associated with each controller signal levels, pressures where new EMCS ties into existing control equipment.
- .3 Spare point capacity of each controller by number and type.
- .4 Controller locations.
- .5 Auxiliary control cabinet locations.
- .6 Single line diagrams showing cable routings, conduit sizes, spare conduit capacity between control centre, field controllers and systems being controlled.
- .7 Valves: complete schedule listing including following information: designation, service, manufacturer, model, point ID, design flow rate, design pressure drop, required Cv, Valve size, actual Cv, spring range, pilot range, required torque, actual torque and close off pressure (required and actual).
- .8 Dampers: sketches showing module assembly, interconnecting hardware, operator locations, operator spring range, pilot range, required torque, actual torque.
- .9 Flow measuring stations: complete schedule listing designation, service, point ID, manufacturer, model, size, velocity at design flow rate, manufacturer, model and range of velocity transmitter.
- .10 Compressor schematic and sizing data.

1.06 DETAILED SHOP DRAWING REVIEW

- .1 Submit detailed shop drawings within 60 working days after award of contract and before start of installation and include following:
 - .1 Corrected and updated versions (hard copy only) of submissions made during preliminary review.
 - .2 Wiring diagrams.
 - .3 Piping diagrams and hook-ups.
 - .4 Interface wiring diagrams showing termination connections and signal levels for equipment to be supplied by others.
 - .5 Shop drawings for each input/output point, sensors, transmitters, showing information associated with each particular point including:
 - .1 Sensing element type and location.
 - .2 Transmitter type and range.
 - .3 Associated field wiring schematics, schedules and terminations.
 - .4 Pneumatic schematics and schedules.
 - .5 Complete Point Name Lists.
 - .6 Setpoints, curves or graphs and alarm limits (high and low, 3 types critical, cautionary and maintenance), signal range.
 - .7 Software and programming details associated with each point.
 - .8 Manufacturer's recommended installation instructions and procedures.
 - .9 Input and output signal levels or pressures where new system ties into existing control equipment.
 - .6 Control schematics, narrative description, CDL's fully showing and describing automatic and manual procedure required to achieve proper operation of project, including under complete failure of EMCS.
 - .7 Graphic system schematic displays of air and water systems with point identifiers and textual description of system, and typical floor plans as specified.
 - .8 Complete system CDL's including companion English language explanations on same sheet but with different font and italics. CDL's to contain specified energy optimization programs.
 - .9 Listing and example of specified reports.
 - .10 Listing of time of day schedules.
 - .11 Mark up to-scale construction drawing to detail control room showing location of equipment and operator work space.
 - .12 Type and size of memory with statement of spare memory capacity.

- .13 Full description of software programs provided.
- .14 Sample of "Operating Instructions Manual" to be used for training purposes.
- .15 Outline of proposed start-up and verification procedures. Refer to Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

1.07 QUALITY ASSURANCE

- .1 Preliminary Design Review Meeting: Convene meeting within 45 working days of award of contract to:
 - .1 Undertake functional review of preliminary design documents, resolve inconsistencies.
 - .2 Resolve conflicts between contract document requirements and actual items (e.g.: points list inconsistencies).
 - .3 Review interface requirements of materials supplied by others.
 - .4 Review "Sequence of Operations".
- .2 Contractor's programmer to attend meeting.
- .3 NRC Project Manager retains right to revise sequence or subsequent CDL prior to software finalization without cost NRC Project Manager.

2 PRODUCTS

2.01 NOT USED

- .1 Not Used.

3 EXECUTION

3.01 NOT USED

- .1 Not Used.

END OF SECTION

1 GENERAL

1.01 SUMMARY

- .1 Section Includes.
 - .1 Requirements and procedures for final control diagrams and operation and maintenance (O&M) manual, for building Energy Monitoring and Control System (EMCS) Work.

1.02 DEFINITIONS

- .1 BECC - Building Environmental Control Centre.
- .2 OWS - Operator Work Station.
- .3 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 10 00 – General Instructions, supplemented and modified by requirements of this Section.
- .2 Submit Record Documents As-built drawings Operation and Maintenance Manual to NRC Project Manager in English and French.
- .3 Provide soft copies and hard copies in hard-back, 50 mm 3 ring, D-ring binders.
 - .1 Binders to be 2/3 maximum full.
 - .2 Provide index to full volume in each binder.
 - .3 Identify contents of each manual on cover and spine.
 - .4 Provide Table of Contents in each manual.
 - .5 Assemble each manual to conform to Table of Contents with tab sheets placed before instructions covering subject.

1.04 AS-BUILTS

- .1 Provide 1 copy of detailed shop drawings generated in Section 25 05 02 - EMCS: Submittals and Review Process and include:
 - .1 Changes to contract documents as well as addenda and contract extras.
 - .2 Changes to interface wiring.
 - .3 Routing of conduit, wiring and control air lines associated with EMCS installation.
 - .4 Locations of obscure devices to be indicated on drawings.
 - .5 Listing of alarm messages.
 - .6 Panel/circuit breaker number for sources of normal/emergency power.
 - .7 Names, addresses, telephone numbers of each sub-contractor having installed equipment, local representative for each item of equipment, each system.
 - .8 Test procedures and reports: provide records of start-up procedures, test procedures, checkout tests and final commissioning reports as specified in Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.
 - .9 Basic system design and full documentation on system configuration.
- .2 Submit for final review by NRC Project Manager.
- .3 Provide before acceptance 4 Hard and 1 soft copy incorporating changes made during final review.

1.05 O&M MANUALS

- .1 Custom design O&M Manuals (both hard and soft copy) to contain material pertinent to this project only and to provide full and complete coverage of subjects referred to in this Section.
- .2 Provide 2 complete sets of hard and soft copies prior to system or equipment tests
- .3 Include complete coverage in concise language, readily understood by operating personnel using common terminology of functional and operational requirements of system. Do not presume knowledge of computers, electronics or in-depth control theory.
- .4 Functional description to include:
 - .1 Functional description of theory of operation.
 - .2 Design philosophy.
 - .3 Specific functions of design philosophy and system.
 - .4 Full details of data communications, including data types and formats, data processing and disposition data link components, interfaces and operator tests or self-test of data link integrity.
 - .5 Explicit description of hardware and software functions, interfaces and requirements for components in functions and operating modes.
 - .6 Description of person-machine interactions required to supplement system description, known or established constraints on system operation, operating procedures currently implemented or planned for implementation in automatic mode.
- .5 System operation to include:
 - .1 Complete step-by-step procedures for operation of system including required actions at each OWS.
 - .2 Operation of computer peripherals, input and output formats.
 - .3 Emergency, alarm and failure recovery.
 - .4 Step-by-step instructions for start-up, back-up equipment operation, execution of systems functions and operating modes, including key strokes for each command so that operator need only refer to these pages for keystroke entries required to call up display or to input command.
- .6 Software to include:
 - .1 Documentation of theory, design, interface requirements, functions, including test and verification procedures.
 - .2 Detailed descriptions of program requirements and capabilities.
 - .3 Data necessary to permit modification, relocation, reprogramming and to permit new and existing software modules to respond to changing system functional requirements without disrupting normal operation.
 - .4 Software modules, fully annotated source code listings, error free object code files ready for loading via peripheral device
 - .5 Complete program cross reference plus linking requirements, data exchange requirements, necessary subroutine lists, data file requirements, other information necessary for proper loading, integration, interfacing, and program execution.
 - .6 Software for each Controller and single section referencing Controller common parameters and functions.
- .7 Maintenance: document maintenance procedures including inspection, periodic preventive maintenance, fault diagnosis, repair or replacement of defective components, including calibration, maintenance, repair of sensors, transmitters, transducers, controller and interface firmware's, plus diagnostics and repair/replacement of system hardware.
- .8 System configuration document:
 - .1 Provisions and procedures for planning, implementing and recording hardware and software modifications required during operating lifetime of system.
 - .2 Information to ensure co-ordination of hardware and software changes, data link or

message format/content changes, sensor or control changes in event that system modifications are required.

- .9 Programmer control panel documentation: provide where panels are independently interfaced with BECC, including interfacing schematics, signal identification, timing diagrams, and fully commented source listing of applicable driver/handler.

2 PRODUCTS

2.01 NOT USED

- .1 Not Used.

3 EXECUTION

3.01 NOT USED

- .1 Not Used.

END OF SECTION

1 GENERAL

1.01 SUMMARY

- .1 Section Includes.
 - .1 Requirements and procedures for identification of devices, sensors, wiring tubing, conduit and equipment, for building Energy Monitoring and Control System (EMCS) Work and nameplates materials, colours and lettering sizes.

1.02 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CSA C22.1-16, The Canadian Electrical Code, Part I (19th Edition), Safety Standard for Electrical Installations.

1.03 DEFINITIONS

- .1 For acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.04 SYSTEM DESCRIPTION

- .1 Language Operating Requirements: provide identification for control items in English and French.

1.05 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 10 00 – General Instructions supplemented and modified by requirements of this Section.
- .2 Submit to NRC Project Manager for approval samples of nameplates, identification tags and list of proposed wording.

2 PRODUCTS

2.01 NAMEPLATES FOR PANELS

- .1 Identify by Plastic laminate, 3 mm thick Melamine, matt white finish, black core, square corners, lettering accurately aligned and engraved into core.
- .2 Sizes: 25 x 67 mm minimum.
- .3 Lettering: minimum 7 mm high, black.
- .4 Inscriptions: machine engraved to identify function.

2.02 NAMEPLATES FOR FIELD DEVICES

- .1 Identify by plastic encased cards attached by plastic tie.
- .2 Sizes: 50 x 100 mm minimum.
- .3 Lettering: minimum 5 mm high produced from laser printer in black.
- .4 Data to include: point name and point address.

- .5 Companion cabinet: identify interior components using plastic enclosed cards with point name and point address.

2.03 NAMEPLATES FOR ROOM SENSORS

- .1 Identify by stick-on labels using point identifier.
- .2 Location: as directed by NRC Project Manager.
- .3 Letter size: to suit, clearly legible.

2.04 WARNING SIGNS

- .1 Equipment including motors, starters under remote automatic control: supply and install orange coloured signs warning of automatic starting under control of EMCS.
- .2 Sign to read: "Caution: This equipment is under automatic remote control of EMCS" as reviewed by NRC Project Manager.

2.05 WIRING

- .1 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets and outlet boxes.
- .2 Colour coding: to CSA C22.1. Use colour coded wiring in communications cables, matched throughout system.
- .3 Power wiring: identify circuit breaker panel/circuit breaker number inside each EMCS panel.

2.06 CONDUIT

- .1 Colour code EMCS conduit.
- .2 Pre-paint box covers and conduit fittings.
- .3 Coding: use fluorescent orange paint and confirm colour with NRC Project Manager during "Preliminary Design Review".

3 EXECUTION

3.01 NAMEPLATES AND LABELS

- .1 Ensure that manufacturer's nameplates, CSA labels and identification nameplates are visible and legible at all times.

3.02 EXISTING PANELS

- .1 Correct existing nameplates and legends to reflect changes made during Work.

END OF SECTION

1 GENERAL

1.01 SUMMARY

- .1 Section Includes.
 - .1 Requirements and procedures for warranty and activities during warranty period and service contracts, for building Energy Monitoring and Control System (EMCS).
- .3 References.
 - .1 Canada Labour Code (R.S. 1985, c. L-2)/Part I - Industrial Relations.
 - .2 Canadian Standards Association (CSA International).
 - .1 CSA Z204-94(R1999), Guidelines for Managing Indoor Air Quality in Office Buildings.

1.02 DEFINITIONS

- .1 BC(s) - Building Controller(s).
- .2 OWS - Operator Work Station.
- .3 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 10 00 – General Instructions.
- .2 Submit detailed preventative maintenance schedule for system components to NRC Project Manager.
- .3 Submit detailed inspection reports to NRC Project Manager.
- .4 Submit dated, maintenance task lists to NRC Project Manager and include the following sensor and output point detail, as proof of system verification:
 - .1 Point name and location.
 - .2 Device type and range.
 - .3 Measured value.
 - .4 System displayed value.
 - .5 Calibration detail
 - .6 Indication if adjustment required,
 - .7 Other action taken or recommended.
- .5 Submit network analysis report showing results with detailed recommendations to correct problems found.
- .6 Records and logs: in accordance with Section 01 10 00 – General Instructions.
 - .1 Maintain records and logs of each maintenance task on site.
 - .2 Organize cumulative records for each major component and for entire EMCS chronologically.
 - .3 Submit records to NRC Project Manager, after inspection indicating that planned and systematic maintenance have been accomplished.
- .7 Revise and submit to NRC Project Manager in accordance with Section 01 10 00 – General Instructions "As-built drawings" documentation and commissioning reports to reflect changes, adjustments and modifications to EMCS made during warranty period.

1.04 MAINTENANCE SERVICE DURING WARRANTY PERIOD

- .1 Provide services, materials, and equipment to maintain EMCS for specified warranty period. Provide detailed preventative maintenance schedule for system components as described in Submittal article.
- .2 Emergency Service Calls:
 - .1 Initiate service calls when EMCS is not functioning correctly.
 - .2 Qualified control personnel to be available during warranty period to provide service to "CRITICAL" components whenever required at no extra cost.
 - .3 Furnish NRC Project Manager with telephone number where service personnel may be reached at any time.
 - .4 Service personnel to be on site ready to service EMCS within 2 hours after receiving request for service.
 - .5 Perform Work continuously until EMCS restored to reliable operating condition.
- .3 Operation: foregoing and other servicing to provide proper sequencing of equipment and satisfactory operation of EMCS based on original design conditions and as recommended by manufacturer.
- .4 Work requests: record each service call request, when received separately on approved form and include:
 - .1 Serial number identifying component involved.
 - .2 Location, date and time call received.
 - .3 Nature of trouble.
 - .4 Names of personnel assigned.
 - .5 Instructions of work to be done.
 - .6 Amount and nature of materials used.
 - .7 Time and date work started.
 - .8 Time and date of completion.
- .5 Provide system modifications in writing.
 - .1 No system modification, including operating parameters and control settings, to be made without prior written approval of NRC Project Manager.

2 PRODUCTS

2.01 NOT USED

- .1 Not Used.

3 EXECUTION

3.01 FIELD QUALITY CONTROL

- .1 Perform as minimum (3) three minor inspections and one major inspection (more often if required by manufacturer) per year. Provide detailed written report to NRC Project Manager as described in Submittal article.
- .2 Perform inspections during regular working hours, 0800 to 1630 h, Monday through Friday, excluding statutory holidays.
- .3 Following inspections are minimum requirements and should not be interpreted to mean satisfactory performance:
 - .1 Perform calibrations using test equipment having traceable, certifiable accuracy at minimum 50% greater than accuracy of system displaying or logging value.

- .2 Check and Calibrate each field input/output device in accordance with Canada Labour Code - Part I and CSA Z204.
- .3 Provide dated, maintenance task lists, as described in Submittal article, as proof of execution of complete system verification.
- .4 Minor inspections to include, but not limited to:
 - .1 Perform visual, operational checks to BC's, peripheral equipment, interface equipment and other panels.
 - .2 Check equipment cooling fans as required.
 - .3 Visually check for mechanical faults, air leaks and proper pressure settings on pneumatic components.
 - .4 Review system performance with NRC Project Manager to discuss suggested or required changes.
- .5 Major inspections to include, but not limited to:
 - .1 Minor inspection.
 - .2 Clean OWS(s) peripheral equipment, BC(s), interface and other panels, micro-processor interior and exterior surfaces.
 - .3 Check signal, voltage and system isolation of BC(s), peripherals, interface and other panels.
 - .4 Verify calibration/accuracy of each input and output device and recalibrate or replace as required.
 - .5 Provide mechanical adjustments, and necessary maintenance on printers.
 - .6 Run system software diagnostics as required.
 - .7 Install software and firmware enhancements to ensure components are operating at most current revision for maximum capability and reliability.
 - .1 Perform network analysis and provide report as described in Submittal article.
- .6 Rectify deficiencies revealed by maintenance inspections and environmental checks.
- .7 Continue system debugging and optimization.
- .8 Testing/verification of occupancy and seasonal-sensitive systems to take place during four (4) consecutive seasons, after facility has been accepted, taken over and fully occupied.
 - .1 Test weather-sensitive systems twice: first at near winter design conditions and secondly under near summer design conditions.

END OF SECTION

1 GENERAL

1.01 SUMMARY

- .1 Section Includes:
 - .1 Control devices integral to the Building Energy Monitoring and Control System (EMCS): transmitters, sensors, controls, meters, switches, transducers, dampers, damper operators, valves, valve actuators, and low voltage current transformers.
 - .2 Related Sections:
 - .1 Section 01 10 00 – General Instructions.
 - .2 Section 07 84 00 - Firestopping.
 - .3 Section 23 09 43 - Pneumatic Control System for HVAC.
 - .4 Section 23 33 15 - Dampers - Operating.
 - .5 Section 25 01 11 - EMCS: Start-Up, Verification and Commissioning.
 - .6 Section 25 05 01 - EMCS: General Requirements.
 - .7 Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
 - .8 Section 25 05 54 - EMCS: Identification.
 - .9 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.
 - .10 Section 26 05 00 - Common Work Results for Electrical.
 - .11 Section 26 27 10 - Modular Wiring System.
 - .12 Section 26 27 26 - Wiring Devices.

1.02 REFERENCES

- .1 American National Standards Institute (ANSI).
 - .1 ANSI C12.7-1993(R1999), Requirements for Watthour Meter Sockets.
 - .2 ANSI/IEEE C57.13-1993, Standard Requirements for Instrument Transformers.
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM B 148-97(03), Standard Specification for Aluminum-Bronze Sand Castings.
- .3 National Electrical Manufacturer's Association (NEMA).
 - .1 NEMA 250-03, Enclosures for Electrical Equipment (1000 Volts Maximum).
- .4 Air Movement and Control Association, Inc. (AMCA).
 - .1 AMCA Standard 500-D-98, Laboratory Method of Testing Dampers For Rating.
- .5 Canadian Standards Association (CSA International).
 - .1 CSA-C22.1-02, Canadian Electrical Code, Part 1 (19th Edition), Safety Standard for Electrical Installations.

1.03 DEFINITIONS

- .1 Acronyms and Definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.04 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 25 05 02 - EMCS: Submittals and Review Process.
- .2 Pre-Installation Tests.
 - .1 Submit samples at random from equipment shipped, as requested by NRC Project Manager, for testing before installation. Replace devices not meeting specified performance and accuracy.

- .3 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions for specified equipment and devices.

1.05 EXISTING CONDITIONS

- .1 Cutting and Patching: in accordance with Section 01 10 00 – General Instructions supplemented as specified herein.
- .2 Repair surfaces damaged during execution of Work.
- .3 Turn over to NRC Project Manager existing materials removed from Work not identified for re-use.

2 PRODUCTS

2.01 GENERAL

- .1 Control devices of each category to be of same type and manufacturer.
- .2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, shockproof, vibration-proof, heat resistant, assembly.
- .3 Operating conditions: 0 - 32 degrees C with 10 - 90% RH (non-condensing) unless otherwise specified.
- .4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.
- .5 Transmitters and sensors to be unaffected by external transmitters including walkie talkies.
- .6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.
- .7 Outdoor installations: use weatherproof construction in NEMA 4 enclosures.
- .8 Devices installed in user occupied space not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.
- .9 Range: including temperature, humidity, pressure, as indicated in I/O summary in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.

2.02 TEMPERATURE SENSORS

- .1 General: except for room sensors to be resistance or thermocouple type to following requirements:
 - .1 Thermocouples: limit to temperature range of 200 degrees C and over.
 - .2 RTD's: 100 or 1000 ohm at 0 degrees C (plus or minus 0.2 ohms) platinum element with strain minimizing construction, 3 integral anchored lead wires. Coefficient of resistivity: 0.00385 ohms/ohm degrees C.
 - .3 Sensing element: hermetically sealed.
 - .4 Stem and tip construction: copper or type 304 stainless steel.
 - .5 Time constant response: less than 3 seconds to temperature change of 10 degrees C.
 - .6 Immersion wells: NPS 3/4, stainless steel spring loaded construction, with heat transfer compound compatible with sensor. Insertion length 100 150 mm as indicated.
- .2 Room temperature sensors and display wall modules.
 - .1 Temperature sensing and display wall module.

- .1 LCD display to show space temperature and temperature setpoint.
- .2 Buttons for occupant selection of temperature setpoint and occupied/unoccupied mode.
- .3 Jack connection for plugging in laptop personal computer contractor supplied zone terminal unit contractor supplied palm compatible handheld device for access to zone bus.
- .4 Integral thermistor sensing element 10,000 ohm at 24 degrees.
- .5 Accuracy 0.2 degrees C over range of 0 to 70 degrees C.
- .6 Stability 0.02 degrees C drift per year.
- .7 Separate mounting base for ease of installation.
- .2 Room temperature sensors:
 - .1 Wall mounting, in slotted type covers having brushed aluminum brushed stainless steel finish, with guard as indicated.
 - .2 Element 10-50 mm long RTD with ceramic tube or equivalent protection or thermistor, 10,000 ohm, accuracy of plus or minus 0.2 degrees C.
- .3 Duct temperature sensors:
 - .1 General purpose duct type: suitable for insertion into ducts at various orientations, insertion length 460 mm or as indicated.
 - .2 Averaging duct type: incorporates numerous sensors inside assembly which are averaged to provide one reading. Minimum insertion length 6000 mm. Bend probe at field installation time to 100 mm radius at point along probe without degradation of performance.
- .4 Outdoor air temperature sensors:
 - .1 Outside air type: complete with probe length 100 - 150 mm long, non-corroding shield to minimize solar and wind effects, threaded fitting for mating to 13 mm conduit, weatherproof construction in NEMA 4 enclosure.

2.03 TEMPERATURE TRANSMITTERS

- .1 Requirements:
 - .1 Input circuit: to accept 3-lead, 100 or 1000 ohm at 0 degrees C, platinum resistance detector type sensors.
 - .2 Power supply: 24 V DC into load of 575 ohms. Power supply effect less than 0.01 degrees C per volt change.
 - .3 Output signal: 4 - 20 mA into 500 ohm maximum load.
 - .4 Input and output short circuit and open circuit protection.
 - .5 Output variation: less than 0.2 % of full scale for supply voltage variation of plus or minus 10 %.
 - .6 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 0.5 % of full scale output.
 - .7 Maximum current to 100 or 1000 ohm RTD sensor: not to exceed 25 mA.
 - .8 Integral zero and span adjustments.
 - .9 Temperature effects: not to exceed plus or minus 1.0 % of full scale/ 50 degrees C.
 - .10 Long term output drift: not to exceed 0.25 % of full scale/ 6 months.
 - .11 Transmitter ranges: select narrowest range to suit application from following:
 - .1 Minus 50 degrees C to plus 50 degrees C, plus or minus 0.5 degrees C.
 - .2 0 to 100 degrees C, plus or minus 0.5 degrees C.
 - .3 0 to 50 degrees C, plus or minus 0.25 degrees C.
 - .4 0 to 25 degrees C, plus or minus 0.1 degrees C.
 - .5 10 to 35 degrees C, plus or minus 0.25 degrees C.

2.04 HUMIDITY SENSORS

- .1 Room and Duct Requirements:
 - .1 Range: 5 - 90 % RH minimum.

- .2 Operating temperature range: 0 - 60 degrees C.
 - .3 Absolute accuracy:
 - .1 Duct sensors: plus or minus 3%.
 - .2 Room sensors: plus or minus 2%.
 - .4 Sheath: stainless steel with integral shroud for specified operation in air streams of up to 10 m/s.
 - .5 Maximum sensor non-linearity: plus or minus 2% RH with defined curves.
 - .6 Room sensors: locate in air stream near RA grille wall mounted as indicated.
 - .7 Duct mounted sensors: locate so that sensing element is in air flow in duct.
- .2 Outdoor Humidity Requirements:
- .1 Range: 0 - 100 % RH minimum.
 - .2 Operating temperature range: -40 - 50 degrees C.
 - .3 Absolute accuracy: plus or minus 2%.
 - .4 Temperature coefficient: plus or minus 0.03%RH/ degrees C over 0 to 50 degrees C.
 - .5 Must be unaffected by condensation or 100% saturation.
 - .6 No routine maintenance or calibration is required.

2.05 HUMIDITY TRANSMITTERS

- .1 Requirements:
- .1 Input signal: from RH sensor.
 - .2 Output signal: 4 - 20 mA onto 500 ohm maximum load.
 - .3 Input and output short circuit and open circuit protection.
 - .4 Output variations: not to exceed 0.2 % of full scale output for supply voltage variations of plus or minus 10 %.
 - .5 Output linearity error: plus or minus 1.0% maximum of full scale output.
 - .6 Integral zero and span adjustment.
 - .7 Temperature effect: plus or minus 1.0 % full scale/ 6 months.
 - .8 Long term output drift: not to exceed 0.25 % of full scale output/ 6 months.

2.06 PRESSURE TRANSDUCERS

- .1 Requirements:
- .1 Combined sensor and transmitter measuring pressure.
 - .1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.
 - .2 Output signal: 4 - 20 mA into 500 ohm maximum load.
 - .3 Output variations: less than 0.2 % full scale for supply voltage variations of plus or minus 10 %.
 - .4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5 % of full scale output over entire range.
 - .5 Temperature effects: not to exceed plus or minus 1.5 % full scale/ 50 degrees C.
 - .6 Over-pressure input protection to at least twice rated input pressure.
 - .7 Output short circuit and open circuit protection.
 - .8 Accuracy: plus or minus 1% of Full Scale.

2.07 DIFFERENTIAL PRESSURE TRANSMITTERS

- .1 Requirements:
- .1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.
 - .2 Output signal: 4 - 20 mA into 500 ohm maximum load.
 - .3 Output variations: less than 0.2 % full scale for supply voltage variations of plus or minus 10 %.
 - .4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5 % of full scale output over entire range.
 - .5 Integral zero and span adjustment.

- .6 Temperature effects: not to exceed plus or minus 1.5 % full scale/ 50 degrees C.
- .7 Over-pressure input protection to at least twice rated input pressure.
- .8 Output short circuit and open circuit protection.
- .9 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit.

2.08 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES

- .1 Requirements:
 - .1 Internal materials: suitable for continuous contact with compressed air, water, steam, etc., as applicable.
 - .2 Adjustable setpoint and differential.
 - .3 Switch: snap action type, rated at 120V, 15 amps AC or 24 V DC.
 - .4 Switch assembly: to operate automatically and reset automatically when conditions return to normal. Over-pressure input protection to at least twice rated input pressure.
 - .5 Accuracy: within 2% repetitive switching.
 - .6 Provide switches with isolation valve and snubber, where code allows, between sensor and pressure source.
 - .7 Switches on steam and high temperature hot water service: provide pigtail syphon.

2.09 TEMPERATURE SWITCHES

- .1 Requirements:
 - .1 Operate automatically. Reset automatically, except as follows:
 - .1 Low temperature detection: manual reset.
 - .2 High temperature detection: manual reset.
 - .2 Adjustable setpoint and differential.
 - .3 Accuracy: plus or minus 1 degrees C.
 - .4 Snap action rating: 120V, 15 amps or 24V DC as required. Switch to be DPST for hardwire and EMCS connections.
 - .5 Type as follows:
 - .1 Room: for wall mounting on standard electrical box with without protective guard as indicated.
 - .2 Duct, general purpose: insertion length = 460 mm.
 - .3 Thermowell: stainless steel, with compression fitting for NPS 3/4 thermowell. Immersion length: 100 mm.
 - .4 Low temperature detection: continuous element with 6000 mm insertion length, duct mounting, to detect coldest temperature in any 30 mm length.
 - .5 Strap-on: with helical screw stainless steel clamp.

2.10 CONTROL DAMPERS

- .1 Construction: blades, 152 mm wide, 1219 mm long, maximum. Modular maximum size, 1219 mm wide x 1219 mm high. Three or more sections to be operated by jack shafts.
- .2 Materials:
 - .1 Frame: 2.03 mm minimum thickness extruded aluminum. For outdoor air and exhaust air applications, frames to be insulated.
 - .2 Blades: extruded aluminum. For outdoor air/exhaust air applications, blades to be internally insulated.
 - .3 Bearings: maintenance free, synthetic type of material.
 - .4 Linkage and shafts: aluminum, zinc and nickel plated steel.
 - .5 Seals: synthetic type, mechanically locked into blade edges.
 - .1 Frame seals: synthetic type, mechanically locked into frame sides.
- .3 Performance: minimum damper leakage meet or exceed AMCA Standard 500-D ratings.
 - .1 Size/Capacity: refer to damper schedule
 - .2 25 L/s/mi. maximum allowable leakage against 1000 Pa static pressure for outdoor air

- and exhaust air applications.
- .3 Temperature range: minus 40 degrees C to plus 100 degrees C.
- .4 Arrangements: dampers mixing warm and cold air to be parallel blade, mounted at right angles to each other, with blades opening to mix air stream.
- .5 Jack shafts:
 - .1 25 mm diameter solid shaft, constructed of corrosion resistant metal complete with required number of pillow block bearings to support jack shaft and operate dampers throughout their range.
 - .2 Include corrosion resistant connecting hardware to accommodate connection to damper actuating device.
 - .3 Install using manufacturers installation guidelines.
 - .4 Use same manufacturer as damper sections.

2.11 ELECTRONIC CONTROL DAMPER ACTUATORS

- .1 Requirements:
 - .1 Direct mount proportional type as indicated.
 - .2 Spring return for "fail-safe" in Normally Open or Normally Closed position as indicated.
 - .3 Operator: size to control dampers against maximum pressure and dynamic closing/opening pressure, whichever is greater.
 - .4 Power requirements: 5 VA maximum at 24 V AC.
 - .5 Operating range: 0 - 10 V DC or 4 - 20 mA DC.
 - .6 For VAV box applications floating control type actuators may be used.
 - .7 Damper actuator to drive damper from full open to full closed in less than 120 seconds.

2.12 CONTROL VALVES

- .1 Body: globe style, characterized ball.
 - .1 Flow characteristic as indicated on control valve schedule: linear, equal percentage, quick opening.
 - .2 Flow factor (KV) as indicated on control valve schedule: CV in imperial units.
 - .3 Normally open normally closed, as indicated.
 - .4 Two Three port, as indicated.
 - .5 Leakage rate ANSI class IV, 0.01% of full open valve capacity.
 - .6 Packing easily replaceable.
 - .7 Stem, stainless steel.
 - .8 Plug and seat, stainless steel, brass, bronze.
 - .9 Disc, replaceable, material to suit application.
 - .10 NPS 2 and under:
 - .1 Screwed National Pipe Thread (NPT) tapered female connections.
 - .2 Valves to ANSI Class 250, valves to bear ANSI mark.
 - .3 Rangeability 50:1 minimum.
 - .11 NPS 2½ and larger:
 - .1 Flanged connections.
 - .2 Valves to ANSI Class 150 or 250 as indicated, valves to bear ANSI mark.
 - .3 Rangeability 100:1 minimum.
- .2 Butterfly Valves NPS 2 and larger:
 - .1 Body: for chilled water ANSI Class 150 cast iron lugged body and wafer body installed in locations as indicated. For steam and heating water ANSI Class 150 carbon steel lugged body and wafer body.
 - .2 End connections to suit flanges that are ANSI Class 150.
 - .3 Extended stem neck to provide adequate clearance for flanges and insulation.
 - .4 Pressure limit: bubble tight sealing to 170 kilopascals.
 - .5 Disc/vane: 316 stainless steel, aluminum bronze to ASTM B 148.

- .6 Seat: for service on chilled water PTFE (polytetrafluoroethylene), EPDM (ethylene propylene diene monomer). For service on steam and heating water PTFE, RTFE (reinforced PTFE).
- .7 Stem: 316 stainless steel.
- .8 Flow factor (KV) as indicated on control valve schedule: CV in imperial units.
- .9 Flow characteristic linear.
- .10 Maximum flow requirement as indicated on control valve schedule.
- .11 Maximum pressure drop as indicated on control valve schedule: pressure drop not to exceed one half of inlet pressure.
- .12 Normally open normally closed, as indicated.
- .13 Valves are to be provided complete with mounting plate for installation of actuators.

2.13 ELECTRONIC / ELECTRIC VALVE ACTUATORS

- .1 Requirements:
 - .1 Construction: steel, cast iron, aluminum.
 - .2 Control signal: 0-10V DC or 4-20 mA DC.
 - .3 Positioning time: to suit application. 90 sec maximum.
 - .4 Fail to normal position as indicated.
 - .5 Scale or dial indication of actual control valve position.
 - .6 Size actuator to meet requirements and performance of control valve specifications.
 - .7 For interior and perimeter terminal heating and cooling applications floating control actuators are acceptable.
 - .8 Minimum shut-off pressure: refer to control valve schedule.

2.14 PANELS

- .1 Free-standing wall mounted enamelled steel cabinets with hinged and key-locked front door.
- .2 Multiple panels as required indicated to handle requirements with additional space to accommodate 25% additional capacity as required by NRC Project Manager without adding additional cabinets.
- .3 Panels to be lockable with same key.

2.15 WIRING

- .1 In accordance with Section 26 27 10 - Modular Wiring System 26 27 26 - Wiring Devices.
- .2 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. Other cases use FT4 wiring.
- .3 Wiring must be continuous without joints.
- .4 Sizes:
 - .1 Field wiring to digital device: #18AWG 20AWG stranded twisted pair.
 - .2 Analog input and output: shielded #18 minimum solid copper #20 minimum stranded twisted pair.

3 EXECUTION

3.01 INSTALLATION

- .1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.
- .2 Install field control devices in accordance with manufacturers recommended methods,

- procedures and instructions.
- .3 Temperature transmitters, humidity transmitters, current-to-pneumatic transducers, solenoid air valves, controllers, relays: install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.
 - .4 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.
 - .5 Fire stopping: provide space for fire stopping in accordance with Section 07 84 00 - Firestopping. Maintain fire rating integrity.
 - .6 Electrical:
 - .1 Complete installation in accordance with Section 26 05 00 - Common Work Results for Electrical.
 - .2 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.
 - .3 Refer to electrical control schematics included as part of control design schematics in Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation on drawings. Trace existing control wiring installation and provide updated wiring schematics including additions, deletions to control circuits for review by NRC Project Manager before beginning Work.
 - .4 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.
 - .5 Install communication wiring in conduit.
 - .1 Provide complete conduit system to link Building Controllers, field panels and OWS(s).
 - .2 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.
 - .3 Maximum conduit fill not to exceed 40%.
 - .4 Design drawings do not show conduit layout.
 - .6 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. NRC Project Manager to review before starting Work. Wiring in mechanical rooms, wiring in service rooms and exposed wiring must be in conduit.
 - .7 Mechanical: supply and install in accordance with Section 23 09 43 - Pneumatic Control System for HVAC.
 - .1 Pipe Taps.
 - .2 Wells and Control Valves.
 - .3 Air flow stations, dampers, and other devices.
 - .8 VAV Terminal Units: supply, install and adjust as required.
 - .1 Air probe, actuator and associated vav controls.
 - .2 Tubing from air probe to dp sensor as well as installation and adjustment of air flow sensors and actuators.
 - .3 Co-ordinate air flow adjustments with balancing trade.

3.02 TEMPERATURE AND HUMIDITY SENSORS

- .1 Stabilize to ensure minimum field adjustments or calibrations.
- .2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.
- .3 Outdoor installation:
 - .1 Protect from solar radiation and wind effects by non-corroding shields.
 - .2 Install in NEMA 4 enclosures.

- .4 Duct installations:
 - .1 Do not mount in dead air space.
 - .2 Locate within sensor vibration and velocity limits.
 - .3 Securely mount extended surface sensor used to sense average temperature.
 - .4 Thermally isolate elements from brackets and supports to respond to air temperature only.
 - .5 Support sensor element separately from coils, filter racks.
- .5 Averaging duct type temperature sensors.
 - .1 Install averaging element horizontally across the ductwork starting 300 mm from top of ductwork. Each additional horizontal run to be no more than 300 mm from one above it. Continue until complete cross sectional area of ductwork is covered. Use multiple sensors where single sensor does not meet required coverage.
 - .2 Wire multiple sensors in series for low temperature protection applications.
 - .3 Wire multiple sensors separately for temperature measurement.
 - .4 Use software averaging algorithm to derive overall average for control purposes.
- .6 Thermowells: install for piping installations.
 - .1 Locate well in elbow where pipe diameter is less than well insertion length.
 - .2 Thermowell to restrict flow by less than 30%.
 - .3 Use thermal conducting paste inside wells.

3.03 PANELS

- .1 Arrange for conduit and tubing entry from top, bottom or either side.
- .2 Wiring and tubing within panels: locate in trays or individually clipped to back of panel.
- .3 Identify wiring and conduit clearly.

3.04 MAGNEHELIC PRESSURE INDICATORS

- .1 Install adjacent to fan system static pressure sensor and duct system velocity pressure sensor as reviewed by NRC Project Manager.
- .2 Locations: as indicated as specified.

3.05 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES AND SENSORS

- .1 Install isolation valve and snubber on sensors between sensor and pressure source where code allows.
 - .1 Protect sensing elements on steam and high temperature hot water service with pigtail syphon between valve and sensor.

3.06 I/P TRANSDUCERS

- .1 Install air pressure gauge on outlet.

3.07 AIR PRESSURE GAUGES

- .1 Install pressure gauges on pneumatic devices, I/P, pilot positioners, motor operators, switches, relays, valves, damper operators, valve actuators.
- .2 Install pressure gauge on output of auxiliary cabinet pneumatic devices.

3.08 IDENTIFICATION

- .1 Identify field devices in accordance with Section 25 05 54 - EMCS: Identification.

3.09 AIR FLOW MEASURING STATIONS

- .1 Protect air flow measuring assembly until cleaning of ducts is completed.

3.10 TESTING AND COMMISSIONING

- .1 Calibrate and test field devices for accuracy and performance in accordance with Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

END OF SECTION

Part 1 General

1 REFERENCES

- .1 Perform all work to meet or exceed the requirements of the Canadian Electrical Code, CSA Standard C22.1 - (latest edition).
- .2 Consider CSA Electrical Bulletins in force at time of tender submission, while not identified and specified by number in this Division, to be forming part of related CSA Part II standard.
- .3 Do overhead and underground systems in accordance with CSA C22.3 except where specified otherwise.
- .4 Where requirements of this specification exceed those of above mentioned standards, this specification shall govern.
- .5 Notify the NRC Departmental Representative as soon as possible when requested to connect equipment supplied by NRC which is not CSA approved.
- .6 Refer to Sections 01 10 00 – General Instructions.
- .7 Electrical shutdowns are to be done after normal working hours. Coordinate all shutdowns with the NRC departmental representative prior to scheduling of shutdowns.

2 PERMITS AND FEES

- .1 Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.
- .2 Pay all fees required for the performance of the work.

3 START-UP

- .1 Instruct the NRC Departmental Representative and operating personnel in the operation, care and maintenance of equipment supplied under this contract.

4 INSPECTION AND FEES

- .1 Furnish a Certificate of Acceptance from the Authorized Electrical Inspection Department on completion of work.
- .2 Request and obtain Special Inspection approval from the Authorized Electrical Inspection Department for any non-CSA approved control panels or other equipment fabricated by the contractor as part of this contract.
- .3 Pay all fees required for inspections.

5 FINISHES

- .1 Shop finish metal enclosure surfaces by removal of rust and scale, cleaning, application of rust resistant primer inside and outside, and at least two coats of finish enamel.
 - .1 Outdoor electrical equipment "equipment green" finish to EEMAC Y1-1-1955.
 - .2 Indoor switchgear and distribution enclosures light grey to EEMAC 2Y-1-1958.

- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

6 ACOUSTICAL PERFORMANCE

- .1 In general provide equipment producing minimal sound levels in accordance with the best and latest practices established by the electrical industry.
- .2 Do not install any device or equipment containing a magnetic flux path metallic core, such as gas discharge lamp ballasts, dimmers, solenoids, etc., which are found to produce a noise level exceeding that of comparable available equipment.

7 EQUIPMENT IDENTIFICATION

- .1 Identify with 3mm (1/8") Brother, P-Touch non-smearing tape, or an alternate approved by the NRC Departmental Representative, all electrical outlets shown on drawings and/or mentioned in the specifications. These are the lighting switches, recessed and surface mounted receptacles such as those in offices and service rooms and used to plug in office equipment, telecommunication equipment or small portable tools. Indicate only the source of power (Ex. for a receptacle fed from panel L32 circuit #1: "L32-1").
- .2 Light fixtures are the only exceptions for electrical equipment identification (except as noted in 7.13 below). They are not to be identified.
- .3 Identify with lamicaid nameplates all electrical equipment shown on the drawings and/or mentioned in the specification such as motor control centers, switchgear, splitters, fused switches, isolation switches, motor starting switches, starters, panelboards, transformers, high voltage cables, industrial type receptacles, junction boxes, control panels, etc., regardless of whether or not the electrical equipment was furnished under this section of the specification.
- .4 Coordinate names of equipment and systems with other Divisions to ensure that names and numbers match.
- .5 Wording on lamicaid nameplates to be approved by the NRC Departmental Representative prior to fabrication.
- .6 Provide two sets of lamicaid nameplates for each piece of equipment; one in English and one in French.
- .7 Lamicaid nameplates shall identify the equipment, the voltage characteristics and the power source for the equipment. Example: A new 120/240 volt single phase circuit breaker panelboard, L16, is fed from panelboard LD1 circuit 10.

"PANEL L16
120/240 V
FED FROM LD1-10"

PANNEAU L16
120/240 V
ALIMENTE PAR LD1-10

- .8 Provide warning labels for equipment fed from two or more sources - "DANGER MULTIPLE POWER FEED" black letters on a yellow background. These labels are available from NRC's Facilities Maintenance group in building M-19.
- .9 Lamicaid nameplates shall be rigid lamicaid, minimum 1.5 mm (1/16") thick with:

- .1 Black letters engraved on a white background for normal power circuits.
- .2 Black letters engraved on a yellow background for emergency power circuits.
- .3 White letters engraved on a red background for fire alarm equipment.
- .10 For all interior lamicoid nameplates, mount nameplates using two-sided tape.
- .11 For all exterior lamicoid nameplates, mount nameplates using self-tapping 2.3 mm (3/32") dia. slot head screws - two per nameplate for nameplates under 75 mm (3") in height and a minimum of 4 for larger nameplates. Holes in lamicoid nameplates to be 3.7 mm (3/16") diameter to allow for expansion of lamicoid due to exterior conditions.
 - .1 No drilling is to be done on live equipment.
 - .2 Metal filings from drilling are to be vacuumed from the enclosure interiors.
- .12 All lamicoid nameplates shall have a minimum border of 3 mm (1/8"). Characters shall be 9 mm (3/8") in size unless otherwise specified.
- .13 Identify lighting fixtures which are connected to emergency power with a label "EMERGENCY LIGHTING/ÉCLAIRAGE D'URGENCE", black letters on a yellow background. These labels are available from NRC's Facilities Maintenance group in building M-19.
- .14 Provide neatly typed updated circuit directories in a plastic holder on the inside door of new panelboards.
- .15 Carefully update panelboard circuit directories whenever adding, deleting, or modifying existing circuitry.
- .16 Identify molded case breaker with lamicoid nameplate.

8 WIRING IDENTIFICATION

- .1 Unless otherwise specified, identify wiring with permanent indelible identifying markings, using either numbered or coloured plastic tapes on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.

9 CONDUIT AND CABLE IDENTIFICATION

- .1 All new conduits to be factory painted, colour-coded EMT, type as follows:
 - .1 Fire alarm – red conduit
 - .2 Emergency power circuits – yellow conduit
 - .3 Voice/data – blue conduit
 - .4 Gas detection system – purple conduit
 - .5 Building Automation system – orange conduit
 - .6 Security system – green conduit
 - .7 Control system – black conduit
- .2 Apply paint to the covers of junction boxes and condulets of existing conduits as follows:
 - .1 Fire alarm – red
 - .2 Emergency power circuits – yellow
 - .3 Voice/data – blue
 - .4 Gas detection system – purple
 - .5 Building Automation system – orange

- .6 Security system – green
- .7 Control system - black
- .3 For system running with cable, half-lap wrap with dedicated coloured PVC tape to 100 mm width, tape every 5 m and both sides where cable penetrates a wall.
- .4 All other systems need not be coloured.

10 MANUFACTURER'S & APPROVALS LABELS

- .1 Ensure that manufacturer's registration plates are properly affixed to all apparatus showing the size, name of equipment, serial number, and all information usually provided, including voltage, cycle, phase and the name and address of the manufacturer.
- .2 Do not paint over registration plates or approval labels. Leave openings through insulation for viewing the plates. Contractor's or sub-contractor's nameplate not acceptable.

11 WARNING SIGNS AND PROTECTION

- .1 Provide warning signs, as specified or to meet requirements of Authorized Electrical Inspection Department and NRC Departmental Representative.
- .2 Accept the responsibility to protect those working on the project from any physical danger due to exposed live equipment such as panel mains, outlet wiring, etc. Shield and mark all live parts with the appropriate voltage. Caution notices shall be worded in both English and French.

12 LOAD BALANCE

- .1 Measure phase current to new panelboards with normal loads operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes, and revise panelboard schedules.
- .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

13 MOTOR ROTATION

- .1 For new motors, ensure that motor rotation matches the requirements of the driven equipment.
- .2 For existing motors, check rotation before making wiring changes in order to ensure correct rotation upon completion of the job.

14 GROUNDING

- .1 Thoroughly ground all electrical equipment, cabinets, metal supporting frames, ventilating ducts and other apparatus where grounding is required in accordance with the requirements of the latest edition of the Canadian Electrical Code Part 1, C.S.A. C22.1 and corresponding Provincial and Municipal regulations. Do not depend upon conduits to provide the ground circuits.
- .2 Run separate green insulated stranded copper grounding conductors in all electrical conduits including those feeding toggle switches and receptacles.

15 TESTS

- .1 Provide any materials, equipment and labour required and make such tests deemed necessary to show proper execution of this work, in the presence of the NRC Departmental Representative.
- .2 Correct any defects or deficiencies discovered in the work in an approved manner at no additional expense to the Owner.
- .3 Megger all branch circuits and feeders using a 600V tester for 240V circuits and a 1000V tester for 600V circuits. If the resistance to ground is less than permitted by Table 24 of the Code, consider such circuits defective and do not energize.
- .4 The final approval of insulation between conductors and ground, and the efficiency of the grounding system is left to the discretion of the local Electrical Inspection Department.

16 COORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, fuses, are installed to values and settings as indicated on the Drawings.

17 WORK ON LIVE EQUIPMENT & PANELS

- .1 NRC requires that work be performed on non-energized equipment, installation, conductors and power panels. For purposes of quotation assume that all work is to be done after normal working hours and that equipment, installation, conductors and power panels are to be de-energized when worked upon.

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

- .1 Common Work Results - Electrical Section 26 05 00.

1.2 MATERIALS

- .1 Provide only new equipment and materials, without blemish or defect, bearing Canadian Standards Association or Authorized Electrical Inspection Department labels, and subject to the approval of the NRC Departmental Representative.
- .2 After a contract is awarded, utilize alternative methods and/or materials only after receiving the NRC Departmental Representative's approval.

Part 2 Products

2.1 BUILDING WIRES AND GENERAL REQUIREMENTS

- .1 Conductor material for branch circuit wiring and grounding:
 - .1 Stranded copper.
 - .2 Neutral wire: continuous throughout its length without breaks.
 - .3 Separate insulated green grounding conductors in all electrical conduits.
 - .4 All wire and cable insulation shall meet the C.S.A. Standards for the types and services hereinafter specified. Colours as per section 4-036 of Electrical Code.
 - .5 Where otherwise specified, use wire and cable types as follows:
 - .1 Type R90 XLPE cross-link polyethylene stranded for applications using wires sized No. 8 and larger.
 - .2 Type T90 stranded for applications using wires sized No. 10 and smaller.
 - .3 For fire alarm wiring refer to Section 283100.
 - .4 Approved heat resistant wire for wiring through and at lighting and heating fixtures. Where insulation types are shown on the drawings other types shall not be used unless the specification is more restrictive.
 - .6 Use BX cable only under the following conditions:
 - .1 Wiring from a junction box to a recessed lighting fixture in suspended ceilings. Cable length not to exceed 1.5 m (5'), or
 - .2 Wiring or switches or 15 amp receptacles in partitions having removable wall panels, or
 - .3 When specifically called for on drawings.
 - .7 Use stranded wire no smaller than No. 12 AWG for lighting and power and no smaller than No. 16 AWG for control wiring.
 - .8 Conductors shall be soft copper properly refined and tinned having a minimum conductivity of 98%.

Part 3 Execution

3.1 BUILDING WIRES

- .1 Install building wires as follows:

- .1 Make joints, taps and splices in approved boxes with solderless connectors. Joints and/or splices are not acceptable inside a panelboard.
- .2 Ensure the lugs accommodate all the strands of the conductor.
- .3 Replace any wire or cable showing evidence of mechanical injury.
- .4 Use No. 10 AWG for branch circuit wiring extending more than 30 m (100 ft.) to farthest outlet from panel.
- .5 Circuit numbers indicated on the drawing are intended as a guide for the proper connection of multi-wire circuits at the panel.
- .6 Take care to keep the conductors free from twisting.
- .7 Use an approved lubricant for pulling in conduit.
- .8 Leave sufficient slack on all runs to permit proper splicing and connection of electrical devices.
- .9 Branch circuit wiring of 120 volt applications to be multi-wire utilizing common neutrals. Under no condition shall any switch break a neutral conductor.
- .10 Provide and install an approved fire- retardant wrap or coating for PVC jacketed cables installed in a grouped configuration of two or more.

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

- .1 Common Work Results - Electrical Section 26 05 00

1.2 MATERIALS

- .1 Provide only new equipment and materials, without blemish or defect, bearing Canadian Standards Association or Authorized Electrical Inspection Department labels, and subject to the approval of the NRC Departmental Representative.
- .2 After a contract is awarded, utilize alternative methods and/or materials only after receiving the NRC Departmental Representative's approval.

Part 2 Products

2.1 WIRE AND BOX CONNECTORS

- .1 Pressure type wire connectors sized to fit conductors.

2.2 WIRING TERMINATIONS

- .1 Provide first grade wire and cable connectors suitable for the service on which they are used and install them in accordance with the latest trade practice.
- .2 Provide high quality extruded copper-free aluminium (0.4% or less) connectors for single and multi conductor cable. Steel and then zinc plated connectors for multi conductor cables.
- .3 When used in hazardous area, connectors should be certified for such location in Class, Division and Group.
- .4 For large conductor sizes, use bolted or compression solderless type connectors.
- .5 Use high temperature connectors and insulation on all connections of high temperature conductors.
- .6 Where connector types are called for on the drawings or in the specification, do not use other types.
- .7 Lugs, terminals, screws used for termination of wiring to be suitable for copper conductors.
- .8 For fire alarm wiring refer to Section 28 31 00.

Part 3 Execution

3.1 INSTALLATION

- .1 Install stress cones, terminations, and splices in accordance with manufacturer's instructions.
- .2 Bond and ground as required to CSA C22.2No.41.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 00 - Common Work Results - Electrical.

Part 2 Products

2.1 EQUIPMENT

- .1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.
- .2 Copper conductor: minimum 6 m long for each concrete encased electrode, bare, stranded, tinned, soft annealed, size as indicated.
- .3 Rod electrodes: copper clad steel 19 mm dia by 3 m long.
- .4 Plate electrodes: galvanized steel, surface area 0.2 m², 1.6 mm thick.
- .5 Grounding conductors: bare stranded copper, tinned, soft annealed, size as indicated.
- .6 Insulated grounding conductors: green.
- .7 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
- .8 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Thermit welded type conductor connectors.
 - .5 Bonding jumpers, straps.
 - .6 Pressure wire connectors.

Part 3 Execution

3.1 INSTALLATION GENERAL

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermit process or permanent mechanical connectors or inspectable wrought copper compression connectors to ANSI/IEEE 837.

- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Soldered joints not permitted.
- .7 Install bonding wire for flexible conduit, connected at one end to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .8 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .9 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .10 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.

3.2 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of NRC Departmental Representative.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator during tests.

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

- .1 Common Work Results - Electrical Section 26 05 00

1.2 MATERIALS

- .1 Provide only new equipment and materials, without blemish or defect, bearing Canadian Standards Association or Authorized Electrical Inspection Department labels, and subject to the approval of the NRC Departmental Representative.
- .2 After a contract is awarded, utilize alternative methods and/or materials only after receiving the NRC Departmental Representative's approval.

Part 2 Products

2.1 FITTINGS

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
- .2 Steel coupling for EMT.
- .3 Fittings for liquid-tight flexible conduits shall be liquid-tight connectors.
- .4 Provide expansion couplings for all conduits running in slabs through expansion joints. These shall be the type approved for use in concrete with a bonding conductor.
- .5 Factory bends are not permitted to be modified. Ensure conduit bends other than factory bends are made with an approved bender. Making offsets and other bends by cutting and rejoining factory bends are not permitted.

2.2 OUTLET BOXES

- .1 Size boxes in accordance with CSA-C22.
- .2 Unless otherwise specified, provide galvanized steel outlet boxes at least 40mm (1-1/2") deep, single or ganged style, of proper size to accommodate devices used and shall be equipped with covers as necessary of the type designed for the specified fittings. Pull boxes shall be steel and shall be galvanized or painted to prevent rusting. For lighting fixture outlets, use 100mm (4") octagon boxes.
- .3 Equip with plaster rings for flush mounting devices in finished walls.
- .4 Blank cover plates for boxes without wiring devices.
- .5 Equip with centre fixture studs for light fixtures.
- .6 Use cast boxes where indicated and for surface mounted wiring. In areas above hung ceilings where appearance is not significant, pressed steel surface boxes may be used.
- .7 Supply all outlet boxes and pull boxes sized according to code requirements unless specified otherwise on the drawings.

2.3 SUPPORT HARDWARE

- .1 Use 10mm (3/8") threaded rod for suspended unistrut and conduit.
- .2 Unless otherwise specified, use 41mm x 41mm (1-5/8" x 1-5/8") galvanized steel unistrut for conduit support systems.

Part 3 Execution

3.1 INSTALLATION

- .1 Install outlet boxes as follows:
 - .1 Support boxes independently of connecting conduits.
 - .2 Make necessary mounting adjustments to the outlet to match interior finish.
 - .3 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of construction material.
 - .4 Where more than one conduit enters a switch or receptacle box on the same side, provide a 100mm (4") minimum square box with a suitable plaster ring.
 - .5 Location and appearance to be to the NRC Departmental Representative's approval.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 10 00 – General Instructions.
- .2 Include schematic, wiring, interconnection diagrams.

Part 2 Products

2.1 CONTROL TRANSFORMER

- .1 Single phase, dry type, control transformer with primary voltage as indicated and 120V secondary, complete with secondary fuse, installed as indicated.
- .2 Size control transformer for control circuit load plus 20% spare capacity.

2.2 FINISHES

- .1 Apply finishes to enclosure in accordance with Section 26 05 00 Common Work Results - Electrical.

2.3 EQUIPMENT IDENTIFICATION

- .1 Apply finishes to enclosure in accordance with Section 26 05 00 Common Work Results - Electrical.
- .2 Provide equipment identification in accordance with Section 26 05 00 Common Work Results - Electrical.

Part 3 Execution

3.1 INSTALLATIONS

- .1 Install control transformers and interconnect as indicated.
- .2 Install correct fuses and overload device elements.

3.2 TESTS

- .1 Perform tests in accordance with Section 26 05 00 Common Work Results - Electrical and Manufacturer's instructions.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 10 00 – General Instructions.
- .2 Submit stamped engineered drawings for structures supporting transformers on walls or other structures other than the floor.
- .3 Prior to any installation of circuit breakers in either a new or existing installation, Contractor must submit three (3) copies of a certificate of origin, from the manufacturer, duly signed by the factory and the local manufacturer's representative, certifying that all circuit breakers come from this manufacturer, they are new and they meet standards and regulations. These certificates must be submitted to the Departmental Representative for approval.
 - .1 The above applies to all breakers rated above 240V.
 - .2 The above applies to all breakers rated up to 240V and 100A or more.
- .4 A delay in the production of the certificate of origin won't justify any extension of the contract and additional compensation.
- .5 Any work of manufacturing, assembly or installation should begin only after acceptance of the certificate of origin by Departmental Representative. Unless complying with this requirement, Departmental Representative reserves the right to mandate the manufacturer listed on circuit breakers to authenticate all new circuit breakers under the contract at the Contractor's expense.
- .6 In general, the certificate of origin must contain:
 - .1 The name and address of the manufacturer and the person responsible for authentication. The responsible person must sign and date the certificate;
 - .2 The name and address of the licensed dealer and the person of the distributor responsible for the Contractor's account.
 - .3 The name and address of the Contractor and the person responsible for the project.
 - .4 The name and address of the local Manufacturer's Representative. The local representative must sign and date the certificate.
 - .5 The name and address of the building where circuit breakers will be installed:
 - .1 Project title.
 - .2 End user's reference number.
 - .3 The list of circuit breakers.

1.2 IDENTIFICATION

- .1 Identification as per Section 26 05 00.

Part 2 Products

2.1 DISCONNECT SWITCHES, FUSED AND NON-FUSED

- .1 Fusible and non-fusible disconnect switches in EEMAC Enclosure as indicated.

- .2 Provision for padlocking in "OFF" switch position.
- .3 Mechanical voidable door interlock in "ON" position.
- .4 Fuses: size and type as indicated.
- .5 Fuseholders in each switch to be suitable without adaptors, for type and size of fuse indicated.
- .6 Quick-make, quick-break action.
- .7 "ON-OFF" switch position indication on switch enclosure cover.
- .8 Standard of acceptance: Square D, Cutler-Hammer, Siemens, ABB.

2.2 GROUNDING

- .1 Insulated grounding conductors in accordance with Section 26 05 00.
- .2 Compression connectors for grounding to equipment provided with lugs.

2.3 DRY TYPE TRANSFORMER

- .1 Type ANN, C802.2.
- .2 Single or three phase, KVA rating, input and output voltage as indicated.
- .3 Class 200, 130°C temperature rise insulation rating for 15kva and 30kva transformer. Class 220, 150°C temperature rise insulation system for other sizes.
- .4 Copper windings.
- .5 Four 2.5% taps, 2-FCAN and 2-FCBN.
- .6 EEMAC 1 enclosure with lifting lugs, removable metal front and side panels.
- .7 Drip shield.
- .8 Standard of acceptance: Hammond or approved equal.

2.4 PANELBOARDS

- .1 600 volt rated power panelboards: bus and breakers rated for 25,000 amp r.m.s. symmetrical interrupting capacity at 600V or as indicated.
- .2 250 volt lighting panelboards to have minimum interrupting capacity of 10,000 amp r.m.s. symmetrical.
- .3 Panelboards that have a main breaker indicated in plan shall be service entranced approved (i.e. barrier to separate main breaker from remainder of panels).
- .4 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- .5 Panelboards: mains, number of circuits, number and size of branch circuit breakers as indicated.

- .6 Two keys for each panelboard and all panelboards to be keyed alike.
- .7 Copper bus, neutral and ground bar with neutral of same ampere rating as mains.
- .8 Suitable for: plug-in breaker for molded case circuit breaker, bolt-on breakers for miniature circuit breaker
- .9 Trim and door finish: baked grey enamel.
- .10 Drip shield.
- .11 Surface mount with hinge door, unless otherwise indicated on drawing.
- .12 Complete circuit directory with typewritten legend showing description of each circuit.
- .13 Manufacturer: Square D or approved equal.

2.5 MOLDED CASE CIRCUIT BREAKER

- .1 Thermal-magnetic moulded case circuit breakers, quick-make, and quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.
- .2 Common-trip breakers with single handle for multiple applications.
- .3 All new 120V to 600V circuit breakers installed on this project are to include the handle accessory, "Handle Padlock Attachment", which locks breakers on or off.
- .4 Magnetic instantaneous trip elements in circuit breakers, to operate only when the value of current reaches 10 times their setting.
- .5 Circuit breaker and panel to be of same manufacturer.

Circuit breakers minimum interrupt rating: 25KA for 600/347V or greater if indicated.
- .6 Electronic trip unit as indicated by drawing.

LI: long time and instantaneous

LSI: long time, short time and instantaneous

LSIG: long time, short time, instantaneous and grounding

A: with Ammeter

E: with energy meter
- .7 On board control power for trip unit
- .8 Standard of acceptance: Square D or approved equal.

2.6 FUSES

- .1 250V and 600V time delay, rejection style, HRC-I, Class RK5.
- .2 Standard of acceptance: Gould-Shawmut or approved equal.

Part 3 Execution

3.1 DISCONNECT SWITCHES

- .1 Install disconnect switches complete with fuses as indicated.

3.2 GROUNDING

- .1 Install complete permanent, continuous, system and circuit, equipment, grounding systems including, conductors, compression connectors, accessories, as indicated, to conform to requirements of Engineer, and local authority having jurisdiction over installation. Where EMT is used, run ground wire in conduit.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Soldered joints not permitted.

3.3 DRY TYPE TRANSFORMER

- .1 Transformers above 75 kVA mount on floor.
- .2 Provide adequate clearance around transformer for ventilation.
- .3 Install transformers in level upright position.
- .4 Remove shipping supports only after transformer is installed and just before putting into service.
- .5 Loosen isolation pad bolts until no compression is visible.
- .6 Make primary and secondary connections shown on wiring diagram.
- .7 Energize transformers immediately after installation is completed, where practicable.
- .8 Provide equipment identification in accordance with Section 26 05 00.
- .9 Connect transformer through side of housing.

3.4 PANELBOARDS

- .1 Locate panelboards as indicated and mount securely, plumb, and square, to adjoining surfaces.
- .2 Mount panels to height specified in section 26 27 26 or as indicated.
- .3 Connect loads to circuits as indicated.
- .4 Connect neutral conductors to common neutral bus.

3.5 MOLDED CASE CIRCUIT BREAKERS

- .1 Install circuit breakers as indicated.

3.6 FUSES

- .1 Install fuses in mounting devices immediately before energizing circuit.
- .2 Install fuses correctly sized to assigned electrical circuits.
- .3 Provide 3 spare fuses for each rating supplied.

END OF SECTION

Part 1 General

1.1 RELATED WORK

- .1 Motors and controls to Sections 26 22 19, 26 29 03 & 26 29 10.

1.2 MATERIALS

- .1 Provide only new equipment and materials, without blemish or defect, bearing Canadian Standards Association or Authorized Electrical Inspection Department labels, and subject to the approval of the NRC Departmental Representative.
- .2 After a contract is awarded, utilize alternative methods and/or materials only after receiving the NRC Departmental Representative's approval.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 10 00 – General Instructions.

1.4 IDENTIFICATION

- .1 Identification as per Section 26 05 00.

Part 2 Products

2.1 WIRING DEVICES

- .1 Switches:
 - .1 Specification grade, shallow body, designed to withstand high inductive fluorescent loads CSA C22.2 No. 55.
 - .2 Number of poles as indicated.
 - .3 Captive mounting screws, quiet safe mechanical action with rust-proofed mounting strap and silver alloy contact points.
 - .4 Toggle actuated, colour white unless otherwise indicated.
 - .5 Brass screw terminals rated 20 AMP at 125 volt.
 - .6 Standard of acceptance: Hubbell, Leviton.
- .2 LED Dimming Switches:
 - .1 0-10VDC, electronic, suitable for use with installed light fixture.
 - .2 Rated for 1200W.
 - .3 Suitable for use in “3-way” configuration where indicated.
 - .4 Standard of acceptance:
 - .1 Philips SR1200ZTUNV or equivalent approved by NRC Departmental Representative.
 - .2 3-way style to be Philips SR3W or equivalent approved by NRC Departmental Representative.
- .3 Receptacles:

- .1 Duplex type, CSA type 5-15R, 125 volt, 15A, U ground, specification grade with the following features:
 - .1 Flush type with parallel blade slots.
 - .2 Double-wiping contacts.
 - .3 Double-grounding terminals.
 - .4 Break-off feature for separate feeds.
 - .5 One piece body, colour white unless otherwise indicated.
- .2 Special receptacles with ampacity and voltage as indicated.
- .3 Receptacles of one manufacturer throughout the project.
- .4 Cover Plates:
 - .1 Cover plates for wiring devices.
 - .2 Smooth white plastic for wiring devices mounted in flush-mounted outlet box.
 - .3 Sheet metal cover plates for wiring devices mounted in surface-mounted outlet box.
 - .4 Weatherproof covers to be die-cast metal, in-use type. Standard of acceptance: Hubbell MX3200 (vertical)/MX3300 (horizontal).
 - .5 Multi-outlet covers as indicated.
- .5 Splitters, Junction Boxes & Cabinets:
 - .1 Sheet metal enclosure, welded corners and formed cover, provided as required.

Part 3 Execution

3.1 LOCATION OF OUTLETS

- .1 The number and general location of outlets for lighting, power, telephones, etc., are to be as shown on the drawings. Install all outlets accurately and uniformly with respect to building details. When centering outlets, make allowance for overhead pipes, ducts, etc. and for variations in wall or ceiling finish, window trim, etc. Reinstall incorrectly installed outlets at no cost to the Owner. Make field power and control connections as indicated.
- .2 The location of all outlets as shown on the plans are approximate and are subject to change, up to 3m (10') without extra cost or credit provided the information is given prior to the installation of the outlet.
- .3 Unless otherwise specified, locate light switches on latch side of doors. Determine the direction of all door swings from the architectural drawings or on site, not from the electrical drawings.

3.2 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not indicated verify before proceeding with installation.
- .3 Generally, locate outlets as follows: (except those otherwise shown on the drawings):
 - .1 Local switches 1.2m (3'-11") to centreline.
 - .2 Wall receptacles 400mm (1'-4") to centreline.
 - .3 Clock receptacles 2.4m (8'-0") to centreline.
 - .4 Lighting panels 1.8m (6'-0") to top.

- .5 Telephone and data communications outlet 400mm (1'-4") to centreline.
- .6 Fan coil speed control switch 1.2m (3'-11") to centreline.

3.3 WIRING DEVICES

- .1 Install wiring devices as follows:
 - .1 Where more than one local device is shown at one location, they are to be set under one cover plate.
 - .2 Install single throw switches with handle in "up" position when switch closed.
 - .3 Devices in gang type outlet box when more than one device is required in one location.
 - .4 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
 - .5 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.
 - .6 Install metal barriers where required.
 - .7 Remove insulation carefully from ends of conductors and connect wiring as required.
 - .8 Bond and ground as required.

3.4 SPLITTERS AND DEVICES

- .1 Installation of splitters, junction boxes, pull boxes & cabinets as follows:
 - .1 Mount plumb, true and square to the building lines.
 - .2 Install in inconspicuous but accessible locations.
 - .3 Install pull boxes so as not to exceed 30 m (100') of conduit run between boxes or as indicated.

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

- .1 Common Work Results - Electrical Section 26 05 00.

1.2 MATERIALS

- .1 Provide only new equipment and materials, without blemish or defect, bearing Canadian Standards Association or Authorized Electrical Inspection Department labels, and subject to the approval of the NRC Departmental Representative.
- .2 After a contract is awarded, utilize alternative methods and/or materials only after receiving the NRC Departmental Representative's approval.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 00 10 00 – General Instructions.

Part 2 Products

2.1 AC CONTROL RELAYS

- .1 Convertible contact type: contacts field convertible from N/O to N/C, electrically held or permanent magnet latched or double- voltage type as indicated. Coil rating: 120V, Contact rating: 120V.
- .2 Standard of acceptance: Allen Bradley.

2.2 SOLID STATE TIMING RELAYS

- .1 Construction: AC operated electronic timing relay with solid-state timing circuit to operate output contact. Timing circuit and output contact completely encapsulated to protect against vibration, humidity and atmospheric contaminants.
- .2 Operation: on-delay or off-delay.
- .3 Potentiometer: self contained to provide time interval adjustment.
- .4 Supply voltage: 120V, 60 Hz. or as specified.
- .5 Temperature range: -20°C to 60°C.
- .6 Output contact rating: maximum voltage 300V AC or DC.
- .7 Timing ranges: as indicated.
- .8 Standard of acceptance: Agastat.

2.3 OPERATOR CONTROL STATIONS

- .1 Enclosure: CSA Type and mounting as indicated.

2.4 PUSHBUTTONS

- .1 As indicated on control schematic.

2.5 SELECTOR SWITCHES

- .1 As indicated on control schematic.

2.6 INDICATION LIGHTS

- .1 As indicated on control schematic.

2.7 CONTROL AND RELAY PANELS

- .1 As indicated on control schematic.

2.8 THERMOSTAT (LINE VOLTAGE)

- .1 Refer to division 23.

2.9 FINISHES

- .1 Apply finishes to enclosure in accordance with Section 26 05 00.

2.10 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00.

Part 3 Execution

3.1 INSTALLATION

- .1 Install control devices and relay panels and interconnect as indicated.
- .2 Install correct fuses and overload device elements.

3.2 TESTS

- .1 Perform tests in accordance with Section 26 05 00 and Manufacturer's instructions.
- .2 Operate switches, contactors to verify correct functioning.
- .3 Perform starting and stopping sequences of contactors and relays.
- .4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

- .1 Common Work Results - Electrical Section 26 05 00.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 00 10 00 – General Instructions.
- .2 Include schematic, wiring, interconnection diagrams.
- .3 Indicate:
 - .1 Mounting method and dimensions.
 - .2 Starter size and type.
 - .3 Layout of identified internal and front panel components.
 - .4 Enclosure types.
 - .5 Wiring diagram for each type of starter.
 - .6 Interconnection diagrams.
- .4 Motors specified and supplied with mechanical equipment. Refer to Division 23.

1.3 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for motor starters for incorporation into manual specified in Section 00 10 00 – General Instructions.
- .2 Include operation and maintenance data for each type and style of starter.

Part 2 Products

2.1 MATERIALS

- .1 Starters:
 - .1 IEC rated starters not acceptable.

2.2 MANUAL MOTOR STARTERS

- .1 Single and three phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:
 - .1 Switching mechanism, quick make and break.
 - .2 One and three overload heaters as indicated, manual reset, trip indicating handle.
- .2 Accessories:
 - .1 Toggle switch, key switch or pushbutton as specified.
 - .2 Indicating light: type and colour as indicated.
 - .3 Locking tab to permit padlocking in "ON" or "OFF" position.
- .3 Standard of acceptance: Square D, Class 2510 or approved equal.

2.3 FULL VOLTAGE MAGNETIC STARTERS

- .1 Magnetic and combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:
 - .1 Contactor solenoid operated, rapid action type.
 - .2 Motor overload protective device in each phase, manually reset from outside enclosure.
 - .3 Power and control terminals.
 - .4 Wiring and schematic diagram inside starter enclosure in visible location.
 - .5 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
- .2 Combination type starters to include motor circuit interrupter or circuit breaker with operating lever on outside of enclosure to control motor circuit interrupter or circuit breaker and provision for:
 - .1 Locking in "OFF" position with up to 3 padlocks.
 - .2 Locking in "ON" position.
 - .3 Independent locking of enclosure door.
 - .4 Provision for preventing switching to "ON" position while enclosure door open.
- .3 Accessories:
 - .1 Pushbuttons and selector switches: type and labelled as indicated.
 - .2 Indicating lights: type and color as indicated.
 - .3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.
- .4 Standard of acceptance: Square D, Class 8539 or approved equal.

2.4 MULTI-SPEED STARTERS

- .1 2-Speed starters of size, type, rating, and enclosure type as indicated. Starter suitable for constant torque and variable torque motor with components as follows:
 - .1 One-3 pole contactor for each winding for separate winding motors.
 - .2 Three overload relays with 3 heater elements and manual reset for each speed.
- .2 Accessories:
 - .1 Selector switches: standard labelled as indicated.
 - .2 Indicating lights: standard type and color as indicated.
 - .3 Auxiliary control devices as indicated.

2.5 FINISHES

- .1 Apply finishes to enclosure in accordance with Section 26 05 00.

2.6 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00.

Part 3 Execution

3.1 INSTALLATION

- .1 Install starters, connect power and control as indicated.

- .2 Install control devices and relay panels and interconnect as indicated.
- .3 Install correct fuses and overload device elements.
- .4 Megger all motors. Dry out motor if dampness is present in accordance with manufacturer's recommendations.
- .5 For installation of motor with mechanical equipment refer to Division 23.
- .6 Make connection to motor as indicated. Use liquid-tight PVC jacketed flexible conduit between rigid conduit and motor.
- .7 Make flexible conduit long enough to permit movement of motor.

3.2 TESTS

- .1 Perform tests in accordance with Section 26 05 00 and Manufacturer's instructions.
- .2 Operate switches, contactors to verify correct functioning.
- .3 Perform starting and stopping sequences of contactors and relays.
- .4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

- .1 Common Work Results - Electrical Section 26 05 00.

1.2 DESCRIPTION

- .1 This specification is to cover a complete Variable Frequency motor Drive (VFD) consisting of a pulse width modulated (PWM) inverter designed for use on a standard NEMA Design B induction motor.
- .2 The drive manufacturer shall supply the drive and all necessary controls as herein specified. The manufacturer shall have been engaged in the production of this type of equipment for a minimum of twenty years. All VFDs installed on this project shall be from the same manufacturer.

1.3 QUALITY ASSURANCE

- .1 Referenced Standards:
 - 1. Institute of Electrical and Electronic Engineers (IEEE)
 - .1 Standard 519-1992, IEEE Guide for Harmonic Content and Control.
 - .2 Underwriters laboratories
 - .1 UL508C
 - .3 National Electrical Manufacturer's Association (NEMA)
 - .1 ICS 7.0, AC Adjustable Speed Drives
 - .4 IEC 16800 Parts 1 and 2
 - .5 CSA 22.2
- .2 Qualifications:
 - .1 VFDs and options shall be UL listed and CSA approved as a complete assembly. VFDs that require the customer to supply external fuses for the VFD to be UL listed are not acceptable. VFDs requiring additional branch circuit protection are not acceptable. The base VFD shall be UL listed for 100 KAIC without the need for input fusing.

1.4 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 00 10 00 – General Instructions.
- .2 Include schematic, wiring, interconnection diagrams.
- .3 Indicate:
 - .1 Outline dimensions, conduit entry locations and weight.
 - .2 Customer connection and power wiring diagrams.
 - .3 Complete technical product description include a complete list of options provided. **Any portions of the specifications not complied with must be clearly indicated or the supplier and contractor shall be liable to provide all components required to meet the specification.**
 - .4 Compliance to IEEE 519 – harmonic analysis for particular jobsite including total harmonic voltage distortion and total harmonic current distortion (TDD).

- .1 The VFD manufacturer shall provide calculations, where required on the drawing; specific to the installation, showing total harmonic voltage distortion is less than 5%.
- .2 Input filters shall be sized and provided as required by the VFD manufacturer to ensure compliance with the IEEE electrical system standard 519. All VFDs shall include a minimum of 5% equivalent impedance reactors, **no exceptions.**
- .4 Motors specified and supplied with mechanical equipment. Refer to Division 23.

1.5 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for motor starters for incorporation into manual specified in Section 00 10 00 – General Instructions.
- .2 Include operation and maintenance data for each type and style of starter.
- .3 On completion of the installation, the supplier shall provide the following:
 - .1 Full commissioning report documenting all programmable settings, AC input voltage, DC Bus voltage, current draw at maximum speed, and a description of ambient conditions.
 - .2 One operator's manual for each VFD installed.
 - .3 One 8.5" x 11" wiring diagram for each VFD installed.

1.6 GENERAL DESIGN CHARACTERISTICS

- .1 The VFD shall be of the Pulse Width Modulated (PWM) type.
- .2 The VFD shall be rated for variable torque applications, with an overload rating of 110% for 60 seconds.
- .3 All VFD's shall be factory UL/cUL Listed.
- .4 All packaged drive systems shall be CSA Listed.
- .5 The VFD shall have the capability of operating multiple motors. The minimum VFD continuous current rating shall be the sum of the full load current ratings of the connected motors.
- .6 The VFD shall have a minimum displacement power factor of 0.96 or higher at all output frequencies.
- .7 The VFD manufacturer shall have a minimum of ten years experience in the Canadian Market.

Part 2 Products

2.1 VARIABLE FREQUENCY DRIVES

- .1 The VFD package as specified herein shall be enclosed in a NEMA rated enclosure, completely assembled and tested by the manufacturer in an ISO9001 facility. The VFD tolerated voltage window shall allow the VFD to operate from a line of +30% nominal, and -35% nominal voltage as a minimum.
 - .1 Environmental operating conditions: 0 – 40° C continuous. Altitude 0 to 3300 feet above sea level, up to 95% humidity, non-condensing. All circuit boards shall have conformal coating.

- .2 The VFD shall operate within the following rated values.
 - .1 Output Frequency Range: 0.1 to 400 Hz.
 - .2 Overload Rating: VT – 110% for 60 seconds
 - .3 Input Voltage: 3 phase + ground, 600V +10% / -20%
 - .4 Input Frequency: 48-62 Hz
- .3 The VFD shall be designed to include the following protective functions and display for maintainability:
 - .1 *Instantaneous over Current Protection*: The VFD output shall be turned off if the operating current exceeds the specified level.
 - .2 *Motor Overload Protection*: cUL/CSA approved electronic thermal overload protection.
 - .3 *External Trip Input*: Programmable for either N/O or N/C operation.
 - .4 *Over Voltage Protection*: The VFD output shall turned off if the DC Bus voltage exceeds the specified level.
 - .5 *Ground Fault Protection*: The VFD output shall turned off in the event of a ground fault.
 - .6 *Line or Load Phase Loss Protection*: Programmable for enable - disable
 - .7 *Software Lock*: The VFD shall include a software function that prevents changes to the user-defined settings.
 - .8 *CPU or EEPROM Error*: The VFD output shall turned off in the event of an error in the CPU or EEPROM.
- .4
- .2 All VFDs shall have the following features:
 - .1 All VFDs shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad shall be removable, capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs.
 - .2 The keypad shall include Hand-Off-Auto selections and manual speed control. There shall be fault reset and "Help" buttons on the keypad. The Help button shall include "on-line" assistance for programming and troubleshooting.
 - .3 There shall be a built-in time clock in the VFD keypad. The clock shall have a battery backup with 10 years minimum life span. The clock shall be used to date and time stamp faults and record operating parameters at the time of fault. If the battery fails, the VFD shall automatically revert to hours of operation since initial power up. The clock shall also be programmable to control start/stop functions, constant speeds, PID parameter sets and output relays. The VFD shall have a digital input that allows an override to the time clock (when in the off mode) for a programmable time frame. There shall be four (4) separate, independent timer functions that have both weekday and weekend settings. Capacitor backup is not acceptable.
 - .4 The VFD shall be capable of starting into a coasting load (forward or reverse) up to full speed and accelerate or decelerate to setpoint without safety tripping or component damage (flying start).
 - .5 The overload rating of the drive shall be 110% of its normal duty current rating for 1 minute every 10 minutes, 130% overload for 2 seconds. The minimum FLA rating shall meet or exceed the values in the NEC/UL table 430-150 for 4-pole motors.
 - .6 The VFD shall have 5% equivalent impedance internal reactors to reduce the harmonics to the power line and to add protection from AC line transients. The 5% equivalent impedance may be from dual (positive and negative DC bus) reactors, or 5% AC line reactors. VFDs with only one DC reactor shall add an AC line reactor.

- .7 The VFD shall include a coordinated AC transient protection system consisting of 4-120 joule rated MOV's (phase to phase and phase to ground), a capacitor clamp, and 5% equivalent impedance internal reactors.
- .8 The VFD shall provide a programmable proof of flow Form-C relay output (broken belt / broken coupling). The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. Relay outputs shall include programmable time delays that will allow for drive acceleration from zero speed without signaling a false underload condition.
- .3 All VFDs to have the following adjustments:
 - .1 Three (3) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed.
 - .2 Two (2) PID Setpoint controllers shall be standard in the drive, allowing pressure or flow signals to be connected to the VFD, using the microprocessor in the VFD for the closed loop control. The VFD shall have 250 ma of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others. There shall be two parameter sets for the first PID that allow the sets to be switched via a digital input, serial communications or from the keypad for night setback, summer/winter setpoints, etc. There shall be an independent, second PID loop that can utilize the second analog input and modulate one of the analog outputs to maintain setpoint of an independent process (ie. valves, dampers, etc.). All setpoints, process variables, etc. to be accessible from the serial communication network.
 - .3 Two (2) programmable analog inputs shall accept current or voltage signals.
 - .4 Two (2) programmable analog outputs (0-20ma or 4-20 ma). The outputs may be programmed to output proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus voltage, Active Reference, and other data.
 - .5 Six (6) programmable digital inputs.
 - .6 Three (3) programmable digital Form-C relay outputs. The relays shall include programmable on and off delay times and adjustable hysteresis. The relays shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 A at 250 VAC; Maximum voltage 300 VDC and 250 VAC; continuous current rating 2 amps RMS. Outputs shall be true Form-C type contacts; open collector outputs are not acceptable.
 - .7 Two separate safety interlock inputs shall be provided. When either safety is opened, the motor shall be commanded to coast to stop, and the damper shall be commanded to close.
 - .8 Two independently adjustable accel and decel ramps with 1 – 1800 seconds adjustable time ramps.
 - .9 The VFD shall include a motor flux optimization circuit that will automatically reduce applied motor voltage to the motor to optimize energy consumption and audible motor noise.
 - .10 The VFD shall include a carrier frequency control circuit that reduces the carrier frequency based on actual VFD temperature that allows higher carrier frequency without derating the VFD or operating at high carrier frequency only at low speeds.
 - .11 The VFD shall include password protection against parameter changes.
- .4 The Keypad shall include a backlit LCD display. The display shall be in complete English words for programming and fault diagnostics (LED and alpha-numeric codes are not acceptable). All VFD faults shall be displayed in English words.
- .5 All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of three operating values from the list below shall be capable of being displayed at all times. The display shall be in complete English words (alpha-numeric codes are not acceptable):

- .1 Output Frequency
 - .2 Motor Speed (RPM, %, or Engineering units)
 - .3 Motor Current
 - .4 Drive Temperature
 - .5 DC Bus Voltage
 - .6 Output Voltage
- .6 The VFD shall include a fireman's override input. Upon receipt of a contact closure from the fireman's control station, the VFD shall operate in one of two modes: 1) Operate at a programmed predetermined fixed speed or operate in a specific fireman's override PID algorithm that automatically adjusts motor speed based on override set point and feedback. The mode shall override all other inputs (analog/digital, serial communication, and all keypad commands), except customer defined safety run interlock, and force the motor to run in one of the two modes above. "Override Mode" shall be displayed on the keypad. Upon removal of the override signal, the VFD shall resume normal operation.
- .7 Serial Communications
- .1 The VFD shall have an RS-485 port as standard. The standard protocols shall be Modbus, BACnet, Johnson Controls N2 bus, and Siemens Building Technologies FLN. Each individual drive shall have the protocol in the base VFD. The use of third party gateways and multiplexers is not acceptable. All protocols shall be "certified" by the governing authority (i.e. BTL Listing for BACnet). Use of non-certified protocols is not allowed.
 - .2 The BACnet connection shall be an RS485, MS/TP interface operating at 9.6, 19.2, 38.4, or 76.8 Kbps. The connection shall be tested by the BACnet Testing Labs (BTL) and be BTL Listed. The BACnet interface shall conform to the BACnet standard device type of an Applications Specific Controller (B-ASC). The interface shall support all BIBBs defined by the BACnet standard profile for a B-ASC including, but not limited to:
 - .1 Data Sharing – Read Property – B.
 - .2 Data Sharing – Write Property – B.
 - .3 Device Management – Dynamic Device Binding (Who-Is; I-AM).
 - .4 Device Management – Dynamic Object Binding (Who-Has; I-Have).
 - .5 Device Management – Communication Control – B.
 - .3 Serial communication capabilities shall include, but not be limited to; run-stop control, speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, accel/decel time adjustments, and lock and unlock the keypad. The drive shall have the capability of allowing the DDC to monitor feedback such as process variable feedback, output speed / frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature. The DDC shall also be capable of monitoring the VFD relay output status, digital input status, and all analog input and analog output values. All diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote VFD fault reset shall be possible.
- .8 EMI / RFI filters. All VFDs shall include EMI/RFI filters. The VFD shall comply with standard EN 61800-3 for the First Environment, restricted level with up to 100' of motor cables. No Exceptions. Certified test lab test reports shall be provided with the submittals.
- .9 All VFDs through 60HP shall be protected from input and output power mis-wiring. The VFD shall sense this condition and display an alarm on the keypad. The VFD shall not be damaged by this condition.

- .10 OPTIONAL FEATURES – Optional features to be furnished and mounted by the drive manufacturer. All optional features shall be UL Listed by the drive manufacturer as a complete assembly and carry a UL508 label. The bypass enclosure door and VFD enclosure must be interlocked such that input power is turned off before either enclosure can be opened. The VFD and Bypass as a package shall have a UL listed short circuit rating of 100,000 amps and shall be indicated on the data label.
- .1 A complete factory wired and tested bypass system consisting of an output contactor and bypass contactor, service (isolation) switch and VFD input fuses are required. Bypass designs, which have no VFD only fuses, or that incorporate fuses common to both the VFD and the bypass will not be accepted
 - .2 Door interlocked padlockable disconnect switch that will disconnect all input power from the drive and all internally mounted options.
 - .3 If Drive is located outdoors, a cabinet with thermostatically controlled heater, suitable for operation at -40° C continuous.
- .11 The following operators shall be provided:
- Bypass Hand-Off-Auto
 - Drive mode selector and light
 - Bypass mode selector and light
 - Bypass fault reset
 - Bypass LDC display, 2 lines, for programming and status / fault / warning indications
- .1 Motor protection from single phase power conditions - The Bypass system must be able to detect a single phase input power condition while running in bypass, disengage the motor in a controlled fashion, and give a single phase input power indication. Bypass systems not incorporating single phase protection in Bypass mode are not acceptable.
 - .2 The systems (VFD and Bypass) tolerated voltage window shall allow the system to operate from a line of +30%, -35% nominal voltage as a minimum. The system shall incorporate circuitry that will allow the drive or bypass contactor to remain “sealed in” over this voltage tolerance at a minimum.
 - .3 The Bypass system shall NOT depend on the VFD for bypass operation. The bypass shall be completely functional in both Hand and Automatic modes even if the VFD has been removed from the enclosure for repair / replacement.
 - .4 Serial communications – the bypass and VFD shall be capable of being monitored and or controlled via serial communications. Provide communications protocols for ModBus; Johnson Controls N2; Siemens Building Technologies FLN (P1) and BACnet in the bypass controller.
 - .5 BACnet Serial communication bypass capabilities shall include, but not be limited to; bypass run-stop control; the ability to force the unit to bypass; and the ability to lock and unlock the keypad. The bypass shall have the capability of allowing the DDC to monitor feedback such as, bypass current (in amps), bypass kilowatt hours (resettable), bypass operating hours (resettable), and bypass logic board temperature. The DDC shall also be capable of monitoring the bypass relays output status, and all digital input status. All bypass diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote bypass fault reset shall be possible. The following additional bypass status indications and settings shall be transmitted over the serial communications bus – keypad “Hand” or “Auto” selected, and bypass selected. The DDC system shall also be able to monitor if the motor is running under load in both VFD and bypass (proof of flow) in the VFD mode over serial communications or Form-C relay output. A minimum of 40 field parameters shall be capable of being monitored in the bypass mode.
 - .6 Run permissive circuit - there shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad, time-clock control, or serial communications) the VFD and bypass shall provide a dry contact closure that

- will signal the damper to open (VFD motor does not operate). When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to a VFD system input and allows motor operation. Two separate safety interlock inputs shall be provided. When either safety is opened, the motor shall be commanded to coast to stop, and the damper shall be commanded to close.
- .7 The bypass control shall monitor the status of the VFD and bypass contactors and indicate when there is a welded contactor contact or open contactor coil. This failed contactor operation shall be indicated on the Bypass LCD display as well as over the serial communications protocol.
 - .8 The bypass control shall include a programmable time delay for bypass start and keypad indication that this time delay is in process. This will allow VAV boxes to be driven open before the motor operates at full speed in the bypass mode. The time delay shall be field programmable from 0 – 120 seconds.
 - .9 The bypass control shall be programmable for manual or automatic transfer to bypass. The user shall be able to select via keypad programming which drive faults will generate an automatic transfer to bypass and which faults require a manual transfer to bypass.
 - .10 There shall be an adjustable motor current sensing circuit for the bypass and VFD mode to provide proof of flow indication. The condition shall be indicated on the keypad display, transmitted over the building automation protocol and on a relay output contact closure.
 - .11 The bypass controller shall have six programmable digital inputs, and five programmable Form-C relay outputs.
 - .12 The relay outputs from the bypass shall be programmable for any of the following indications.
 - .1 System started
 - .2 System running
 - .3 Bypass override enabled
 - .4 Drive fault
 - .5 Bypass fault
 - .6 Bypass H-O-A position
 - .7 Motor proof of flow (broken belt)
 - .8 Overload
 - .9 Bypass selected
 - .10 Bypass run
 - .11 System started (damper opening)
 - .12 Bypass alarm
 - .13 Over temperature
 - .13 The digital inputs for the system shall accept 24VAC or 24VDC. The bypass shall incorporate internally sourced power supply and not require an external control power source. The bypass power board shall supply 250 ma of 24 VDC for use by others to power external devices.
 - .14 Customer Interlock Terminal Strip – provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external safety interlocks shall remain fully functional whether the system is in VFD or Bypass mode. The remote start/stop contact shall operate in VFD and bypass modes. The terminal strip shall allow for independent connection of up to four (4) unique safety inputs.
 - .15 The user shall be able to select the text to be displayed on the keypad when the safety opens. Example text display indications include “Firestat”, “Freezestat”, “Over pressure” and “Low pressure”. The user shall also be able to determine which of the four (4) safety contacts is open over the serial communications connection.

- .16 Class 10, 20, or 30 (selectable) electronic motor overload protection shall be included.
- .17 Standard of acceptance:
 - .1 ABB ACH Series or equivalent approved by NRC departmental representative.
Approval does not relieve supplier of specification requirements.

Part 3 Execution

3.1 INSTALLATION

- .1 Installation shall be the responsibility of the electrical contractor. The contractor shall install the drive in accordance with the requirements of the VFD manufacturer's installation manual.
- .2 The contractor is to verify that the jobsite conditions for installation meet the factory recommendations and code required conditions for the VFD installation prior to installation. These shall include as a minimum:
 - .1 Clearance spacing.
 - .2 Compliance with environmental ratings of the VFD system.
 - .3 Separate conduit installation of the input wiring, the motor wiring, and control wiring. At no time does any of this wiring run in parallel with each other.
 - .4 All power and control wiring is complete.
- .3 The VFD is to be covered and protected from installation dust and contamination until the environment is cleaned and ready for operation. The VFD system shall not be operated while the unit is covered.
- .4 The contractor to provide all mounting supports such as unistruts, angulars and all support accessories for the mounting of VFD's.

3.2 ON-SITE STARTUP

- .1 The manufacturer shall provide start-up and commissioning of the variable frequency drive and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. The commissioning personnel shall be the same personnel that will provide the factory service and warranty repairs at the customer site. Sales personnel and other agents who are not factory certified technicians for drive repair shall not be acceptable as commissioning agents.
- .2 Start-up services shall include checking for verification of proper operation and installation of the VFD, its options and its interface wiring to the building automation system. Included in this service shall be as a minimum:
 - .1 Verification of contractor wire terminations and conduit runs to and from the VFD.
 - .2 Up to four hours of customer operator training on the operation and service diagnostics at the time of commissioning. On-site training is to be provided by the same factory trained application engineering and service personnel to demonstrate full programming and operating features and procedures. Date and time for this training is to be coordinated with the NRC Departmental Representative.
 - .3 Measurement for verification of proper operation of the following:
 - .1 Motor voltage and frequency. Verification of proper motor operation.
 - .2 Control input for proper building automation system interface and control calibration.
 - .3 Calibration check for the following set-points:
 - .1 Minimum speed

- .2 Maximum speed
- .3 Acceleration and deceleration rates.
- .3 Commissioning agent to verify the programming of the VFD and to provide a written copy of the settings to the engineer.
- .4 Commissioning agent to lock out critical frequencies throughout the operating curve of the equipment as identified and required by the engineer. The agent shall record amperages at six (minimum) different frequencies from minimum to maximum speed.

3.3 PRODUCT SUPPORT

- .1 Factory trained application engineering and service personnel that are thoroughly familiar with the VFD products offered shall be locally available at both the specifying and installation locations. A toll free 24/365 technical support line shall be available.
- .2 A computer based training CD or 8-hour professionally generated video (VCR format) shall be provided to the owner at the time of project closeout. The training shall include installation, programming and operation of the VFD, bypass and serial communication.

3.4 WARRANTY

- .1 Warranty shall be 24 months from the date of certified start-up. The warranty shall include all parts, labor, travel time and expenses

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

- .1 Common Work Results - Electrical Section 26 05 00.

1.2 MATERIALS

- .1 Provide only new equipment and materials, without blemish or defect, bearing Canadian Standards Association or Authorized Electrical Inspection Department labels, and subject to the approval of the NRC Departmental Representative.
- .2 After a contract is awarded, utilize alternative methods and/or materials only after receiving the NRC Departmental Representative's approval.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 00 10 00 – General Instructions.
- .2 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by NRC Departmental Representative.

Part 2 Products

2.1 FINISHES

- .1 Baked enamel finish.
 - .1 Metal surfaces of luminaire housing and reflectors finished with high gloss powder coated baked enamel applied after fabrication to give smooth uniform appearance, free from pinholes or defects.

2.2 METAL SURFACES

- .1 Metal surfaces to be minimum 20 gauge steel.

2.3 LIGHT CONTROL DEVICES

- .1 All luminaire lenses to be injection moulded clear virgin acrylic unless otherwise noted.

2.4 LUMINAIRES

- .1 Type A: Recessed LED fixture.
 - .1 I20V, 610mm x 1219mm, LED troffer, suitable for recessed mounting in T-bar ceiling.
 - .2 5-year warranty.
 - .3 0-10V dimming driver.
 - .4 Removable LED boards and driver for ease of service/replacement.
 - .5 Rated to deliver L70 performance for 50,000 hours.
 - .6 4000k colour temperature, 82 CRI, minimum 3660 lumen output minimum.
 - .7 Standard of acceptance: Philips Day-Brite CFI 2TG-43L-840-4-FS-02F-UNV-DIM-F1D; Lithonia 2GT-L4-48L-FS-120-EZ1-LP840-DIM, Columbia LLT-24-

- 40-ML-G-FS-A12F(-ED for dimming)-U, CREE ZR24-40L-40K-10V or equivalent approved by the NRC Departmental Representative.
- .2 Type B: Recessed LED fixture.
 - .1 I20V, 305mm x 1219mm, LED troffer, suitable for recessed mounting in T-bar ceiling.
 - .2 5-year warranty.
 - .3 0-10V dimming driver.
 - .4 Removable LED boards and driver for ease of service/replacement.
 - .5 Rated to deliver L70 performance for 50,000 hours.
 - .6 4000k colour temperature, 82 CRI, minimum 3660 lumen output minimum.
 - .7 Standard of acceptance: Philips Day-Brite CFI 1TG-42L-840-4-FS-02F-UNV-DIM-F1D; Lithonia 1GT-L4-40L-FS-120-EZ1-LP840-DIM, Columbia LLT-14-40-ML-G-FS-A12F(-ED for dimming)-U, CREE ZR14-40L-40K-10V or equivalent approved by the NRC Departmental Representative.
 - .3 Type L1: Surface/Pendant mounted fixture.
 - .1 120V, 1140-1220mm long, LED linear strip, suitable for surface or suspended mounting.
 - .2 5-year warranty.
 - .3 Suitable for dimming (if not necessary, remove).
 - .4 Rated to deliver L70 performance for 100,000 hours.
 - .5 4000k colour temperature, minimum 3800 lumen output.
 - .6 Standard of acceptance: Philips Fluxstream LF-4-FR-39-40-U-LAG (or -DZT for dimming), Peerless Electric NSL-4-46-40k-RA-WH-MV (-D1 for dimming), CREE LS4-40L-40K-10V or equivalent approved by the NRC Departmental Representative.
 - .2 LED Pot light
 - .1 Type C: (Recessed mounted potlight)
 - .1 I20V, 150mm open LED downlight, suitable for recessed mounting in [drywall] [T-bar] ceiling.
 - .2 5-year warranty.
 - .3 3500k colour temperature, 82 CRI, minimum 1500 lumen output.
 - .4 Standard of acceptance: Lithonia Reality REAL6C6D-MW-ESL-1500L-35K-.95SC-120, Philips Lightolier C6L-15-N-U-VB-ZIOV with trim kit C6L-1520-DL-35K-W-WH-W-VB, Prescolite LiteFrame LC6LED-120-6LCLED-7-35K-8-WH-WT, CREE KR6-20L-40K-120-10V or equivalent approved by the NRC Departmental Representative.

Part 3 Execution

3.1 INSTALLATION

- .1 Supply and install all lighting fixtures complete with lamps, switches, supports, etc., to provide a complete working lighting system.
- .2 Locate and install luminaires as indicated.

3.2 LUMINAIRE SUPPORTS

- .1 For suspended ceiling installations support each luminaire, including exit lights and pot lights, independently of the ceiling support system with separate chains at each end. No. 80 steel sash chain minimum.
- .2 Unless otherwise specified support fluorescent luminaires mounted in continuous rows once every 3.6 m (12').

3.3 WIRING

- .1 Connect luminaires to lighting circuits directly for exit fixtures and exterior floodlights.

3.4 LUMINAIRE ALIGNMENT

- .1 Align luminaires mounted in continuous rows to form a straight uninterrupted line.
- .2 Align luminaires mounted individually parallel or perpendicular to building grid lines as shown on drawing.

3.5 EXTERIOR FLOODLIGHTS

- .1 Install floodlights in accordance with manufacturer's instructions and as indicated.
- .2 Aim energized floodlights as indicated during darkness and in the presence of the NRC Departmental Representative.

3.6 PHOTOELECTRIC LIGHTING CONTROL

- .1 Install photoelectric controls in accordance with manufacturer's instructions.

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

- .1 Common Work Results - Electrical Section 26 05 00.

1.2 MATERIALS

- .1 Provide only new equipment and materials, without blemish or defect, bearing Canadian Standards Association or Authorized Electrical Inspection Department labels, and subject to the approval of the NRC Departmental Representative.
- .2 After a contract is awarded, utilize alternative methods and/or materials only after receiving the NRC Departmental Representative's approval.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 00 10 00 – General Instructions.

1.4 SCOPE OF WORK

- .1 Supply and install all required material, equipment and labour to provide the fire alarm changes and additions as shown on the drawings and indicated by this section of the specification.

1.5 CONTRACTOR QULIFICATION

- .1 The contractor must ensure the supervisor, site foreman and electrician working on site hold valid fire alarm certificate.

1.6 REFERENCES

- .1 Government of Canada
 - .1 TB OSH Chapter 3-03, latest edition, Treasury Board of Canada, Occupational Safety and Health, Chapter 3-03, Standard for Fire protection Electronic Data Processing Equipment.
 - .2 TB OSH Chapter 3-04, latest edition, Treasury Board of Canada, Occupational Safety and Health, Chapter 3-04, Standard for Fire Alarm Systems.
- .2 Treasury Board: Fire Protection Standard effective April 1, 2010
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .4 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN/ULC-S524- latest edition, Standard for the Installation of Fire Alarm Systems.
 - .2 CAN/ULC-S525- latest edition, Audible Signal Device for Fire Alarm Systems.
 - .3 CAN/ULC-S526- latest edition, Visual Signal Devices for Fire Alarm Systems.
 - .4 CAN/ULC-S527- latest edition, Control Units.
 - .5 CAN/ULC-S528- latest edition, Manual Pull Stations for Fire Alarm Systems.
 - .6 CAN/ULC-S529- latest edition, Smoke Detectors for Fire Alarm Systems.
 - .7 CAN/ULC-S530- latest edition, Heat Actuated Fire Detectors for Fire Alarm Systems.

- .8 CAN/ULC-S531- latest edition, Standard for Smoke Alarms.
- .9 CAN/ULC-S536-S537- latest edition, Burglar and Fire Alarm Systems and Components.
- .5 National Fire Protection Agency
 - .1 NFPA 72- latest edition, National Fire Alarm Code.
 - .2 NFPA 90A- latest edition, Installation of Air Conditioning and Ventilating Systems.

Part 2 Products

2.1 AUTOMATIC ALARM INITIATING DEVICES

- .1 Conventional system
 - .1 Combination Fixed temperature and rate-of-rise thermal fire detector, self-restoring, rated 57°C (135°F) with 8.3°C (15°F) rate-of-rise, single circuit. Edwards model No. 5601A.
 - .2 Combination Fixed temperature and rate-of-rise thermal fire detector, self-restoring, rated 90°C (194°F) with 8.3°C (15°F) rate-of-rise, single circuit. Edwards model No. 5602A.
 - .3 Photoelectric smoke detector, 2-wire, self-diagnostic, built-in fixed/rate-of-rise heat sensor and rated for 12-24VDC. Edwards model No. C2M-PD.
 - .4 Photoelectric smoke detector, self-diagnostic, built-in fixed/rate-of-rise heat sensor and rated for 24VDC. Auxiliary relay contact rated for 2A @ 30Vdc. Edwards's model No. C2M-PDHRC.
 - .5 Explosion proof heat detector. Fixed temperature/rate-of-rise. Rated 57°C (135°F). Hazardous location Class I Groups C & D, Class II Groups E, F, & G, and Class III. Weather proof. Water-tight and dust-tight. Edwards model No. CR135EWT.
- .2 Addressable system
 - .1 Intelligent heat detector. Rate-of-rise rated at 8.3°C (15°F)/min. Optional carbon monoxide sensor. Automatic device mapping, self-diagnostic. Stand-alone operation. Edwards model No. SIGA2-HRS.
 - .2 Intelligent photoelectric smoke detector. Self-diagnostics and history mapping. Automatic device mapping. Stand-alone operation. Edwards model No. SIGA2-PS.
 - .3 Intelligent duct smoke detector. Can be installed in ducts up to 10ft. remote LED and test station accessories. Edwards model No. SIGA-DH.

2.2 MANUAL ALARM STATIONS

- .1 Conventional system
 - .1 Pull lever, breakglass, wall mounted, non-coded, red, bilingual and having one normally open contact rated for 30VDC, 3.0 A, Edwards model No. 270 SPOB.
- .2 Addressable system
 - .1 Pull lever, breakglass, wall mounted, red, bilingual and with electronic addressing. Edwards model No. SIGC-270B.

2.3 AUDIBLE, VISUAL DEVICES

- .1 Fire bell AC vibrating type, 150 mm (6") Signal size, red and rated for 6VAC, 1.2 A, Edwards Devices model No. 325-6C5.

- .2 Fire bell DC polarized vibrating type, 150 mm (6") size, red and rated for 24VDC, 0.15 A, 92db at 3 m (10'). Edwards model No. 439D-6AWC.
- .3 Addressable system
- .4 Combination horn/strobe device:
 - .1 Fire alarm Horn/strobe combination device, red in colour.
 - .2 Adjustable cd output of 15, 20, 75 & 110. Selectable hi/low dB output.
 - .3 Red with red trim ring.
 - .4 Include Synchronization module to synchronize strobes.
 - .5 Standard of acceptance: Chubb Edwards G1R-HDVM.
- .5 Visual Device:
 - .1 Fire alarm strobe only, red in colour.
 - .2 Adjustable cd output of 15, 20, 75 & 110.
 - .3 Red with red trim ring.
 - .4 Include Synchronization module to synchronize strobes.
 - .5 Standard of acceptance: Chubb Edwards G1R-VM.

2.4 CONDUIT AND WIRING

- .1 Raceway to be 21mm EMT unless indicated otherwise on the drawings. Wiring between junction box on underside of slab and heat detector junction box in T-bar ceiling to be 21mm flexible conduit.
- .2 All wiring is to be colour coded to match existing system and is to be of stranded copper.
- .3 Zone wiring is to be #16 TEW colour coded stranded copper.
- .4 Signal wiring to be sized to take into account voltage drop and is not to be smaller than #12 TW colour coded stranded copper.
- .5 conventional devices All fire alarm trouble and alarm zone wiring to be class "A" using #16 TEW colour coded stranded copper wire, and in accordance with manufacturer's requirements. Connect two red and two zone colour wires to each device. If the colour coding is not given on drawings, coding will be provided after contract is awarded.
- .6 conventional devices Run all four zone or signal circuit wires in the same conduit (i.e. Do not install only two of the four zone wires in a conduit - all four zone wires must be in each conduit.)
- .7 addressable devices All fire alarm initiating device circuits wiring to be class "A" using #18 minimum FAS-105 red jacketed twisted shielded pairs cable, and in accordance with manufacturer's requirements. Run each pair of wire in separate conduit to make it true class 'A'.
- .8 addressable devices horn All fire alarm signal circuits wiring to be R90/ T90 #16 minimum, and in accordance with manufacturer's requirements.
- .9 Bell All signal circuit wiring to be class "A" using 4#16 TW (or larger) colour coded stranded copper wires. Where series 6 VAC series bells are used, two #12 TW colour coded stranded copper wires are to be used and the bells are to be connected in series.

Part 3 Execution

3.1 MOUNTING OF EQUIPMENT

- .1 Recess mount equipment in all areas except where specified in unfinished areas.
 - .1 Fire alarm stations 1.2m (3'-11") to centreline.
 - .2 Fire alarm bells 2.1m (7'-0") to centreline.
- .2 Mounting heights from floor level to centerline of equipment are as follows:
 - .1 Fire alarm stations 1.2m (3'-11") to centreline.
 - .2 Fire alarm bells, horns, strobes 2.1m (7'-0") to centreline.

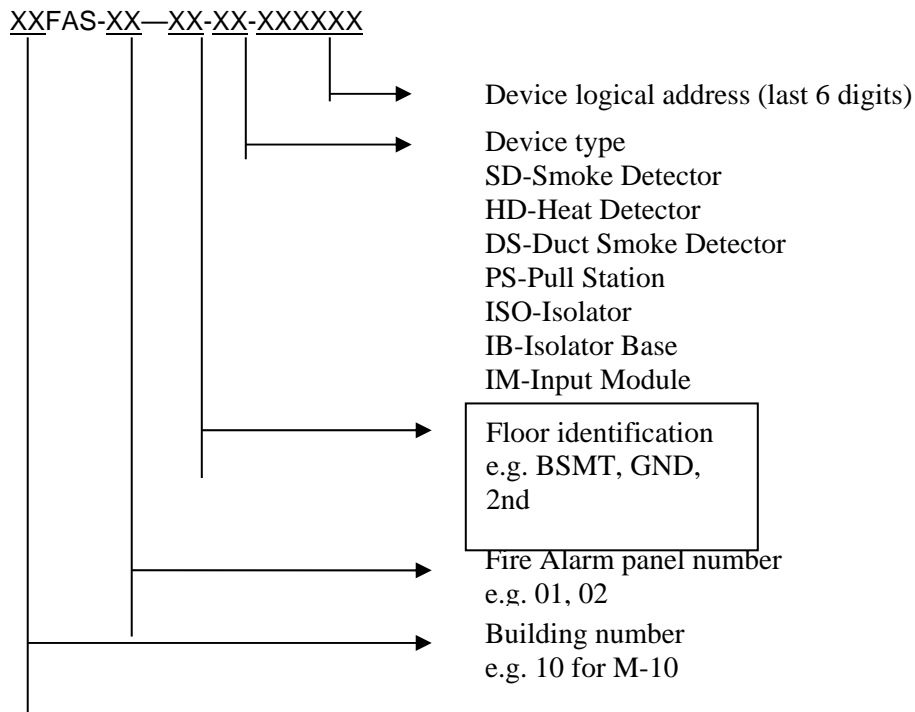
3.2 CONDUIT AND WIRING

- .1 All conduit to include a #16 TW stranded copper green ground wire.
- .2 Use only uninsulated ring-type STA-KON lugs on screw connections.
- .3 Run conduit tight along underside of ceiling slab or roof deck, unless noted otherwise on drawings.
- .4 In rooms having false ceilings, each fire detection device is to have one junction box secured to the underside of the ceiling slab or roof deck and another firmly supported to the false ceiling tile. The junction box connected to the fire alarm device is not to be used as a raceway for connection to other devices. All splices and routing to other fire alarm devices is to be from the junction box mounted on the underside of the ceiling slab or roof deck.
- .5 Use Tee bar electrical box hangers (Caddy #51224 for 610mm T-bar spacing) to mount heat detectors on T-bar ceiling tiles.
- .6 Install a maximum of 1.5 m (5'-0") 3/4" (21mm) flexible conduit where a heat detector is installed on T-bar ceiling tiles. This is to allow the ceiling tile, having the device, to be shifted two feet either direction for access above the ceiling.
- .7 Leave 6 inch loops of wire in all junction boxes.
- .8 For new installations, no splicing of wires is to be made.
- .9 For renovations, splices may be made in junction boxes other than those at heat detectors after receiving approval of the NRC Departmental Representative. All splices must be soldered and taped.
- .10 Upon awarding of the contract, the NRC Departmental Representative shall provide the contractor with the standard wiring diagram for detection devices, A-7481.
- .11 Prior to installing raceways, submit to the NRC Departmental Representative a proposed method and layout of conduit for approval.

3.3 EQUIPMENT IDENTIFICATION

- .1 Label each manual alarm station and each audible signal device with its unique identification number as per drawings. Use lamicaid nameplates as per Section 26 05 00.
- .2 Label each initiating device use P-Touch type as per Section 26 05 00. Devices are to be numbered per the format shown below.

Example M-10 fire alarm #1 Heat detector 000001
10FAS-01-GND-HD-000001



- .3 Refer to 26 05 00 for fire alarm conduit color coding.
- .4 Label wires as per drawing and as per Section 26 05 00.
- .5 Update remote annunciator panels and fire alarm panel zone directories if new zones are added to the system.

3.4 SCHEDULING OF SHUTDOWNS

- .1 Make written shutdown request to the NRC Departmental Representative at least 48 hours in advance. Acceptance of shutdown request will be determined by the NRC Departmental Representative based on building user needs. Fire alarm systems are to be shut down by NRC staff only. **Contractor is not to shutdown system on their own.**

3.5 INTEGRATION INTO SYSTEM MONITORING AT BUILDING M-1

Presently all NRC buildings in Ottawa report back their fire alarm status to the M1 building central monitoring station. The monitoring station consists of a computer graphics terminal showing building layouts of each building, and is linked on an internal NRC network. The new fire alarm system under this contract must communicate all addressable input points to the existing computer graphics monitoring station, Fireworks by Chubb Edwards. All required modifications to the existing Fireworks station are to be included in this tender.

- .1 Addressable devices:
 - .1 Integrate any new addressable devices installed as part of this project into the monitoring system at building M-1.
 - .2 Remove from the monitoring system at building M-1 any addressable devices removed as part of this project.

- .3 Make appropriate changes to the monitoring system at building M-1 to reflect any relocated addressable devices.
- .4 All work on the monitoring system at building M-1 is to be done by factory trained technician.
- .2 Conventional (non-addressable) devices:
 - .1 Integrate any new zones installed as part of this project into the monitoring system at building M-1. This is to be done by factory trained technician.
 - .2 Remove from the monitoring system at building M-1 any zones removed as part of this project.
 - .3 Make appropriate changes to the monitoring system at building M-1 to reflect any zone location changes as appropriate.
 - .4 All work on the monitoring system at building M-1 is to be done by factory trained technician.

3.6 ACCEPTANCE TEST

- .1 Perform tests in accordance with the latest regulations and in the presence of the NRC Departmental Representative and the representative of the regulating authority.
- .2 Test each device and alarm circuit to ensure manual alarm stations, thermal and smoke detectors transmit alarms to control panel and actuate alarm.
- .3 Check annunciator panels to ensure that the correct zones are activated.
- .4 Simulate grounds and breaks on alarm and signalling circuits to ensure proper operation of trouble signals.
- .5 Record amperage drawn by audible signal device circuits if new audible signal devices have been added to the circuit.
- .6 Give the NRC Departmental Representative one set of marked in red prints labelled "As Built".
- .7 Provide the NRC Departmental Representative with a letter of verification from the manufacturer of the equipment stating that the equipment supplied under this contract has been installed as per the latest CAN/ULC S537 and CAN/ULC-S524 standards and as per the latest edition of the Ontario Building Code.
- .8 For new fire alarm systems provide the NRC Departmental Representative with a certificate of verification stating that the equipment has been installed as per the latest CAN/ULC-S537 and CAN/ULC-S524 standards and as per the latest edition of the National Building Code.

END OF SECTION

National Research Council
1200 Montreal Road Building M-19
Ottawa, Ontario

January 19, 2017

Via e-mail: Derek.Foot@nrc-cnrc.gc.ca

Attention: Derek Foot, Construction Project Manager

RE: Project-Specific Hazardous Materials Survey – Summary Report, Rev.1
Chiller and Ductwork Replacement Project
Building U-66, Ottawa, ON

DST File No.: GV-OT-026806

1.0 INTRODUCTION

DST Consulting Engineers Inc. (DST) was retained by the National Research Council (NRC) to conduct a Hazardous Materials Survey for the Chiller and Ductwork Replacement Project, scheduled to be completed in select basement, ground, second floor and Penthouse areas of Building U-66, Ottawa, Ontario, prior to the planned project.

The Hazardous Materials Report is required under the Ontario Occupational Health and Safety Act in order to identify designated substances and other hazardous materials that may be present within the project area. The Canada Labour Code also stipulates under Part II, Section 124 that every employer shall ensure that the health and safety at work of every person employed by the employer is protected. By having a Hazardous Materials Survey Report conducted, NRC will be able to inform his or her employees, contractors, and tenants of any hazardous materials that may be present and possibly disturbed throughout the planned replacement work.

DST staff completed a visual inspection of building materials for the presence of suspected designated substances and select hazardous materials in the project areas on August 31, 2016 and November 9, 2016.

2.0 SCOPE OF WORK

The survey implemented by DST included the 11 designated substances listed in Section 30 of the Occupational Health and Safety Act, R.S.O. 1990, Chapter 0.1. Designated Substances, as identified under the Ontario Occupational Health and Safety Act, are as follows:

- Acrylonitrile;
- Arsenic;
- Asbestos-Containing Materials (ACMs) - both friable and non-friable;
- Benzene;
- Coke Oven Emissions;
- Ethylene Oxide;
- Isocyanates;
- Lead;
- Mercury;

- Silica; and
- Vinyl Chloride.

Other Hazardous Materials which are not classified as designated substances, but were included as part of the survey and considered pertinent due to applicable regulations, best practice guidelines and/or potential risks to human health and/or the environment, are:

- Polychlorinated Biphenyls (PCBs);
- Mould;
- Ozone-depleting substances; and
- Other hazardous materials, as deemed pertinent.

3.0 METHODOLOGY

The field program for this survey was completed by DST on August 31, 2016 and November 9, 2016. The survey was limited to select areas of the building which are anticipated to be affected by the planned chiller and associated ducting replacement project. These project areas were delineated onsite with an NRC representative who was familiar with the project, and are also delineated on floor plans attached as Appendix B. Due to the nature of the project (replacement of ducting, AHUs etc.), flooring materials were generally not assessed as part of the survey. An overview of the project areas is as follows:

Basement

- Chiller mechanical room and adjacent corridor running north-south.

1st Floor

- Northwest wing, and rooms off the north-south central corridor up to and including where the lunch room is located.

2nd Floor

- Entrance lobby and stairwell.
- Northwest wing rooms and corridor.
- Northeast wing rooms and corridor, up to where the transition to the newer west addition is located.
- Rooms off the north-south central corridor, up to and including Mechanical Room 257.

Penthouse

- North Penthouse mechanical room, and exterior materials.

No other areas of Building U-66 were included as part of this Hazardous Materials Survey.

Although a previous consultant report (referenced in Section 4.0) was provided for the building by the NRC for DST to review, certain ceiling cavities that are concealed by solid building finishes have not been investigated prior to the survey performed by DST. As a precaution, DST performed initial representative ceiling entries during the survey using Type 2 asbestos precautions. Since no friable materials were identified during the initial Type 2 entries, remaining ceiling entries conducted by DST utilised general dust containment measures only. Ambient air sampling was also performed during the survey, and the samples were then analysed by qualified DST

personnel immediately following the survey. The DST PCM Certificate of analysis summarising the sampling analytical results was then provided to the NRC via e-mail¹ (all results were considered satisfactory when compared to applicable regulatory limits for ambient airborne fibre limits.)

Materials suspected of containing designated substances were visually identified, based on the surveyor's knowledge of the historical composition of building products. Equipment that may contain polychlorinated biphenyls (e.g. electrical transformers and fluorescent light ballasts) can often be identified by examining manufacturer's labels. For safety reasons, DST personnel do not remove the ballast shields from fluorescent light fixtures to examine the ballast codes unless the electrical circuit for the lighting has been tagged and locked out by a qualified electrician. Visual identification of materials suspected to contain asbestos or lead (in paint) was supported by the collection and analysis of a limited number of representative samples, where applicable. Materials suspected of containing designated substances other than asbestos or lead (in paint) were identified by appearance, age, and knowledge of historical applications.

In Ontario, a material is defined as an Asbestos-Containing Material (ACM) if the material has a minimum asbestos content of 0.5 per cent (%) by dry weight, as O. Reg. 278/05, as amended. ACMs can be divided into two categories: friable and non-friable material. A friable ACM is a material that can be crumbled, powdered, or pulverized by hand pressure and can readily release fibres when disturbed. Common applications of friable ACMs are sprayed or trowelled surfacing materials (e.g. sprayed fireproofing and textured coatings) as well as mechanical and thermal insulation. Non-friable materials are materials that will generally release fibres only when cut or shaped. Common non-friable ACMs include vinyl floor products, caulking applications, asbestos textile products and asbestos cement products (transite). Some of these products may become friable with time or when disturbed.

Representative bulk samples of suspected ACMs were collected by DST during the site investigation. Samples were collected in order to meet the bulk sampling requirements stipulated in O.Reg. 278/05, as amended. The bulk samples were submitted to and analyzed by Paracel Laboratories Ltd. (Paracel). Paracel is an accredited laboratory through the Canadian Association for Laboratory Accreditation (CALA) and the National Voluntary Laboratory Accreditation Program (NVLAP). The bulk samples were analyzed using polarised light microscopy (PLM). This analytical method complies with the United States Environmental Protection Agency (U.S. EPA) Method 600/R-93/116 dated July, 1993, which is the regulatory approved protocol for bulk asbestos analysis in Ontario.

With regards to lead in paint, although the Ontario Ministry of Labour (MoL) has published a guideline for control of lead exposures on construction projects in Ontario, it does not include criteria for the classification of lead-paint. Instead, it uses presumed airborne lead concentrations for specific tasks as criteria for classifying work. However, in regulations set by the United States (U.S.) Department of Housing and Urban Development, lead-based paint is classified as any paint application containing at least 1.0 milligrams of lead per square centimetre of surface area (1.0 mg/cm²), or at least 0.5% lead content by weight [(5,000 parts per million (ppm))]. This criterion was widely, although not universally, used in Canada. In Canada, the Federal Canada Consumer Product Safety Act's *Surface Coating Materials Regulations SOR/2005-109* has lowered the allowable concentration of lead in paints for new consumer products to 0.009% lead content by

¹ E-mail to NRC Project Coordinator from DST, subject: GVOT026806 - Chiller Replacement DSS - ambient air sampling results. Dated September 1, 2016.

weight (90 ppm). For the purposes of the survey and this report, paint applications having detectable concentrations of lead are considered to be lead-containing.

Representative lead paint samples were collected and submitted by DST for lead content analysis. The samples were analyzed at Paracel using Inductively Coupled Plasma – Optical Emission Spectrometry (ICP-OES) in accordance with MOE E3470, ICP-OES.

Selected site photographs are included in Appendix A. Floor plans with sample locations, room numbers and the project area boundaries are included in Appendix B. Bulk asbestos and lead sample analytical results are included in Appendix C.

4.0 BACKGROUND REPORT REVIEW

Prior to the survey, the NRC provided DST with the following document:

- Designated Substances Survey, Building U-66, March 2012, Oakhill Environmental Inc.

DST referenced any previously identified confirmed or assumed asbestos-containing materials or other designated substances as they pertained to the scope of work for this project. This included bulk sampling analytical results for materials inside ductwork in other areas of the building, that were considered homogenous with materials encountered by DST in the project areas for this project.

5.0 INACCESSIBLE AREAS

The following areas were not accessible to DST personnel during the survey:

- Ceiling spaces concealed by solid ceilings, which were not investigated as part of the representative intrusive investigations.
- Closet/small room (NRC Room 153, 1st Floor).

6.0 FINDINGS

6.1. Asbestos

Based on previous sampling, visual observations and analytical results for bulk samples collected by DST, the following materials were identified in the project areas as containing regulated concentrations of asbestos and are anticipated to be affected as part of the scope of work for this project:

- Aircell pipe insulation, containing 30-50% Chrysotile (previous consultant);
- Sweatwrap pipe insulation, containing 75% Chrysotile (previous consultant);
- Grey cement compound on pipe fittings (“mud joint compound”), containing 50-70% Chrysotile (previous consultant);
- HVAC parging insulation, containing 50-70% Chrysotile (previous consultant), and associated debris containing 60% Chrysotile (DST Samples 11A and B);
- Exterior stucco, containing 0.5-5% Chrysotile (previous consultant);
- Transite panels (assumed ACM);
- Grey parging layer under maroon-coloured burlap covering, inside ductwork (previous DST sample 26548-03A);
- Tar with cork pipe insulation, containing 0.53% Chrysotile (DST Sample 03A);

- Black mastic, used to adhere HVAC tank insulation panels, containing 11.22% Chrysotile (DST Sample 04A);
- Brown mastic pucks associated with 1’x1’ Acoustic ceiling tiles, pinhole (DST Samples 16A-C);
- Internal, concealed lining of the fire door (suspect ACM), that separates the 1st floor stairwell to 2nd floor lobby; and
- Cast-iron drain pipe joint caulking (suspect ACM).

Based on visual observations and limited, destructive investigations, the following table summarizes the identified occurrences of ACMs and suspected ACMs in the project areas, on a room-by-room basis:

Table 1: Summary of Identified ACMs					
Room, Floor	DST Room#	Material, Friability	ACM Location	Quantity	Condition
Throughout Project Areas					
All	All	Caulking	Cast-iron drainpipe joints	Throughout	Good
Basement					
Basement, Chiller Mechanical Room	1	Sweatwrap, Friable	Storm pipe piping	10 linear metres	Good
		Tar with cork pipe insulation. Non-friable	Chiller water supply and return piping and fittings, under metal jacketing	20 linear metres and 6 fittings	Good
		Grey cement compound, Friable	Chilled water supply pipe fittings	3 fittings	Good
Basement, Tunnel	2	Sweatwrap, Friable	Storm pipe piping	15 linear metres	Good
1st Floor					
Shop/ Storage, 1 st Floor	5	Sweatwrap, Friable	Piping	15 linear metres	Good
		Grey cement compound, Friable	Pipe fittings	6 fittings	Good
Room under stairs, 1 st Floor	6	Aircell, Friable	Piping	10 linear metres	Good
		Grey cement compound, Friable	Pipe fittings	8 fittings	Good
Shop/ Storage, 1 st Floor	7	Transite panels	Walls	30 square metres	Good
Hallway, 1 st Floor	10	Sweatwrap, Friable	Piping	30 linear metres	Good
		Grey cement compound, Friable	Pipe fittings	14 fittings	Good
		Duct parging, Friable	Ducting	90 square metres	Good
		Internal lining, Friable	Fire door, base of north stairs, 1 st Floor level	20 square metres	Unknown
Workshop, 1 st Floor	12	Sweatwrap/ Aircell, Friable	Piping	10 linear metres	Good
		Grey cement compound, Friable	Pipe fittings	8 fittings	Good
		Duct parging, Friable	Ducting	40 square metres	Good
Workshop, 1 st Floor	13	Sweatwrap/ Aircell, Friable	Piping	linear metres	Good
		Grey cement compound, Friable	Pipe fittings	8 fittings	Good

Table 1: Summary of Identified ACMs					
Room, Floor	DST Room#	Material, Friability	ACM Location	Quantity	Condition
		Duct parging, Friable	Ducting	20 square metres	Good
		Tar with cork pipe insulation, non-friable	Piping	10 linear metres	Good
Workshop, 1 st Floor	14	Sweatwrap/ Aircell, Friable	Piping	8 linear metres	Good
		Duct parging, Friable	Ducting	5 square metres	Good
Electrical Room, 1 st Floor	16	Sweatwrap/ Aircell, Friable	Piping	4 linear metres	Good
		Grey cement compound, Friable	Pipe fittings	8 fittings	Good
Men's Washroom, 1 st Floor	18	Tar with cork pipe insulation, non-friable	Piping	10 linear metres	Good
		Sweatwrap/ Aircell, Friable	Piping, concealed inside wall cavity	~10 linear metres	Unknown
		Grey cement compound, Friable	Pipe fittings, concealed inside wall cavity	~10 fittings	Unknown
Kitchen, 1 st Floor	19	Tar with cork pipe insulation, non-friable	Piping	20 linear metres	Good
Storage, 1 st Floor	49	Parging layer, Friable	Inside ducting associated with AHUPSA2257	15 square metres	Exposed edges
Control Room, 1 st Floor	50	Duct parging, Friable	Ducting	45 square metres	Fair, exposed
		Duct parging, Friable	Ducting	10 square metres, sporadic	Debris on ceiling tiles
		Parging layer, Friable	Inside ducting associated with AHUPSA2257	45 square metres	Exposed edges
Corridor outside Control room	52	Duct parging, Friable	Ducting	35 square metres	Fair, exposed
		Duct parging, Friable	Ducting	1 square metre, sporadic	Debris on ceiling tiles
		Parging layer, Friable	Inside ducting associated with AHUPSA2257	35 square metres	Exposed edges
2nd Floor					
Mechanical Room 257, 2 nd Floor	3	Duct parging, Friable	Ducting associated with AHUPSA2257	30 square metres	Good
Mechanical Room 257, 2 nd Floor	3	Parging layer, Friable	Inside ducting associated with AHUPSA2257	3 square metres	Exposed edges
Offices	20-30, 33-48	Brown mastic pucks, Non-friable	Adheres 1'x1' ceiling tiles to Gyproc ceiling substrate	1,100 square metres	Assumed good
Storage, 2 nd Floor	51	Parging layer, Friable	Inside ducting associated with AHUPSA2257	6 square metres	Exposed edges
Penthouse/Roof					
North Penthouse Mechanical/ AHU Room	4	Duct parging, Friable	Ducting associated with AHUs	140 square metres	Good
		Duct parging, Friable	Inside return air ducting to AHU	5 square metres	Debris
		Mastic, non-friable	On metal surfaces beneath insulation on AHUs and associated ducting	200 square metres	Good (assumed)
		Tank parging, Friable	Outer AHUs (solid parging boards)	10 square metres	Good

Table 1: Summary of Identified ACMs					
Room, Floor	DST Room#	Material, Friability	ACM Location	Quantity	Condition
		Sweatwrap, Friable	Piping	50 linear metres	Good
		Grey cement compound, Friable	Pipe fittings	25 fittings	Good
North Penthouse Mechanical/AHU Room	4, Exterior	Stucco finish, friable	Exterior walls	120 square metres	Good

Based on bulk sampling conducted previously and this survey, DST has confirmed that the following materials do not contain regulated concentrations of asbestos within the project areas:

- Plaster materials (previous consultant samples U66-01A-G);
- Textured wall finish, Basement Chiller Mechanical Room (DST samples 01A-E);
- White cement compound on chiller piping endcaps/fittings, Basement Chiller Mechanical Room (DST samples 02A-C);
- White fibrous insulation, in lower metal housing of 3 boilers located in the north Penthouse Mechanical Room (DST samples 05A-C);
- 2'x4' Lay-in acoustic ceiling tiles, pinholes with width-wise fissures (DST samples 06A-C);
- 2'x4' Lay-in ceiling tiles, textured finish (DST samples 07A-C);
- Mortar associated with terra-cotta block (DST samples 08A-C);
- Black tar applied to fibreglass panel insulation, on ducting in ceiling spaces on the 2nd Floor (DST samples 09A-C); and
- Brown mastic applied to fibreglass panel insulation, on ducting in ceiling spaces on the 2nd Floor (DST samples 10A-C);
- Black tar at seams of fibreglass acoustic panels inside ductwork (DST Samples 12A-C);
- Brown mastic, used to adhere fibreglass acoustic panels inside ductwork (DST Samples 13A-C); and
- Tar paper layer, over fibreglass acoustic panels inside ductwork (DST Samples 14A-C);
- 1'x1' Acoustic ceiling tiles, pinhole (DST Samples 15A-C).

6.2. Lead

Table 2 below presents the findings of bulk lead (in paint) samples collected from and applicable to the project areas by DST for this survey, based on visual observations at the time of the site survey. No previous sampling results were considered applicable for the purposes of this project:

Table 2: Summary of Bulk Paint Samples Analyzed for Lead Content			
Sample I.D.	Sample Location	Sample Description	Lead Content (ppm or µg/g)
LP01	Basement, Chiller Mechanical Room, floor	Grey Floor Paint	2,660
LP02	Basement, Chiller Mechanical Room, concrete bases	Yellow Paint	77
LP03	2 nd Floor, Mechanical Room 257, concrete base	Red Paint	2,320

Based on the analytical results presented in Table 2, the following paints contain detectable concentrations of lead, and are considered to be “lead containing”:

- Grey paint on concrete floors contains 2,660 ppm lead, and was observed throughout the project areas;
- Yellow paint on the concrete bases in the Chiller Mechanical Room contains 77 ppm lead; and
- Red paint on the AHU concrete base in Room 257 contains 2,320 ppm lead.

No further paint samples were collected by DST for lead content analysis during the site investigation, as other paints encountered in the project areas were in good condition and sampling without matrix interference (i.e. removing the paint without the substrate material) would have proved difficult. As such, all paint finishes that have not been sampled are assumed to be lead containing.

Lead is suspected to be present in the following materials:

- Solder on the joints of copper pipes;
- Emergency light batteries;
- Ceramic tile glazing; and
- Cast iron drain pipe joint caulking.

6.3. Mercury

Mercury is suspected to be present in the following equipment:

- Fluorescent light fixtures containing fluorescent light tubes were observed. Fluorescent light tubes contain mercury in a vapour form and in the phosphor coating on the lamp tube; and
- Tilt switches within thermostats.

6.4. Silica

Based on the historical composition of building materials, silica is expected to be present in:

- 1'x1' ceiling tiles;
- Drywall;
- Terracotta brick and mortar;
- Plaster;
- Ceramic tiles, mortars, and grout;
- Ceiling tiles; and
- Concrete materials.

6.5. Polychlorinated Biphenyls (PCBs)

Polychlorinated Biphenyls (PCBs) are hazardous chemicals which were used in the manufacturing of a variety of equipment, such as electrical equipment, heat exchangers, hydraulic systems, and for several other specialized applications. PCBs are commonly found within

electrical ballasts manufactured prior to 1981, found within fluorescent light fixtures and high intensity discharge lamps.

Light fixtures with T12 lamps are more likely to contain ballasts that were manufactured prior to 1981. T8 lamps are associated with light fixtures that were manufactured after the phase-out of PCB-containing ballasts. The letter "T" denotes the shape of the light fixture (e.g. tubular) and the number which follows indicates the diameter in eighths of an inch.

DST did not disassemble light fixtures in the project area. Based on limited visual observations, the fluorescent light fixtures throughout the project areas were observed to contain T-8 lamps, which are not suspected to contain PCB-containing ballasts.

6.6. Ozone-Depleting Substances (ODSs)

The following equipment containing ODSs were observed by DST during the survey:

- Chiller 66CCH01 in the Basement Chiller Mechanical Room contains 50 lbs of Refrigerant (R)-22.
- Chiller 66PAS2257 in Mechanical Room 257 on the 2nd Floor contains 30 lbs of R-22.

6.7. Mould

The term "mould" applies to a large group of micro-organisms, which together, with mushrooms and yeast, form the Fungi Kingdom of living matter. Mould organisms grow by degrading nutrients from organic substrates such as wood and wood products, fabrics, foodstuff, plant and soil. The growth of mould necessitates three essential conditions; a suitable temperature, an appropriate substrate and adequate moisture.

Public health and regulatory agencies acknowledge mould growth to be a risk factor for adverse health effects in occupants. Occupants may experience allergic responses such as asthma, headache, respiratory tract irritation, eye irritation, skin irritation, and sinus congestion. More severe health effects are rare and typically limited to individuals with suppressed immune systems, children, elderly people and persons with high occupational exposure.

Suspected mould was observed in the following area:

- 5 square metres of suspected mould-impacted fibreglass acoustic panels inside ducting, Penthouse Mechanical Room.

6.8. Other Designated Substances and Hazardous Materials

The following Designated Substances and Hazardous Materials were neither observed, nor suspected of being present, in forms or quantities that would impact the renovation work:

- Acrylonitrile;
- Arsenic;
- Benzene;
- Coke Oven Emissions;
- Ethylene Oxide;
- Isocyanates; and

- Vinyl Chloride.

7.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the site investigation, review of previous reports, sampling and analysis, the following Designated Substances and Hazardous Materials are present in forms and quantities expected to have a measurable impact on the Chiller and Ducting Replacement Project, Building U-66, Ottawa, ON:

- Asbestos;
- Lead;
- Mercury;
- Silica;
- ODSs; and,
- Mould

DST's recommendations for each material, which are based upon both regulatory compliance and best practice guidelines, are included in the following sections below.

7.1. Asbestos

The disturbance of asbestos-containing materials on construction and demolition projects in the province of Ontario is governed by *O. Reg. 278/05, Asbestos on Construction Projects and in Buildings and Repair Operations* enabled under the *Occupational Health and Safety Act (R.S.O. 1990, Chapter 0.1)*, as amended. This regulation classifies all asbestos disturbances as either Low Risk (Type 1), Moderate Risk (Type 2), or High Risk (Type 3), each of which has defined precautionary measures. All asbestos materials are subject to specific handling and disposal precautions, and must be removed prior to demolition or renovation. The Ontario Ministry of Labour (MOL) must be notified of any project involving removal of more than a minor amount (e.g. typically one square metre) of friable asbestos material.

The removal or disturbance of 1 square metre or less of friable asbestos-containing material must be conducted using a minimum of Type 2 asbestos precautionary measures. The removal or disturbance of greater than 1 square metre of friable ACMs must be conducted using Type 3 asbestos precautionary measures. Pipe fitting insulation can be removed using Type 2 glove bag procedures, provided the pipe fittings are in good condition, and the work is performed in accordance with the requirements of O.Reg 278/05, as amended. Note that a proper seal must be maintained during the removal process.

The removal or disturbance of non-friable asbestos-containing materials can be completed using Type 1 asbestos precautionary measures, provided the material is wetted and only non-powered hand-held tools are used. If these conditions cannot be met, than more stringent (Type 2 or Type 3) procedures are required.

The time weight average exposure limit (TWAEEL) for airborne asbestos is prescribed by Ontario Regulation 490/09 *Designated Substances*, as amended. Work procedures and personal protective equipment must be used to ensure that workers are not exposed to airborne asbestos levels that exceed this TWAEEL.

The following recommendations apply to ACMs:

1. In general, materials must be maintained in good condition;
2. The condition of material(s) identified in this report must be inspected at least annually, and this record must be updated accordingly;
3. Appropriate work procedures and precautionary measures must be used, as outlined in O. Reg. 278/05, as amended, when performing work that may disturb ACMs or suspected ACMs, including prior to building demolition;
4. If ACMs or suspected ACMs become damaged and worker exposure to the material is likely to occur, the damaged material must be repaired or removed following work procedures outlined in O. Reg. 278/05, as amended; and
5. Disposal of asbestos waste is controlled by the Ontario Environmental Protection Act, R.R.O., 1990, Regulation 347, *General – Waste Management*, as amended. This regulation requires that asbestos waste be sealed in double containers resistant to puncture and tears, and appropriately labelled. The waste must be disposed at a licensed waste disposal site. Proper notification must be issued to the site representative prior to transportation of waste. The transport of the waste to the disposal site is controlled by the federal *Transportation of Dangerous Goods Act*, 1992 (TDGA).

Although every attempt was made to look above false ceilings and into wall cavity hatches, some ACMs may be concealed and thus not observed at the time of the survey. Should any previously unidentified suspect ACMs be encountered as part of future work, these materials are to be treated as ACMs and handled accordingly, unless sampling proves otherwise.

Materials that have not been analyzed, but are visibly similar to other materials identified as asbestos-containing, must be considered asbestos-containing unless proven otherwise by laboratory analysis.

7.2. Lead

The Occupational Health and Safety Branch of the Ontario MoL has published *Guideline: Lead on Construction Projects*. This document classifies all lead disturbances as Type 1, Type 2a, Type 2b, Type 3a or Type 3b work, and assigns different levels of respiratory protection and work procedures for each classification. In the absence of specific legislation for lead on construction projects, this guideline should be followed when disturbing lead-containing materials.

Paints containing elevated concentrations of lead can pose a health risk to humans if ingested or inhaled. Such lead paints are also a risk to the environment with the potential to contaminate soil and groundwater. Paints with elevated lead content can also pose a health risk to workers while completing renovations within the building.

Although the Federal Canada Consumer Product Safety Act's *Surface Coating Materials Regulations SOR/2005-109*, as amended, has set a limit of 90 ppm for surface coating materials, there may be a potential for exposure to high levels of lead depending on the activities performed that disturb the lead-containing materials, even at low lead concentrations. Conducting a risk assessment to assess the potential for exposure should be performed to determine the need to follow procedures such as those in the MoL guideline referenced above.

The TWael for airborne lead is prescribed by Ontario Regulation 490/09 *Designated Substances*, as amended. Work procedures and personal protective equipment must be used to ensure that workers are not exposed to airborne lead levels that exceed this TWael.

DST recommends that any future disturbance of lead-containing materials avoid operations that generate high levels of dust (e.g. sanding, grinding) and that should these operations be required, appropriate precautionary measures be implemented for worker exposure.

The disposal of construction waste containing lead is governed by O. Reg. 347/90 - General – Waste Management, as amended. The transport of the waste to the disposal site is controlled by the federal Transportation of Dangerous Goods Act (TDGA), 1992.

If required at some future date to accommodate work, the following procedures are appropriate for other materials containing lead:

- Copper piping and cast iron joint caulking can be cut a small distance (e.g. 50 mm) from the joints to avoid direct disturbance of suspected lead solder and caulking; and
- Ceramic tiles can be removed using Type 1 work procedures and respiratory protection provided that only non-powered hand tools are used.

7.3. Mercury

There are no regulations that specifically govern the disturbance of mercury on construction projects. However, the Occupational Health and Safety Division of the Ontario MoL has published *The Safe Handling of Mercury: A Guide for the Construction Industry*. This document provides advice on how to reduce the risk of mercury exposure, and outlines clean-up methods for spills. In the absence of specific legislation for mercury on construction projects, this guideline would serve as a reasonable, peer reviewed standard for work procedures.

When the removal of fluorescent light tubes is required, the tubes should be removed intact from the fixtures. This prevents worker exposure to mercury vapour, particularly if the tube was energized shortly before removal. Thermostats containing liquid mercury can be removed in the same fashion.

The TWael for mercury is prescribed by Ontario Regulation 490/09 *Designated Substances*, as amended. Work procedures and personal protective equipment must be used to ensure that workers are not exposed to airborne mercury levels that exceed this exposure limit.

Liquid mercury is classified as a hazardous waste under O. Reg. 347/90, as amended. The transport of the waste to a disposal site is controlled by O. Reg. 347/90 and by the federal TDGA. It is now common practice to recycle fluorescent light tubes and avoiding the generation of hazardous waste.

7.4. Silica

The Occupational Health and Safety Branch of the Ontario Ministry of Labour have published *Guideline: Silica on Construction Projects*. This document classifies all silica disturbances as Type 1, Type 2 or Type 3 work, and assigns different levels of respiratory protection and work procedures for each classification.

The TWael for airborne silica is prescribed by Ontario Regulation 490/09 *Designated Substances*, as amended. Work procedures and personal protective equipment must be used to ensure that workers are not exposed to airborne silica levels that exceed this exposure limit.

As a general rule, it is preferable to use more stringent dust suppression techniques and engineering controls as opposed to relying on respiratory protection to control worker exposure. Respiratory protection should only be relied on as a last resort when dust suppression techniques and engineering controls fail to control worker.

7.5. Ozone-Depleting Substances (ODSs)

The handling, transport and disposal of ODSs is governed by the following:

- *Ozone-depleting Substances Regulations, 1998, as amended;*
- *O.Reg 463/10, Ozone Depleting Substances and Other Halocarbons; and,*
- *Federal Halocarbon Regulations, 2003 (FHR).*

Two chillers, located in the project areas, were observed to contain Refrigerant R-22 during the survey. When these units are taken out of service, the ODS refrigerants must be captured and reclaimed by a licensed technician. Appropriate records of equipment decommissioning must be maintained in accordance with requirements of the FHR.

7.6. Mould

Currently, there are no regulations pertaining to mould or other microorganisms on construction projects. Most jurisdictions have issued alerts or bulletins concerning the hazard of mould in indoor environments. The Canadian Construction Association (CCA) published the following document as a response to concerns in the construction industry: *CCA 82-2004, "Mould Guidelines for the Canadian Construction Industry", 2004*. The Guideline recommends Level I, II and III mould abatement procedures for small (<1 m²), medium (1 m² to 10 m²) and large scale (>10 m²) mould abatement operations that are to be determined by professionals based on the extent and density of mould on site.

The removal of suspected mould impacted building materials should follow the above noted guideline. In the case of conflict between mould and other material abatement requirements, the more stringent precautionary measures shall apply.

8.0 CLOSURE

A Limitations of Report section, which forms an integral part of this report, is attached.

We trust that the information contained herein meets your needs. Should you have any questions or comments, please do not hesitate to contact us.

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LIMITATIONS OF REPORT

This report is intended for client use only. Any use of this document by a third party, or any reliance on or decisions made based on the findings described in this report, are the sole responsibility of such third parties, and DST Consulting Engineers Inc. accepts no responsibility for damages, suffered by any third party as a result of decisions made or actions conducted based on this report. No other warranties are implied or expressed.

The data, conclusions and recommendations which are presented in this report, and the quality thereof, are based on a scope of work authorized by the client. The sampling program included asbestos and lead in paint bulk sampling in select representative areas for laboratory analysis. There is a practical limitation on the number of intrusive test cuts that can be made and the number of samples that can be collected in an occupied building. This requires the investigator to extrapolate observations and analytical results between test cut locations. The uncertainty, and inherent risk, associated with this necessity increases with the distance between sampling locations. Note, however, that no scope of work, no matter how exhaustive, can guarantee to identify all contaminants. This report therefore cannot warranty that all building conditions are represented by those identified at specific locations.

Recommendations, when included, are made in good faith and are based on several successful experiences. If either the condition of the building or the health of the occupants changes in the future with respect to potential indoor air quality issues, the case should be reviewed and appropriate measures taken. DST is not in a position to evaluate the health risks associated with exposure to the mould referenced in this report. Since human reactions to mould exposure vary widely amongst individuals, and specific segments of the population are generally recognized to be more susceptible than others, an evaluation of health risks can only be made on an individual basis and even then, only by a licensed medical practitioner equipped with knowledge of the individual's medical history.

Any use of this report by the client and any other party is contingent upon their understanding and acceptance of the following condition:

“Mould is a naturally occurring substance and regardless of the results of an assessment or how completely it is removed, it could reoccur.”

Regardless of the effectiveness of any remedial actions, mould growth may occur/reoccur anywhere within a building at any time, should conditions be favourable. It is therefore essential to maintain buildings, surfaces, appliances and furnishings under conditions which are not favourable to mould incubation and growth (warm, dry, and clean). The scope of services

provided by DST for this assignment did not include a detailed evaluation of the thermal and moisture management characteristics of the exterior wall assembly, or a detailed building envelope investigation to ascertain every potential root cause of the water infiltration that created an environment favourable to mould proliferation. Similarly, DST has not been engaged to provide detailed designs for the reinstatement of building finishes or for improvements to the building envelope.

Any recommendations and conclusions provided that are based on conditions or assumptions reported herein will inherently include any uncertainty associated with those conditions or assumptions.

Note also that standards, guidelines and practices related to environmental investigations may change with time. Those which were applied at the time of this investigation may be obsolete or unacceptable at a later date.

Any comments given in this report on potential remediation problems and possible methods are intended only for the guidance of the designer. The scope of work may not be sufficient to determine all of the factors that may affect construction, clean-up methods and/or costs. Contractors bidding on this project or undertaking clean-ups should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the conditions may affect their work.

Any results from an analytical laboratory or other subcontractor reported herein have been carried out by others, and DST Consulting Engineers Inc. cannot warranty their accuracy. Similarly, DST cannot warranty the accuracy of information supplied by the client.

APPENDIX A
Select Photographs



Photo 1: Grey cement compound was observed on AHUs and ducting, including in solid-board form (pictured).



Photo 2: Black mastic, applied to the AHUs and associated ducting to adhere the grey cement compound outer insulation contains 11.22% Chrysotile asbestos.



Photo 3: The internal, concealed lining of the fire door (suspect ACM), that separates the 1st floor stairwell to 2nd floor lobby.



Photo 4: Exterior stucco on the north Penthouse Mechanical Room, contains 0.5-5% Chrysotile.



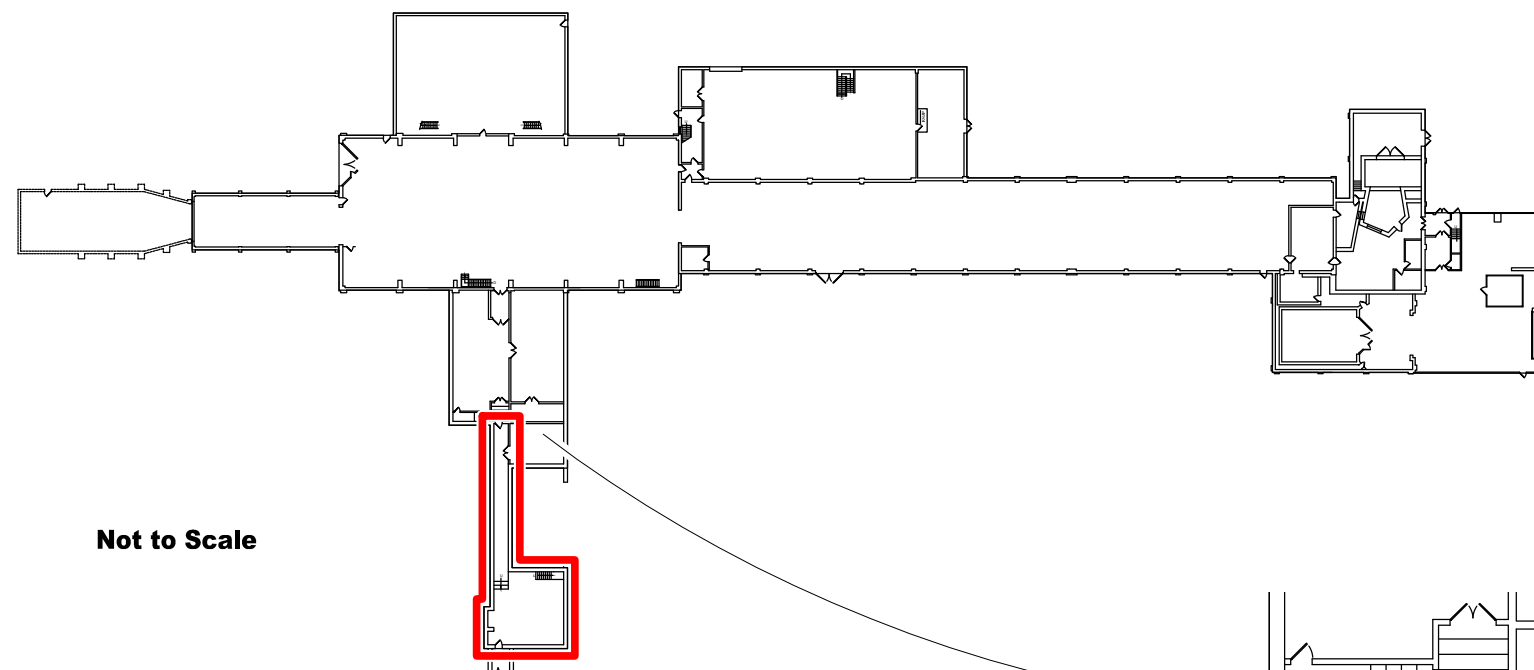
Photo 5: Maroon-coloured burlap covering over asbestos-containing grey parging, inside ducting associated with AHU in Room 257. The ducting traverses down to connect to air diffusers in DST Rooms 49 and 50.



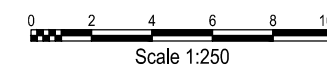
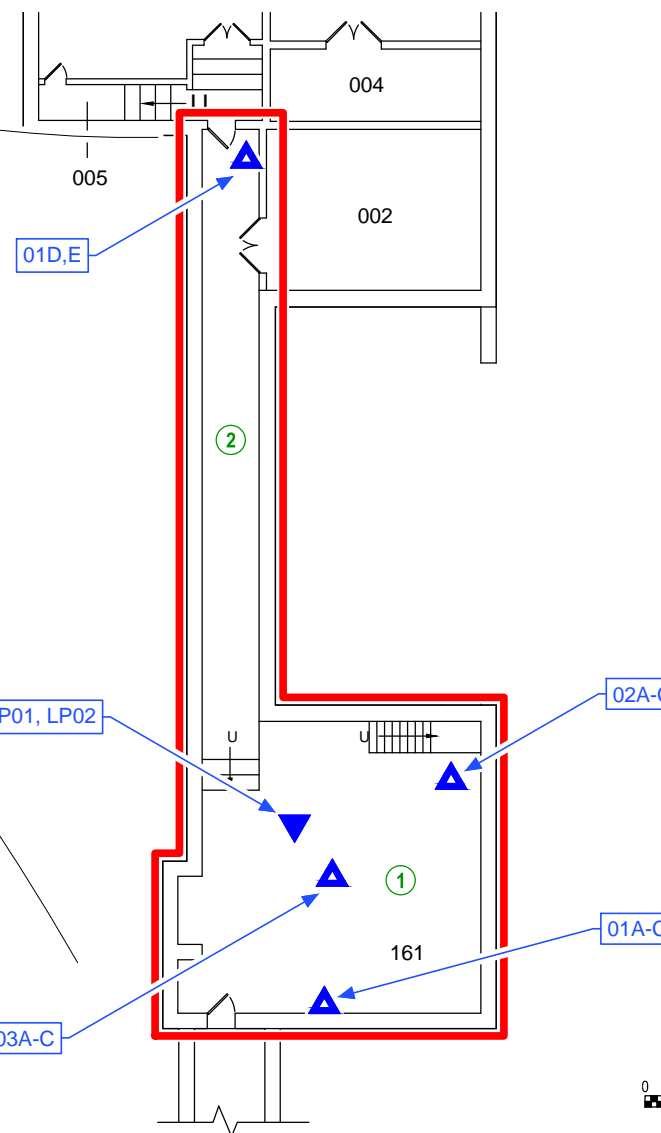
Photo 6: Suspected mould-impacted tar-paper (non-asbestos) over fibreglass acoustic panels, inside ductwork associated with AHU03 in the Penthouse.

APPENDIX B

Floor Plans with Sample Locations, Room Numbers and Project Area Boundaries



Not to Scale



Notes

1. This drawing shall be read in conjunction with the associated technical report.
2. Do not scale drawing.
3. All sample identifiers are prefixed with '26806-' which was excluded for drawing clarity.
4. Base drawings provided by client.

Legend

- Project area boundary
- ▲ Approximate asbestos sample location, as applicable
- ▼ Approximate paint sample location, lead testing (LP-#), as applicable
- 1 DST room number

Revision	Date	Issue	Approval
0	13-09-16	Original	N.S.

Client
National Research Council Canada

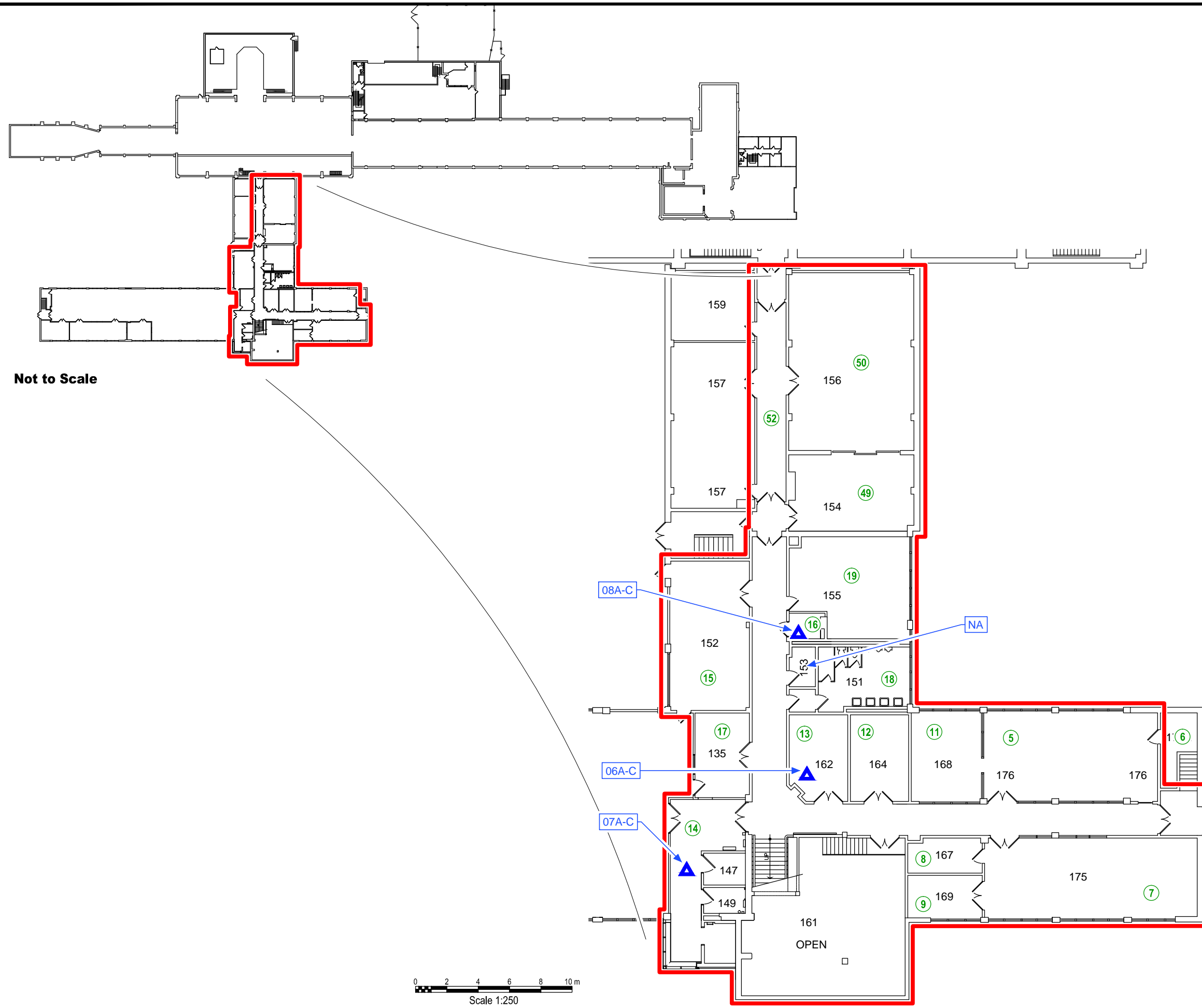
Site
Building U-66

Project Title
U-66 Chiller and Ductwork Replacement Project

Drawing Title
Building U-66 Basement Project Area and Sample Location Plan

Designed By	N.S.	Scale	As shown
Drawn By	R.W.	Date	January 2017
Approved By	N.S.	Project No.	GV-OT-026806

Figure No. **1**



- Notes**
1. This drawing shall be read in conjunction with the associated technical report.
 2. Do not scale drawing.
 3. All sample identifiers are prefixed with '26806-' which was excluded for drawing clarity.
 4. Base drawings provided by client.

- Legend**
- Project area boundary
 - ▲ Approximate asbestos sample location, as applicable
 - 1 DST room number
 - NA Not accessible

Revision	Date	Issue	Approval
0	13-09-16	Original	N.S.

Client
National Research Council Canada

Site
Building U-66

Project Title
U-66 Chiller and Ductwork Replacement Project

Drawing Title
Building U-66 First Floor Project Area and Sample Location Plan

Designed By	N.S.	Scale	As shown
Drawn By	R.W.	Date	January 2017
Approved By	N.S.	Project No.	GV-OT-026806

Figure No. **2**

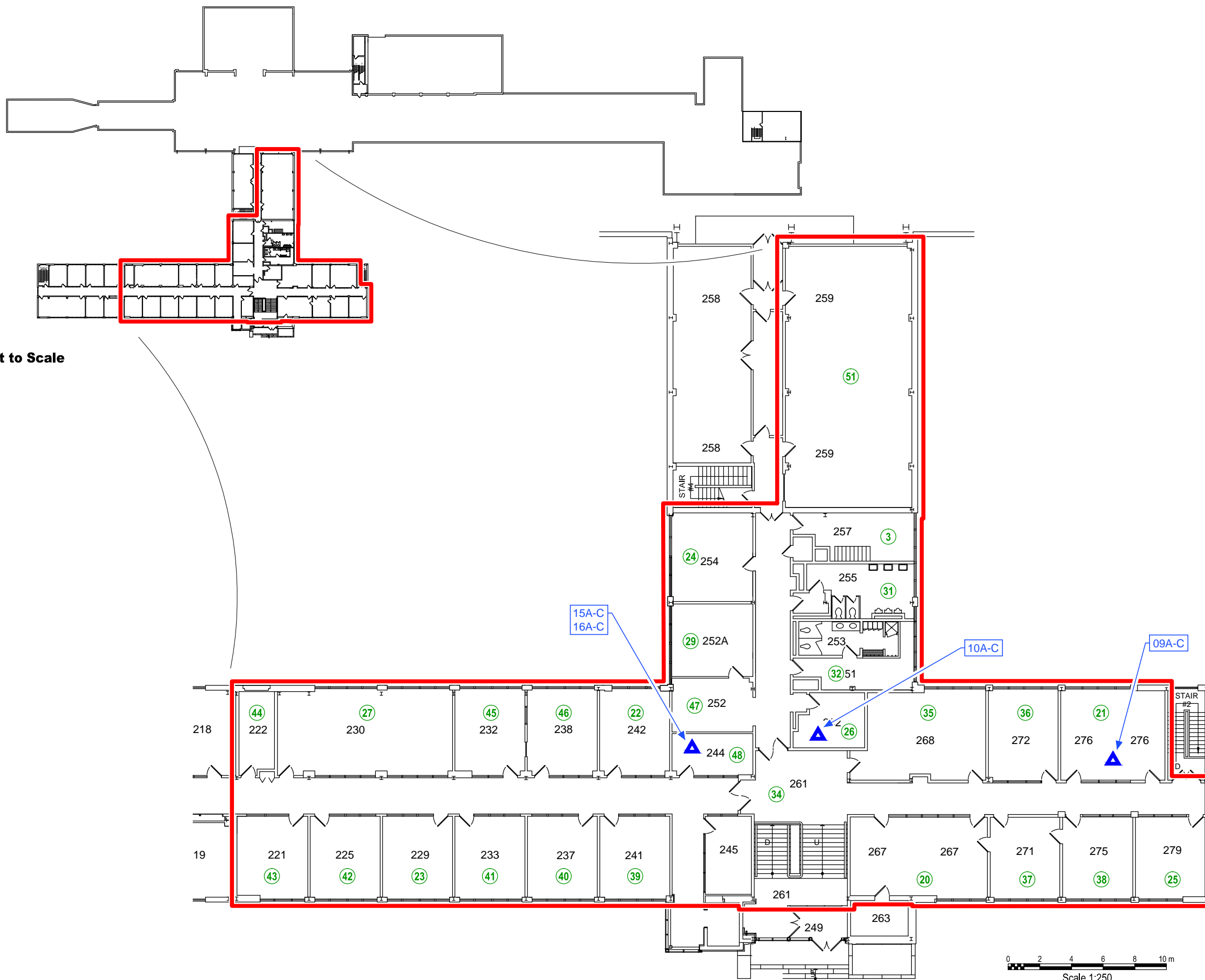
Saved: Thursday, January 19, 2017 @ 12:57 by Rob Wesson
 File: L:\GV\GVSO\GVOT026806 NRC U-66 Chiller Replacement Abatement Consulting\AutoCAD\DWGs\U-66 Chiller and Duct Work Replacement\2 U-66 1st flr.dwg
 Copyright © 2016 DST Consulting Engineers Inc.

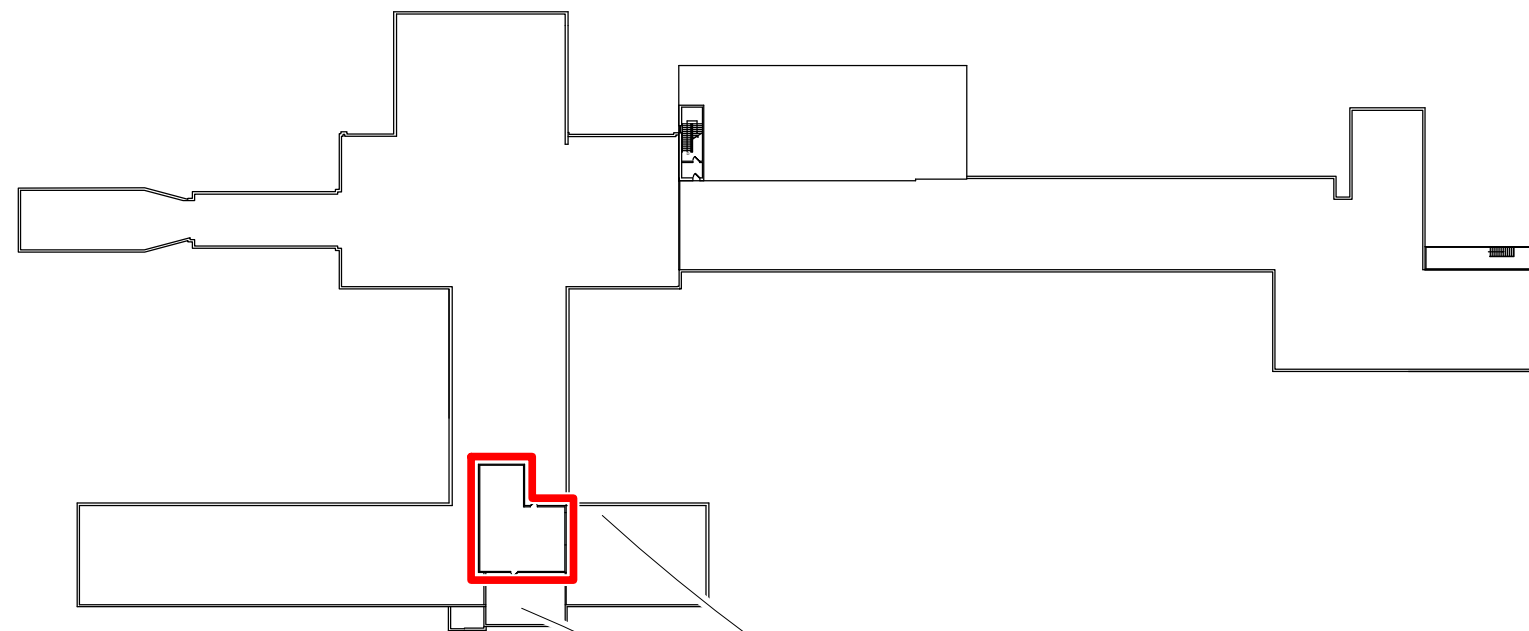
Notes

1. This drawing shall be read in conjunction with the associated technical report.
2. Do not scale drawing.
3. All sample identifiers are prefixed with '26806-' which was excluded for drawing clarity.
4. Base drawings provided by client.

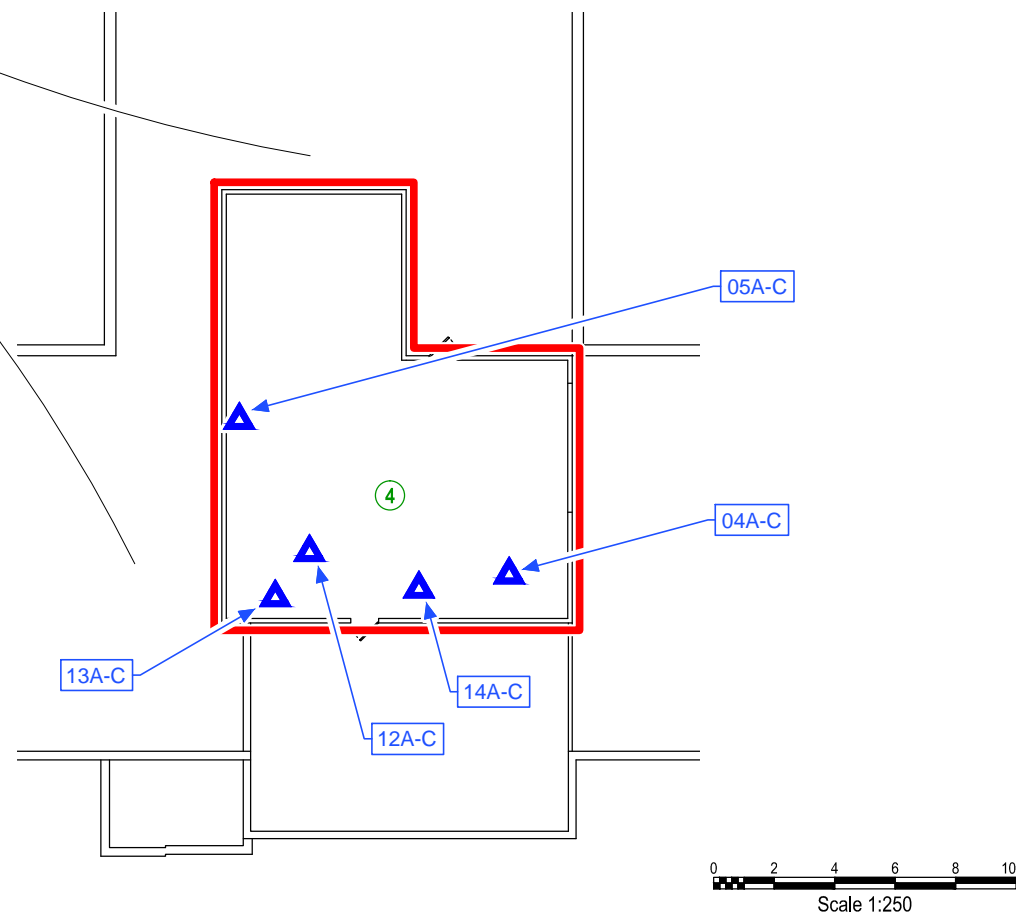
Legend

- Project area boundary
- ▲ Approximate asbestos sample location, as applicable
- ▼ Approximate paint sample location, lead testing (LP-#), as applicable
- 1 DST room number








Not to Scale



Notes

1. This drawing shall be read in conjunction with the associated technical report.
2. Do not scale drawing.
3. All sample identifiers are prefixed with '26806-' which was excluded for drawing clarity.
4. Base drawings provided by client.

Legend

-  Project area boundary
-  Approximate asbestos sample location, as applicable
-  DST room number

Revision	Date	Issue	Approval
0	13-09-16	Original	N.S.

Client
National Research Council Canada

Site
Building U-66

Project Title
U-66 Chiller and Ductwork Replacement Project

Drawing Title
Building U-66 Penthouse Project Area and Sample Location Plan

Designed By	N.S.	Scale	As shown
Drawn By	R.W.	Date	January 2017
Approved By	N.S.	Project No.	GV-OT-026806

Figure No. **4**

Appendix C

Laboratory Certificate of Analysis – Asbestos and Lead Samples Collected by DST, 2016

Certificate of Analysis

DST Consulting Engineers Inc. (Ottawa)

203-2150 Thurston Dr.
Ottawa, ON K1G 5T9
Attn: Nicolas Strang

Client PO:
Project: GV OT 026806
Custody:

Report Date: 7-Sep-2016
Order Date: 1-Sep-2016

Order #: 1636308

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Parcel ID	Client ID
1636308-01	LP-01 - Grey Floor
1636308-02	LP-02 - Yellow Base
1636308-03	LP-03 - Red Base

Approved By:



Mark Foto, M.Sc.
Lab Supervisor

Any use of these results implies your agreement that our total liability in connection with this work, however arising shall be limited to the amount paid by you for this work, and that our employees or agents shall not under circumstances be liable to you in connection with this work

Certificate of Analysis
Client: **DST Consulting Engineers Inc. (Ottawa)**
Client PO:

Report Date: 07-Sep-2016
Order Date: 1-Sep-2016
Project Description: **GV OT 026806**

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Metals, ICP-OES	based on MOE E3470, ICP-OES	6-Sep-16	6-Sep-16

Sample Data Revisions

None

Work Order Revisions/Comments:

None

Other Report Notes:

n/a: not applicable
ND: Not Detected
MDL: Method Detection Limit
Source Result: Data used as source for matrix and duplicate samples
%REC: Percent recovery.
RPD: Relative percent difference.

Certificate of Analysis
 Client: DST Consulting Engineers Inc. (Ottawa)
 Client PO:

Report Date: 07-Sep-2016
 Order Date: 1-Sep-2016
 Project Description: GV OT 026806

Sample Results

Lead				Matrix: Paint	
				Sample Date: 31-Aug-16	
Paracel ID	Client ID	Units	MDL	Result	
1636308-01	LP-01 - Grey Floor	ppm	20	2660	
1636308-02	LP-02 - Yellow Base	ppm	20	77	
1636308-03	LP-03 - Red Base	ppm	20	2320	

Laboratory Internal QA/QC

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Matrix Blank									
Lead	ND	20	ppm						
Matrix Duplicate									
Lead	550000	2000	ppm	615000			11.2	30	
Matrix Spike									
Lead	185		ug/L		74.1	70-130			



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www.paracellabs.com

Chain of Custody
(Lab Use Only)

Page 1 of 1

TAT: Regular 3 Day
 2 Day 1 Day
Date Required: _____

Client Name: <u>DOT Consulting Engineers</u>	Project Reference: <u>GU0T026806</u>
Contact Name: <u>Nick Strong</u>	Quote # <u>16-17</u>
Address: <u>2150 Thurston Dr. Ottawa, ON</u>	PO #
Telephone: <u>613 748 1415</u>	Email Address: <u>nstrong@dotgroup.com</u>

Criteria: O. Reg. 153/04 (As Amended) Table RSC Filing O. Reg. 558/00 PWQO CCME SUB (Storm) SUB (Sanitary) Municipality: _____ Other: _____

Matrix Type: S (Soil/Sed.) GW (Ground Water) SW (Surface Water) SS (Storm/Sanitary Sewer) P (Paint) A (Air) O (Other)

Required Analyses

Paracel Order Number: <u>1636308</u>		Matrix	Air Volume	# of Containers	Sample Taken		PHCs FI-F4+BTEX	VOCs	PAHs	Metals by ICP	Hg	Cr-VI	B (HWS)	Lead Content (ppm)							
Sample ID/Location Name	Date				Time																
1	<u>LP-01 - Grey floor</u>	<u>P</u>	<u>N/A</u>	<u>1</u>	<u>3/8/16</u>									<input checked="" type="checkbox"/>							
2	<u>LP-02 - Yellow base</u>	<u>↓</u>	<u>↓</u>	<u>↓</u>	<u>↓</u>									<input checked="" type="checkbox"/>							
3	<u>LP-03 - Red base</u>	<u>↓</u>	<u>↓</u>	<u>↓</u>	<u>↓</u>									<input checked="" type="checkbox"/>							
4																					
5																					
6																					
7																					
8																					
9																					
10																					

Comments: _____ Method of Delivery: Walk-in

Relinquished By (Sign): <u>[Signature]</u>	Received by Driver/Depot:	Received at Lab: <u>SUNEPORN DOKMAN</u>	Verified By: <u>Rachel Subject</u>
Relinquished By (Print): <u>N-Strong</u>	Date/Time:	Date/Time: <u>SEP 06 2016 01:29</u>	Date/Time: <u>SEP 16 2016 3:22</u>
Date/Time: <u>1/9/16</u>	Temperature: _____ °C	Temperature: _____ °C	pH Verified <input checked="" type="checkbox"/> By: <u>N/A</u>

Certificate of Analysis

DST Consulting Engineers Inc. (Ottawa)

203-2150 Thurston Dr.
Ottawa, ON K1G 5T9
Attn: Nicolas Strang

Client PO:

Project: GV OT 026806

Custody:

Report Date: 8-Sep-2016

Order Date: 1-Sep-2016

Order #: 1637085

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Parcel ID	Client ID		
1637085-01	01A	1637085-27	08A
1637085-02	01B	1637085-28	08B
1637085-03	01C	1637085-29	08C
1637085-04	01D	1637085-30	09A
1637085-05	01E	1637085-31	09B (Tar)
1637085-06	02A	1637085-32	09C
1637085-07	02B	1637085-33	09B (Tar Paper)
1637085-08	02C	1637085-34	10A
1637085-09	03A (Cork)	1637085-35	10B
1637085-10	03B (Cork)	1637085-36	10C
1637085-11	03C (Cork)		
1637085-12	03A (Tar)		
1637085-13	03B (Tar)		
1637085-14	03C (Tar)		
1637085-15	04A		
1637085-16	04B		
1637085-17	04C		
1637085-18	05A		
1637085-19	05B		
1637085-20	05C		
1637085-21	06A		
1637085-22	06B		
1637085-23	06C		
1637085-24	07A		
1637085-25	07B		
1637085-26	07C		

Approved By:



Emma Diaz

Senior Analyst

Any use of these results implies your agreement that our total liability in connection with this work, however arising, shall be limited to the amount paid by you for this work, and that our employees or agents shall not under any circumstances be liable to you in connection with this work.

Certificate of Analysis
 Client: **DST Consulting Engineers Inc. (Ottawa)**
 Client PO:

Report Date: 08-Sep-2016
 Order Date: 1-Sep-2016
 Project Description: **GV OT 026806**

Asbestos, PLM Visual Estimation **MDL - 0.5%**

<i>Parcel I.D.</i>	<i>Sample Date</i>	<i>Layers Analyzed</i>	<i>Colour</i>	<i>Description</i>	<i>Asbestos Detected:</i>	<i>Material Identification</i>	<i>% Content</i>
1637085-01	31-Aug-16	sample homogenized	Grey	Concrete	No	Client ID: 01A Non-Fibers	100
1637085-02	31-Aug-16	sample homogenized	Grey	Concrete	No	Client ID: 01B Non-Fibers	100
1637085-03	31-Aug-16	sample homogenized	Grey	Concrete	No	Client ID: 01C Non-Fibers	100
1637085-04	31-Aug-16	sample homogenized	Grey	Concrete	No	Client ID: 01D Non-Fibers	100
1637085-05	31-Aug-16	sample homogenized	Grey	Concrete	No	Client ID: 01E Non-Fibers	100
1637085-06	31-Aug-16	sample homogenized	Grey	Parging Cement	No	Client ID: 02A Cellulose MMVF Non-Fibers	3 10 87
1637085-07	31-Aug-16	sample homogenized	Grey	Parging Cement	No	Client ID: 02B [AS-PRE] Cellulose MMVF Non-Fibers	5 5 90
1637085-08	31-Aug-16	sample homogenized	Black/Grey	Foam/Parging Cement	No	Client ID: 02C [AS-PRE, Z-01] Cellulose MMVF Non-Fibers	5 5 90
1637085-09	31-Aug-16	sample homogenized	Brown	Cork	No	Client ID: 03A (Cork) [AS-PRE] Non-Fibers	100
1637085-10	31-Aug-16	sample homogenized	Brown	Cork	No	Client ID: 03B (Cork) [AS-PRE] Non-Fibers	100
1637085-11	31-Aug-16	sample homogenized	Brown	Cork	No	Client ID: 03C (Cork) [AS-PRE] Non-Fibers	100
1637085-12	31-Aug-16	sample homogenized	Black	Tar	Yes	Client ID: 03A (Tar) [AS-PRE] Chrysotile MMVF Non-Fibers	0.53 <MDL 99.47
1637085-13	31-Aug-16					Client ID: 03B (Tar) not analyzed	

Certificate of Analysis
 Client: DST Consulting Engineers Inc. (Ottawa)
 Client PO:

Report Date: 08-Sep-2016
 Order Date: 1-Sep-2016
 Project Description: GV OT 026806

Asbestos, PLM Visual Estimation **MDL - 0.5%**

Parcel I.D.	Sample Date	Layers Analyzed	Colour	Description	Asbestos Detected:	Material Identification	% Content
1637085-14	31-Aug-16					Client ID: 03C (Tar) not analyzed	
1637085-15	31-Aug-16	sample homogenized	Black	Mastic	Yes	Client ID: 04A [AS-PRE] Chrysotile Non-Fibers	11.22 88.78
1637085-16	31-Aug-16					Client ID: 04B not analyzed	
1637085-17	31-Aug-16					Client ID: 04C not analyzed	
1637085-18	31-Aug-16	sample homogenized	White	Insulation	No	Client ID: 05A MMVF Non-Fibers	95 5
1637085-19	31-Aug-16	sample homogenized	White	Insulation	No	Client ID: 05B MMVF Non-Fibers	95 5
1637085-20	31-Aug-16	sample homogenized	White	Insulation	No	Client ID: 05C MMVF Non-Fibers	95 5
1637085-21	31-Aug-16	sample homogenized	White/Brown	Ceiling Tile	No	Client ID: 06A [AS-PRE] Cellulose MMVF Non-Fibers Other fibers	40 15 40 5
1637085-22	31-Aug-16	sample homogenized	White/Brown	Ceiling Tile	No	Client ID: 06B [AS-PRE] Cellulose MMVF Non-Fibers Other fibers	40 15 40 5
1637085-23	31-Aug-16	sample homogenized	White/Brown	Ceiling Tile	No	Client ID: 06C [AS-PRE] Cellulose MMVF Non-Fibers Other fibers	40 15 40 5

Certificate of Analysis

Report Date: 08-Sep-2016

Client: DST Consulting Engineers Inc. (Ottawa)

Order Date: 1-Sep-2016

Client PO:

Project Description: GV OT 026806

Asbestos, PLM Visual Estimation **MDL - 0.5%**

Parcel I.D.	Sample Date	Layers Analyzed	Colour	Description	Asbestos Detected:	Material Identification	% Content
1637085-24	31-Aug-16	sample homogenized	White/Grey	Ceiling Tile	No	Client ID: 07A [AS-PRE]	
						Cellulose	10
						MMVF	50
						Non-Fibers	40
1637085-25	31-Aug-16	sample homogenized	White/Grey	Ceiling Tile	No	Client ID: 07B [AS-PRE]	
						Cellulose	10
						MMVF	50
						Non-Fibers	40
1637085-26	31-Aug-16	sample homogenized	White/Grey	Ceiling Tile	No	Client ID: 07C [AS-PRE]	
						Cellulose	10
						MMVF	50
						Non-Fibers	40
1637085-27	31-Aug-16	sample homogenized	Grey	Mortar	No	Client ID: 08A	
						Non-Fibers	100
1637085-28	31-Aug-16	sample homogenized	Grey	Mortar	No	Client ID: 08B	
						Non-Fibers	100
1637085-29	31-Aug-16	sample homogenized	Grey	Mortar	No	Client ID: 08C	
						Non-Fibers	100
1637085-30	31-Aug-16	sample homogenized	Black	Tar	No	Client ID: 09A [AS-PRE]	
						MMVF	5
						Non-Fibers	95
1637085-31	31-Aug-16	sample homogenized	Black	Tar	No	Client ID: 09B (Tar) [AS-PRE]	
						MMVF	5
						Non-Fibers	95
1637085-32	31-Aug-16	sample homogenized	Black	Tar	No	Client ID: 09C [AS-PRE]	
						MMVF	5
						Non-Fibers	95
1637085-33	31-Aug-16	sample homogenized	Black	Tar Paper	No	Client ID: 09B (Tar Paper) [AS-PRE]	
						Cellulose	50
						MMVF	1
						Non-Fibers	49
1637085-34	31-Aug-16	sample homogenized	Brown	Mastic	No	Client ID: 10A [AS-PRE]	
						Non-Fibers	100
1637085-35	31-Aug-16	sample homogenized	Brown	Mastic	No	Client ID: 10B [AS-PRE]	
						Non-Fibers	100

Certificate of Analysis
 Client: **DST Consulting Engineers Inc. (Ottawa)**
 Client PO:

Report Date: 08-Sep-2016
 Order Date: 1-Sep-2016
 Project Description: **GV OT 026806**

Asbestos, PLM Visual Estimation **MDL - 0.5%**

Paracel I.D.	Sample Date	Layers Analyzed	Colour	Description	Asbestos Detected:	Material Identification	% Content
1637085-36	31-Aug-16	sample homogenized	Brown	Mastic	No	Client ID: 10C Non-Fibers	<small>(AS-PRE)</small> 100

* MMVF: Man Made Vitreous Fibers: Fiberglass, Mineral Wool, Rockwool, Glasswool

** Analytes in bold indicate asbestos mineral content.

Analysis Summary Table

Analysis	Method Reference/Description	Lab Location	NVLAP Lab Code *	Analysis Date
Asbestos, PLM Visual Estimation	by EPA 600/R-93/116	2 - Ottawa West Lab	200812-0	8-Sep-16

* Reference to the NVLAP term does not permit the user of this report to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

Qualifier Notes

Sample Qualifiers :

AS-PRE: Due to the difficult nature of the bulk sample (interfering fibers/binders), additional NOB preparation was required prior to analysis

Z-01: Insufficient foam to analyze separately, homogenized with parging cement.

Work Order Revisions / Comments

None



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Ottawa, Ontario K1G 4J8
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e parcel@paracellabs.com

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Page 1 of 1

Client Name: DST Consulting Engineers	Project Reference: GVO7026806	Turnaround Time: <input type="checkbox"/> Immediate <input type="checkbox"/> 1 Day <input checked="" type="checkbox"/> 4 Hour <input type="checkbox"/> 2 Day <input type="checkbox"/> 8 Hour <input type="checkbox"/> 3 Day <input checked="" type="checkbox"/> Regular
Contact Name: Nick Strong	Quote #: 16-17	
Address: 2150 Thurston Dr. Ottawa, ON	PO #:	
Telephone: 613 748 1415	Email Address: nstrong@dctgroup.com	
Date Required: _____		

ASBESTOS & MOLD ANALYSIS

Matrix: Air Bulk Tape Lift Swab Other Regulatory Guideline: _____

Required Analyses: Microscopic Mold Culturable Mold Bacteria GRAM PCM PLM Chatfield TEM

Parcel Order Number: 4057085				Asbestos - Bulk		
Sample ID	Sampling Date	Air Volume (L)	Analysis Required	Matrix Description	Positive Stop? (Y/N)	If layered, Describe Layer(s) to be Analyzed Separately* or Homogenize all **
01A-E	3/18/16	N/A	PCM	Tex. conc	Y	Analyze all layers separately
02A-C	↓	↓	↓	Paving	↓	
03A-C	↓	↓	↓	Tar w/ Cork	↓	
04A-C	↓	↓	↓	Mastic	↓	
05A-C	↓	↓	↓	Insulation	↓	
06A-C	↓	↓	↓	Ceiling tiles	↓	
07A-C	↓	↓	↓	Ceiling tiles	↓	
08A-C	↓	↓	↓	Mortar	↓	
09A-C	↓	↓	↓	Tar	↓	
10A-C	↓	↓	↓	Mastic	↓	
11						
12						
13						
14						
15						

*Each layer will be analyzed and charged separately **Homogenize = All layers are blended into a single uniform sample.

Comments: _____ Method of Delivery: Walker

Relinquished By (Sign): [Signature]	Received at Depot: [Signature]	Received at Lab: [Signature]	Verified By: [Signature]
Relinquished By (Print): N. STRONG	Date/Time: Sept 1/16	Date/Time: 09/01/16 2:38pm	Date/Time: 09/02/16 11:19am

1:27pm

Certificate of Analysis

DST Consulting Engineers Inc. (Ottawa)

203-2150 Thurston Dr.
Ottawa, ON K1G 5T9
Attn: Nicolas Strang

Client PO:

Project: GV SO 025648

Custody: 17938

Report Date: 28-Sep-2016

Order Date: 27-Sep-2016

Order #: 1640157

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
1640157-01	26548-03A (Grey)
1640157-02	26548-03B (Grey)
1640157-03	26548-03C (Grey)

Approved By:



Emma Diaz

Senior Analyst

Any use of these results implies your agreement that our total liability in connection with this work, however arising, shall be limited to the amount paid by you for this work, and that our employees or agents shall not under any circumstances be liable to you in connection with this work.

Certificate of Analysis
 Client: **DST Consulting Engineers Inc. (Ottawa)**
 Client PO:

Report Date: 28-Sep-2016
 Order Date: 27-Sep-2016
 Project Description: **GV SO 025648**

Asbestos, PLM Visual Estimation **MDL - 0.5%**

Parcel I.D.	Sample Date	Layers Analyzed	Colour	Description	Asbestos Detected:	Material Identification	% Content
1640157-01	27-Sep-16	sample homogenized	Grey	Parging	Yes	Client ID: 26548-03A (Grey) Chrysotile	60
						Cellulose	15
						Non-Fibers	25
1640157-02	27-Sep-16					Client ID: 26548-03B (Grey) not analyzed	
1640157-03	27-Sep-16					Client ID: 26548-03C (Grey) not analyzed	

**** Analytes in bold indicate asbestos mineral content.**

Analysis Summary Table

Analysis	Method Reference/Description	Lab Location	NVLAP Lab Code *	Analysis Date
Asbestos, PLM Visual Estimation	by EPA 600/R-93/116	2 - Ottawa West Lab	200812-0	28-Sep-16

* Reference to the NVLAP term does not permit the user of this report to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

Work Order Revisions / Comments

None

Client Name: <u>DST</u>	Project Reference: <u>GV-50-025648</u>	Turnaround Time: <input type="checkbox"/> Immediate <input type="checkbox"/> 1 Day <input type="checkbox"/> 4 Hour <input type="checkbox"/> 2 Day <input checked="" type="checkbox"/> 8 Hour <input type="checkbox"/> 3 Day <input type="checkbox"/> Regular Date Required: _____
Contact Name: <u>Nick Strang</u>	Quote #: <u>16-17</u>	
Address: <u>Ottawa office</u>	PO #:	
Telephone: <u>613 748 1415</u>	Email Address: <u>nstrang@dcbgroup.com</u>	

ASBESTOS & MOLD ANALYSIS

Matrix: Air Bulk Tape Lift Swab Other Regulatory Guideline: _____

Required Analyses: Microscopic Mold Culturable Mold Bacteria GRAM PCM PLM Chatfield TEM

Parcel Order Number: <u>1640157</u>				Asbestos - Bulk			
Sample ID	Sampling Date	Air Volume (L)	Analysis Required	Matrix Description	Positive Stop? (Y/N)	Is the Sample Layered? (Y/N)	If layered, Describe Layer(s) to be analyzed Separately* or Homogenize all**
1	<u>27/9/16</u>	<u>N/A</u>	<u>PLM</u>	<u>Grey parging</u>	<u>Y</u>	<u>Y</u>	<u>Analyze grey layer only</u>
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							

*Each layer will be analyzed and charged separately **Homogenize = All layers are blended into a single uniform sample.

Comments: 8-hour TAT please - BY noon wed Sept. 28, 16 Method of Delivery: Walk-in

Relinquished By (Sign): <u>[Signature]</u>	Received at Depot: <u>[Signature]</u>	Received at Lab: <u>[Signature]</u>	Verified By: <u>[Signature]</u>
Relinquished By (Print): <u>N. STRANG</u>	Date/Time: <u>27/9/16 12:51 PM</u>	Date/Time: <u>09/27/16 3:50 PM</u>	Date/Time: <u>09/27/16 4:29 PM</u>

Certificate of Analysis

DST Consulting Engineers Inc. (Ottawa)

203-2150 Thurston Dr.
Ottawa, ON K1G 5T9
Attn: Nicolas Strang

Client PO:

Project: GV OT 026806

Custody: 18243

Report Date: 10-Nov-2016

Order Date: 9-Nov-2016

Order #: 1646252

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
1646252-01	AHU01-01A
1646252-02	AHU01-01B
1646252-03	AHU01-01C
1646252-04	26806-11A
1646252-05	26806-11B
1646252-06	26806-12A
1646252-07	26806-12B
1646252-08	26806-12C
1646252-09	26806-13A
1646252-10	26806-13B
1646252-11	26806-13C
1646252-12	26806-14A
1646252-13	26806-14B
1646252-14	26806-14C

Approved By:



Emma Diaz

Senior Analyst

Any use of these results implies your agreement that our total liability in connection with this work, however arising, shall be limited to the amount paid by you for this work, and that our employees or agents shall not under any circumstances be liable to you in connection with this work.

Certificate of Analysis
 Client: **DST Consulting Engineers Inc. (Ottawa)**
 Client PO:

Report Date: 10-Nov-2016
 Order Date: 9-Nov-2016
 Project Description: **GV OT 026806**

Asbestos, PLM Visual Estimation **MDL - 0.5%**

<i>Parcel I.D.</i>	<i>Sample Date</i>	<i>Layers Analyzed</i>	<i>Colour</i>	<i>Description</i>	<i>Asbestos Detected:</i>	<i>Material Identification</i>	<i>% Content</i>
1646252-01	09-Nov-16	sample homogenized	Black	Tar Paper	No	Client ID: AHU01-01A [AS-PRE] MMVF Non-Fibers	80 20
1646252-02	09-Nov-16	sample homogenized	Black	Tar Paper	No	Client ID: AHU01-01B [AS-PRE] MMVF Non-Fibers	80 20
1646252-03	09-Nov-16	sample homogenized	Black	Tar Paper	No	Client ID: AHU01-01C [AS-PRE] MMVF Non-Fibers	80 20
1646252-04	09-Nov-16	sample homogenized	Grey/Black	Parging/Tar Paper	Yes	Client ID: 26806-11A [ASLYR] Chrysotile MMVF Non-Fibers	60 10 30
1646252-05	09-Nov-16	sample homogenized	Grey	Parging	Yes	Client ID: 26806-11B Chrysotile Non-Fibers	40 60
1646252-06	09-Nov-16	sample homogenized	Black/Yellow	Tar/Insulation	No	Client ID: 26806-12A [ASLYR, AS-PRE] MMVF Non-Fibers	40 60
1646252-07	09-Nov-16	sample homogenized	Black/Yellow	Tar/Insulation	No	Client ID: 26806-12B [ASLYR, AS-PRE] MMVF Non-Fibers	40 60
1646252-08	09-Nov-16	sample homogenized	Black/Yellow	Tar/Insulation	No	Client ID: 26806-12C [ASLYR, AS-PRE] MMVF Non-Fibers	40 60
1646252-09	09-Nov-16	sample homogenized	Brown	Mastic	No	Client ID: 26806-13A [AS-PRE] MMVF Non-Fibers	5 95
1646252-10	09-Nov-16	sample homogenized	Brown	Mastic	No	Client ID: 26806-13B [AS-PRE] MMVF Non-Fibers	5 95
1646252-11	09-Nov-16	sample homogenized	Brown	Mastic	No	Client ID: 26806-13C [AS-PRE] MMVF Non-Fibers	5 95

Certificate of Analysis
 Client: **DST Consulting Engineers Inc. (Ottawa)**
 Client PO:

Report Date: 10-Nov-2016
 Order Date: 9-Nov-2016
 Project Description: **GV OT 026806**

Asbestos, PLM Visual Estimation **MDL - 0.5%**

Paracel I.D.	Sample Date	Layers Analyzed	Colour	Description	Asbestos Detected:	Material Identification	% Content
1646252-12	09-Nov-16	sample homogenized	Black/Yellow	Tar Paper	No	Client ID: 26806-14A [AS-PRE] MMVF Non-Fibers	60 40
1646252-13	09-Nov-16	sample homogenized	Black/Yellow	Tar Paper	No	Client ID: 26806-14B [AS-PRE] MMVF Non-Fibers	60 40
1646252-14	09-Nov-16	sample homogenized	Black/Yellow	Tar Paper	No	Client ID: 26806-14C [AS-PRE] MMVF Non-Fibers	60 40

* MMVF: Man Made Vitreous Fibers: Fiberglass, Mineral Wool, Rockwool, Glasswool
 ** Analytes in bold indicate asbestos mineral content.

Analysis Summary Table

Analysis	Method Reference/Description	Lab Location	NVLAP Lab Code *	Analysis Date
Asbestos, PLM Visual Estimation	by EPA 600/R-93/116	2 - Ottawa West Lab	200812-0	10-Nov-16

* Reference to the NVLAP term does not permit the user of this report to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

Qualifier Notes

- Sample Qualifiers :
- ASLYR: Layers were noted for this sample, however, the entire sample was homogenized per client request.
 - AS-PRE: Due to the difficult nature of the bulk sample (interfering fibers/binders), additional NOB preparation was required prior to analysis

Work Order Revisions / Comments

None



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Chain of Custody
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No 18243

Page 1 of 1

Client Name: <u>DST</u>	Project Reference: <u>GV-OT-026806</u>	Turnaround Time: <input checked="" type="checkbox"/> Immediate <input type="checkbox"/> 1 Day <input type="checkbox"/> 4 Hour <input type="checkbox"/> 2 Day <input type="checkbox"/> 8 Hour <input type="checkbox"/> 3 Day <input type="checkbox"/> Regular Date Required: <u>10:30 am TUEW/saturday</u>
Contact Name: <u>Nick Strang</u>	Quote #: <u>16-17</u>	
Address: <u>Ottawa office</u>	PO #:	
Telephone: <u>613 748 1415 cell 613 292 1124</u>	Email Address: <u>nstrang@dstgroup.com</u>	

ASBESTOS & MOLD ANALYSIS

Matrix: Air Bulk Tape Lift Swab Other Regulatory Guideline:

Required Analyses: Microscopic Mold Culturable Mold Bacteria GRAM PCM PLM Chatfield TEM

Paracel Order Number: <u>1646252</u>				Asbestos - Bulk			
Sample ID	Sampling Date	Air Volume (L)	Analysis Required	Matrix Description	Positive Stop? (Y/N)	Is the Sample Layered? (Y/N)	If layered, Describe Layer(s) to be Analyzed Separately* or Homogenize all **
1	<u>9/11/16</u>	<u>N/A</u>	<u>PCM</u>	<u>Tar paper</u>	<u>Y</u>	<u>N</u>	<u>homog.</u>
2	↓	↓	↓	<u>Packing debris</u>	<u>N</u>	↓	↓
3	↓	↓	↓	<u>Tar</u>	<u>Y</u>	↓	↓
4	↓	↓	↓	<u>Brown Mastic</u>	↓	↓	↓
5	↓	↓	↓	<u>Tar paper</u>	↓	↓	↓
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							

*Each layer will be analyzed and charged separately **Homogenize = All layers are blended into a single uniform sample.

Comments: _____ Method of Delivery: Walk-in

Relinquished By (Sign): <u>[Signature]</u>	Received at Depot:	Received at Lab: <u>[Signature]</u>	Verified By: <u>[Signature]</u>
Relinquished By (Print): <u>N STRANG</u>	Date/Time: <u>16:51 9/11/16</u>	Date/Time: <u>11/09/16 4:57 pm</u>	Date/Time: <u>11/10/16 8:09 am</u>

Certificate of Analysis

DST Consulting Engineers Inc. (Ottawa)

203-2150 Thurston Dr.
Ottawa, ON K1G 5T9
Attn: Nicolas Strang

Client PO:

Project: GV OT 026806

Custody: 17917

Report Date: 29-Nov-2016

Order Date: 24-Nov-2016

Order #: 1648325

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
1648325-01	26806-15A
1648325-02	26806-15B
1648325-03	26806-15C

Approved By:



Emma Diaz

Senior Analyst

Any use of these results implies your agreement that our total liability in connection with this work, however arising, shall be limited to the amount paid by you for this work, and that our employees or agents shall not under any circumstances be liable to you in connection with this work.

Certificate of Analysis
 Client: **DST Consulting Engineers Inc. (Ottawa)**
 Client PO:

Report Date: 29-Nov-2016
 Order Date: 24-Nov-2016
 Project Description: **GV OT 026806**

Asbestos, PLM Visual Estimation **MDL - 0.5%**

Parcel I.D.	Sample Date	Layers Analyzed	Colour	Description	Asbestos Detected:	Material Identification	% Content
1648325-01	16-Nov-16	sample homogenized	White/Brown	Ceiling Tile	No	Client ID: 26806-15A [AS-PRE]	
						Cellulose	95
						Non-Fibers	5
1648325-02	16-Nov-16	sample homogenized	White/Brown	Ceiling Tile	No	Client ID: 26806-15B [AS-PRE]	
						Cellulose	95
						Non-Fibers	5
1648325-03	16-Nov-16	sample homogenized	White/Brown	Ceiling Tile	No	Client ID: 26806-15C [AS-PRE]	
						Cellulose	95
						Non-Fibers	5

Analysis Summary Table

Analysis	Method Reference/Description	Lab Location	NVLAP Lab Code *	Analysis Date
Asbestos, PLM Visual Estimation	by EPA 600/R-93/116	2 - Ottawa West Lab	200812-0	29-Nov-16

* Reference to the NVLAP term does not permit the user of this report to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

Qualifier Notes

Sample Qualifiers :

AS-PRE: Due to the difficult nature of the bulk sample (interfering fibers/binders), additional NOB preparation was required prior to analysis

Work Order Revisions / Comments

None



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No 17917

Page 1 of 1

Client Name: <u>DST</u>	Project Reference: <u>GV-OT-026806</u>
Contact Name: <u>Nicolas Strang</u>	Quote #: <u>16-17</u>
Address: <u>2150 Thurston Drive, Ottawa, ON</u>	PO #:
Telephone: <u>613 748 1415</u>	Email Address: <u>nstrang@dstgroup.com</u>

Turnaround Time:

Immediate 1 Day
 4 Hour 2 Day
 8 Hour 3 Day
 Regular

Date Required: _____

ASBESTOS & MOLD ANALYSIS

Matrix: Air Bulk Tape Lift Swab Other Regulatory Guideline: _____

Required Analyses: Microscopic Mold Culturable Mold Bacteria GRAM PCM PLM Chatfield TEM

Parcel Order Number: <u>1048325</u>				Asbestos - Bulk			
Sample ID	Sampling Date	Air Volume (L)	Analysis Required	Matrix Description	Positive Stop? (Y/N)	Is the Sample Layered? (Y/N)	If layered, Describe Layer(s) to be analyzed Separately* or Homogenize all **
1	<u>Nov/16</u>	<u>N/A</u>	<u>PLM</u>	<u>1x1 CT</u>	<u>Y</u>	<u>N</u>	<u>Homog.</u>
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							

*Each layer will be analyzed and charged separately **Homogenize = All layers are blended into a single uniform sample.

Comments: _____ Method of Delivery: Walkin

Relinquished By (Sign): <u>N Strang</u>	Received at Donor: <u>[Signature]</u>	Received at Lab: <u>[Signature]</u>	Verified By: <u>[Signature]</u>
Relinquished By (Print): <u>N. STRANG</u>	Date/Time: <u>Nov 24/16 9:43a</u>	Date/Time: <u>11/24/16 1:30pm</u>	Date/Time: <u>11/24/16 3:30pm</u>

Certificate of Analysis

DST Consulting Engineers Inc. (Ottawa)

203-2150 Thurston Dr.
Ottawa, ON K1G 5T9
Attn: Nicolas Strang

Client PO:

Project: GV OT 026806

Custody:

Report Date: 2-Dec-2016

Order Date: 28-Nov-2016

Order #: 1649165

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
1649165-01	26806-16A
1649165-02	26806-16B
1649165-03	26806-16C

Approved By:



Emma Diaz

Senior Analyst

Certificate of Analysis
Client: **DST Consulting Engineers Inc. (Ottawa)**
Client PO:

Report Date: 02-Dec-2016
Order Date: 28-Nov-2016
Project Description: **GV OT 026806**

Asbestos, PLM Visual Estimation **MDL - 0.5%**

Parcel I.D.	Sample Date	Layers Analyzed	Colour	Description	Asbestos Detected:	Material Identification	% Content
1649165-01	28-Nov-16	sample homogenized	Brown	Mastic	Yes	Client ID: 26806-16A [AS-PRE]	
						Chrysotile	0.9
						Non-Fibers	98.2
						Other fibers	0.9
1649165-02	28-Nov-16					Client ID: 26806-16B	
						not analyzed	
1649165-03	28-Nov-16					Client ID: 26806-16C	
						not analyzed	

**** Analytes in bold indicate asbestos mineral content.**

Analysis Summary Table

Analysis	Method Reference/Description	Lab Location	NVLAP Lab Code *	Analysis Date
Asbestos, PLM Visual Estimation	by EPA 600/R-93/116	2 - Ottawa West Lab	200812-0	30-Nov-16

* Reference to the NVLAP term does not permit the user of this report to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

Qualifier Notes

Sample Qualifiers :

AS-PRE: Due to the difficult nature of the bulk sample (interfering fibers/binders), additional NOB preparation was required prior to analysis

Work Order Revisions / Comments

None



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Page 1 of 1

Client Name: DST	Project Reference: GVD1026806
Contact Name: Nick Strang	Quote #:
Address: 2150 Thurston Dr	PO #:
Telephone: 613-748-1415	Email Address: nstrang@dstgroup.com

Turnaround Time:

Immediate 1 Day
 4 Hour 2 Day
 8 Hour 3 Day
 Regular

Date Required: _____

ASBESTOS & MOLD ANALYSIS

Matrix: Air Bulk Tape Lift Swab Other Regulatory Guideline: _____

Required Analyses: Microscopic Mold Culturable Mold Bacteria GRAM PCM PLM Chatfield TEM

Paracel Order Number: 1649165		Asbestos - Bulk						
Sample ID	Sampling Date	Air Volume (L)	Analysis Required	Matrix Description	Positive Stop? (Y/N)	Is the Sample Layered? (Y/N)	If layered, Describe Layer(s) to be Analyzed Separately* or Homogenize all **	
1 26806-16A-C	16/11/28		PLM	Brown mastic	Y	N	Analyze all layers separately	
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								

*Each layer will be analyzed and charged separately **Homogenize = All layers are blended into a single uniform sample.

Comments:			Method of Delivery: <i>Walkin</i>	
Relinquished By (Sign): <i>[Signature]</i>	Received at Depot: <i>[Signature]</i>	Received at Lab: <i>[Signature]</i>	Verified By: <i>[Signature]</i>	
Relinquished By (Print): Andree Young	Date/Time: <i>Nov 28/16</i>	Date/Time: <i>11/28/16 4:40p</i>	Date/Time: <i>11/30/16 8:43am</i>	

11.46a



MP1 Montant à payer – Généralités

1.1 Sous réserve de toutes autres dispositions du Contrat, Sa Majesté paie à l'Entrepreneur, aux dates et de la manière énoncées ci-après, le montant par lequel:

1.1.1 l'ensemble des montants prévus à l'article MP2 excède,

1.1.2 l'ensemble des montants prévus à l'article MP3

et l'Entrepreneur accepte le paiement comme paiement final de tout ce qu'il a fourni et fait relativement aux travaux auxquels le paiement se rapporte.

MP2 Montants payables à l'Entrepreneur

2.1 Les montants mentionnés à l'alinéa MP1.1.1 sont l'ensemble :

2.1.1 des montants prévus dans les Articles de convention; et

2.1.2 le montant, s'il en est, payable à l'Entrepreneur conformément aux Conditions générales.

MP3 Montants payables à Sa Majesté

3.1 Les montants mentionnés à l'alinéa MP1.1.2 sont l'ensemble des montants, s'il en est, que l'Entrepreneur est tenu de payer à Sa Majesté en vertu du Contrat.

3.2 Dans tout paiement fait à l'Entrepreneur, le fait pour Sa Majesté d'omettre de déduire d'un montant mentionné à l'article MP2 un montant mentionné au paragraphe MP3.1 ne peut constituer un abandon de son droit de faire une telle déduction, ni une reconnaissance de l'absence d'un tel droit lors de tout paiement ultérieur à l'Entrepreneur.

MP4 Date de paiement

4.1 Dans les présentes modalités de paiement :

4.1.1 «période de paiement» signifie un intervalle de 30 jours consécutifs ou tout autre intervalle plus long convenu entre l'Entrepreneur et le représentant ministériel;

4.1.2 un montant est «dû et payable» lorsqu'il doit être versé à l'Entrepreneur par Sa Majesté selon les paragraphes MP4.4, MP4.7 ou MP4.10;

4.1.3 un montant est en souffrance lorsqu'il demeure impayé le premier jour suivant le jour où il est dû et payable;

4.1.4 «date de paiement» signifie la date du titre négociable d'un montant dû et payable par le Receveur général du Canada et émis aux fins de paiement;

4.1.5 «taux d'escompte» signifie le taux d'intérêt, fixé par la Banque du Canada, en vigueur à l'ouverture des bureaux à la date de paiement.

4.2 À l'expiration d'une période de paiement, l'Entrepreneur doit remettre au représentant ministériel



une demande d'acompte par écrit et y décrire toute partie achevée des travaux et tous les matériaux livrés aux lieux des travaux, mais non incorporés aux travaux, durant la période de paiement faisant l'objet de la demande d'acompte.

- 4.3 Le représentant ministériel, dans les dix jours suivant réception d'une demande d'acompte mentionnée au paragraphe MP4.2 :
- 4.3.1 fait l'inspection de la partie des travaux et des matériaux qui y sont décrits, et
 - 4.3.2 présente un rapport sur le progrès des travaux, dont le représentant ministériel envoie une copie à l'Entrepreneur, indiquant la valeur de la partie des travaux et des matériaux décrits dans la demande d'acompte que, selon le représentant ministériel :
 - 4.3.2.1 sont conformes aux dispositions du Contrat, et
 - 4.3.2.2 n'étaient visés par aucun autre rapport concernant des travaux du Contrat.
- 4.4 Sous réserve de l'article MP1 et du paragraphe MP4.5, Sa Majesté, au plus tard 30 heures après la réception par le représentant ministériel de la demande d'acompte mentionnée au paragraphe MP4.2, paie à l'Entrepreneur :
- 4.4.1 une somme égale à 95% de la valeur indiquée dans le rapport sur le progrès des travaux mentionné à l'alinéa MP4.3.2, si l'Entrepreneur a fourni un cautionnement pour le paiement de la main-d'œuvre et des matériaux, ou
 - 4.4.2 un montant égal à 90% de la valeur indiquée dans le rapport sur le progrès des travaux mentionné à l'alinéa 4.3.2, si l'Entrepreneur n'a pas fourni un cautionnement pour le paiement de la main-d'œuvre et des matériaux.
- 4.5 Il est essentiel, pour que Sa Majesté s'acquitte de son obligation mentionnée au paragraphe MP4.4, que l'Entrepreneur fasse et remette au représentant ministériel,
- 4.5.1 une déclaration conforme à celle décrite au paragraphe MP4.6, pour les travaux et matériaux visés dans la demande d'acompte prévue au paragraphe MP4.2,
 - 4.5.2 dans le cas de la première demande d'acompte de l'Entrepreneur, un calendrier d'exécution conformément aux parties pertinentes des Devis, et
 - 4.5.3 si un calendrier est exigé, sa mise à jour aux moments précisés dans les parties pertinentes des Devis.
- 4.6 Dans la déclaration mentionnée au paragraphe MP4.5, l'Entrepreneur atteste :
- 4.6.1 qu'au jour de la demande d'acompte de l'Entrepreneur, l'Entrepreneur s'est acquitté de toutes ses obligations légales aux termes des Conditions de travail, et
 - 4.6.2 qu'au jour de la précédente demande d'acompte, l'Entrepreneur s'est acquitté de toutes ses obligations légales envers ses sous-entrepreneurs et ses fournisseurs de matériaux en ce qui concerne les travaux visés par le Contrat.



- 4.7 Sous réserve de l'article MP1 et du paragraphe MP4.8, Sa Majesté verse à l'Entrepreneur, dans les 30 jours suivant la date de délivrance du Certificat provisoire d'achèvement mentionné au paragraphe CG44.2, la somme mentionnée à l'article MP1, moins l'ensemble :
- 4.7.1 de tous les paiements effectués conformément au paragraphe MP4.4;
 - 4.7.2 du montant égal au coût pour Sa Majesté, estimé par le représentant ministériel de la correction de toutes déficiences dans les travaux et décrites dans le Certificat provisoire d'achèvement; et
 - 4.7.3 du montant égal au coût pour Sa Majesté, estimé par le représentant ministériel de l'achèvement de toute partie des travaux décrite dans le Certificat provisoire d'achèvement ne comportant pas la correction des déficiences visées par l'alinéa MP4.7.2.
- 4.8 Il est essentiel, pour que Sa Majesté s'acquitte de son obligation mentionnée au paragraphe MP4.7, que l'Entrepreneur fasse et remette au représentant ministériel,
- 4.8.1 une déclaration conforme à celle décrite au paragraphe MP4.9 relativement au Certificat provisoire d'achèvement mentionné au paragraphe CG44.2, et
 - 4.8.2 s'il est précisé dans les parties pertinentes des Devis, une mise à jour du calendrier d'exécution mentionné à l'alinéa MP4.5.2 qui, en plus des exigences énoncées, soit suffisamment détaillé concernant l'achèvement des travaux non-terminés et la correction de tous les défauts, le tout à la satisfaction du représentant ministériel.
- 4.9 Dans la déclaration mentionnée au paragraphe MP4.8, l'Entrepreneur atteste qu'au jour de l'émission du Certificat provisoire d'achèvement :
- 4.9.1 l'Entrepreneur s'est acquitté de toutes ses obligations légales aux termes des Conditions de travail;
 - 4.9.2 l'Entrepreneur s'est acquitté de toutes ses obligations légales envers ses sous-entrepreneurs et ses fournisseurs de matériaux en ce que concerne les travaux visés par le Contrat; et
 - 4.9.3 l'Entrepreneur s'est acquitté de toutes ses obligations mentionnées au paragraphe CG14.6.
- 4.10 Sous réserve de l'article MP1 et du paragraphe MP4.11, Sa Majesté verse à l'Entrepreneur, dans les 60 jours suivant la date de délivrance du Certificat définitif d'achèvement mentionné au paragraphe CG44.1, la somme mentionnée à l'article MP1, moins l'ensemble :
- 4.10.1 de tous les paiements effectués conformément au paragraphe MP4.4, et
 - 4.10.2 de tous les paiements effectués conformément au paragraphe MP4.7.
- 4.11 Il est essentiel, pour que Sa Majesté s'acquitte de son obligation mentionnée au paragraphe MP4.10, que l'Entrepreneur fasse et remette au représentant ministériel une déclaration conforme



à celle décrite au paragraphe MP4.12.

- 4.12 Dans la déclaration mentionnée au paragraphe MP4.11, l'Entrepreneur atteste, outre les mentions requises en vertu du paragraphe MP4.9, que l'Entrepreneur s'est acquitté de toutes ses obligations légales et qu'il a satisfait à toutes les réclamations légales formulées contre lui par suite de l'exécution des travaux.

MP5 Le rapport sur le progrès des travaux et le paiement y afférent ne lient pas Sa Majesté

- 5.1 Ni le rapport sur le progrès des travaux mentionné au paragraphe MP4.3, ni les paiements effectués par Sa Majesté en conformité des Modalités ne doivent être interprétés comme une admission que les travaux et les matériaux sont, en totalité ou en partie, complets, satisfaisants ou conformes au Contrat.

MP6 Retard du paiement

- 6.1 Nonobstant l'article CG7, le retard apporté par Sa Majesté à faire un paiement à sa date d'exigibilité en vertu du présent Contrat, ne constitue pas un bris du Contrat.
- 6.2 Sa Majesté versera, sans que l'Entrepreneur le demande, des intérêts simples au taux d'escompte plus 1 ¼ p. 100 sur les montants en souffrance en vertu de l'alinéa MP4.1.3, intérêts qui s'appliquent à compter du premier jour de retard jusqu'au jour précédant la date de paiement, sauf que
- 6.2.1 les intérêts se seront ni exigibles ni versés à moins que le montant dont il est question au paragraphe MP6.2 ait été en souffrance pendant plus de 15 jours suivant :
- 6.2.1.1 la date à laquelle ladite somme est devenue due et payable, ou
- 6.2.1.2 la date de réception par le représentant ministériel de la déclaration conforme à celle décrite aux paragraphes MP4.5, MP4.8 ou MP4.11;
- selon la plus avancée de ces deux dates, et
- 6.2.2 les intérêts ne seront ni exigibles ni versés sur les paiements anticipés en souffrance, le cas échéant.

MP7 Droit de compensation

- 7.1 Sans restreindre tout droit de compensation ou de retenue découlant explicitement ou implicitement de la loi ou d'une disposition quelconque du Contrat, Sa Majesté peut opérer compensation de toute somme due par l'Entrepreneur à Sa Majesté en vertu du Contrat ou de tout contrat en cours, à l'encontre des sommes dues par Sa Majesté à l'Entrepreneur en vertu du Contrat.
- 7.2 Pour les fins du paragraphe MP7.1, l'expression «contrat en cours» signifie un contrat entre Sa Majesté et l'Entrepreneur :
- 7.2.1 en vertu duquel l'Entrepreneur est légalement obligé d'exécuter ou de fournir du travail,



de la main-œuvre ou des matériaux; ou

- 7.2.2 à l'égard duquel Sa Majesté a, depuis la date à laquelle les présents Articles de convention sont intervenus, exercé le droit de retirer à l'Entrepreneur les travaux faisant l'objet du contrat.

MP8 Paiement en cas de résiliation

- 8.1 En cas de résiliation du Contrat conformément à l'article CG41, Sa Majesté paie à l'Entrepreneur le plus tôt possible eu égard aux circonstances, tout montant qui lui est légalement dû et payable.

MP9 Intérêts sur les réclamations réglées

- 9.1 Sa Majesté versera à l'Entrepreneur des intérêts simples sur le montant d'une réclamation réglée, au taux d'escompte moyen plus q $\frac{1}{4}$ p. 100 à compter du premier jour de retard jusqu'au jour précédant la date de paiement.
- 9.2 Aux fins du paragraphe MP9.1:
- 9.2.1 une réclamation est réputée être réglée lorsqu'une entente par écrit est signée par le représentant ministériel et l'Entrepreneur et fait état du montant de la réclamation à verser par Sa Majesté et des travaux pour lesquels ledit montant doit être versé;
- 9.2.2 le «taux d'escompte moyen» signifie le taux d'intérêt moyen, fixé par la Banque du Canada, en vigueur à la fin de chaque mois civil au cours de la période pendant laquelle la réclamation réglée était impayée;
- 9.2.3 une réclamation réglée est réputée être impayée à compter de la journée qui suit immédiatement la date à laquelle la réclamation était due et payable conformément au Contrat, s'il n'y avait pas eu contestation.
- 9.3 Aux fins de l'Article MP9, une réclamation signifie tout montant faisant l'objet d'un litige et assujéti à des négociations entre Sa Majesté et l'Entrepreneur en vertu du Contrat.



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CG1 Interpretation

1.1 Dans le Contrat:

- 1.1.1 tout renvoi à une autre partie du Contrat désignée par des numéros précédés de lettres est censé renvoyer à la partie du Contrat qui est désignée par cette combinaison de lettres et de chiffres, de même qu'à toute autre partie du Contrat qui y est mentionnée ;
- 1.1.2 « Contrat » signifie les documents mentionnés dans les Articles de convention;
- 1.1.3 « garantie du contrat » signifie toute garantie fournie à Sa Majesté par l'Entrepreneur conformément au Contrat;
- 1.1.4 « le représentant ministériel » signifie l'officier ou l'employé de Sa Majesté désigné aux Articles de convention et toute personne autorisée spécialement par le représentant ministériel à accomplir, en son nom, n'importe laquelle des fonctions qui lui sont confiées en vertu du Contrat, et signalée comme tel par écrit à l'Entrepreneur;
- 1.1.5 « matériaux » comprend toutes les marchandises, articles et choses à être fournies par ou pour l'Entrepreneur en vertu du Contrat, pour être incorporés dans les travaux;
- 1.1.6 « Ministre » comprend une personne agissant pour ou, si la charge est sans titulaire, à la place du Ministre ou des personnes lui succédant, de même que son ou leurs adjoints ou représentants dûment nommés aux fins du Contrat;
- 1.1.7 « personne » comprend, sauf lorsque le contexte exige une interprétation différente, une société, une entreprise, une firme, une co-entreprise, un consortium et une corporation;
- 1.1.8 « outillage » comprend les animaux, outils, instruments, machines, véhicules, bâtiments, ouvrages, équipements et marchandises, articles et choses autres que les matériaux, qui sont nécessaires à l'exécution des travaux;
- 1.1.9 « sous-entrepreneur » signifie une personne à qui l'Entrepreneur a, conformément à l'article CG4, confié l'exécution des travaux en tout ou en partie;
- 1.1.10 « surintendant » signifie l'employé de l'Entrepreneur désigné par ce dernier pour remplir les fonctions décrites à l'article CG19;
- 1.1.11 « travaux » comprend, sous réserve de toute stipulation expressément contraire dans le Contrat, tout ce que l'Entrepreneur doit faire, fournir, livrer ou accomplir pour l'exécution du Contrat.

1.2 Sauf quant à ceux apparaissant aux Plans et devis, les en-têtes apparaissent dans le Contrat, ne font pas partie du Contrat, mais y sont uniquement pour fin d'utilité pratique.

1.3 Aux fins de l'interprétation du Contrat, en cas de contradiction ou de divergence entre les Plans et devis et les Conditions générales, les Conditions générales prévalent.

1.4 Dans l'interprétation des Plans et devis, en cas de contradiction ou de divergence entre :

- 1.4.1 les Plans et les devis, les devis prévalent;
- 1.4.2 les plans, les plans tracés à l'échelle la plus grande prévalent; et
- 1.4.3 les dimensions exprimées en chiffres et les dimensions à l'échelle, les dimensions exprimées en chiffres prévalent.

CG2 Successeurs et ayants droit

- 2.1 Le Contrat est au bénéfice des parties au Contrat, de même que de leurs héritiers légaux, exécuteurs, administrateurs, successeurs et ayants droit, qui sont tous par ailleurs liés par ses dispositions.

CG3 Cession du Contrat

- 3.1 L'Entrepreneur ne peut céder le Contrat, en tout ou en partie, sans le consentement écrit du Ministre.

CG4 Sous-traitance par l'Entrepreneur

- 4.1 Sous réserve des Conditions générales, l'Entrepreneur peut sous-traiter une partie quelconque des travaux.
- 4.2 L'Entrepreneur doit aviser le représentant ministériel par écrit de son intention de sous-traiter.
- 4.3 L'avis mentionné au paragraphe CG4.2 doit identifier le sous-entrepreneur de même que la partie des travaux qu'il entend lui confier.
- 4.4 Le représentant ministériel peut s'objecter à la sous-traitance projetée en avisant par écrit l'Entrepreneur dans les six jours suivant la réception par le représentant ministériel de l'avis mentionné au paragraphe CG4.2.
- 4.5 Si le représentant ministériel s'oppose à une sous-traitance en vertu du paragraphe CG4.4, l'Entrepreneur ne peut procéder à la sous-traitance envisagée.
- 4.6 L'Entrepreneur ne peut, sans la permission écrite du représentant ministériel, remplacer un sous-entrepreneur dont il a retenu les services conformément aux Conditions générales.
- 4.7 Tout contrat entre l'Entrepreneur et un sous-entrepreneur doit comporter tous les termes et conditions du Contrat qui sont d'application générale.
- 4.8 Nul contrat entre l'Entrepreneur et un sous-entrepreneur ou nul consentement de le représentant ministériel à tel contrat sera interprété comme relevant l'Entrepreneur de quelque obligation en vertu du Contrat ou comme imposant quelque responsabilité à Sa Majesté.

CG5 Modifications

- 5.1 Nulle modification ou changement à quelque disposition du Contrat aura d'effet avant que d'avoir été consignée par écrit.

CG6 Nulle obligation implicite

- 6.1 Il ne découlera du Contrat aucune disposition ou obligation implicite de la part de Sa Majesté; seules les dispositions expresses du Contrat, stipulées par Sa Majesté, doivent servir de fondement à tout droit contre Sa Majesté.
- 6.2 Le présent Contrat remplace toutes communications, négociations et ententes, écrites ou verbales, concernant les travaux et qui auraient en lieu avant la date du Contrat.

CG7 Caractère essentiel des délais et échéances

- 7.1 Le temps est l'essence même du Contrat.

CG8 Indemnisation par l'Entrepreneur

- 8.1 L'Entrepreneur doit tenir Sa Majesté indemne et à couvert de toutes réclamations, demandes, pertes, frais, dommages, actions, poursuites ou procédures de la part de quiconque, fondés, découlant, reliés, occasionnés ou attribuables aux activités de l'Entrepreneur, de ses employés, agents, sous-entrepreneurs et sous-entrepreneurs de ces derniers dans l'exécution des travaux faisant l'objet du Contrat, incluant toute contrefaçon ou prétendue contrefaçon d'un brevet d'invention ou de toute autre forme de propriété intellectuelle.
- 8.2 Aux fins du paragraphe CG8.1, le terme « activités » comprend tout acte ou omission, de même que tout retard à accomplir un acte.

CG9 Indemnisation par Sa Majesté

- 9.1 Sa Majesté, sous réserve des dispositions de la Loi sur la responsabilité de la Couronne, de la Loi sur les brevets et de toute autre loi affectant les droits, pouvoirs, privilèges ou obligations de Sa Majesté, doit tenir l'Entrepreneur indemne et à couvert de toutes réclamations, demandes, pertes, frais, dommages, actions, poursuites ou procédures découlant de ses activités en vertu du Contrat et directement attribuables à :
- 9.1.1 une absence ou un vice, actuel ou allégué, dans le titre de Sa Majesté concernant l'emplacement des travaux, ou
- 9.1.2 une contrefaçon ou prétendue contrefaçon par l'Entrepreneur de tout brevet d'invention ou de toute autre forme de propriété intellectuelle, dans l'exécution de tout acte aux fins de Contrat, comportant l'utilisation d'un modèle, d'un plan, d'un dessin ou de toute autre chose fournis par Sa Majesté à l'Entrepreneur aux fins des travaux.

CG10 Interdiction aux députés de la Chambre des communes de tirer profit d'un contrat

- 10.1 Conformément à la Loi sur le Parlement du Canada, il est expressément interdit à tout membre de la Chambre des communes de posséder quelque part ou intérêt dans le Contrat, ou d'en tirer quelque bénéfice ou profit.

CG11 Avis

- 11.1 Tout avis, consentement, ordre, décision, directive ou communication autre qu'un avis suivant le paragraphe CG11.4, qui peut être donné à l'Entrepreneur conformément au Contrat, peut être donné de quelque manière que ce soit.
- 11.2 Tout avis, consentement, ordre, décision, directive ou autre communication devant être donné par écrit à une partie ou une autre conformément au Contrat, sera, sous réserve du paragraphe CG11.4, réputé avoir été effectivement donné :
- 11.2.1 à l'Entrepreneur, s'il a été livré personnellement à l'Entrepreneur ou au surintendant de l'Entrepreneur, ou s'il a été envoyé par la poste, par télex ou par télécopieur à l'Entrepreneur, à l'adresse indiquée au paragraphe A4.1; ou
- 11.2.2 à Sa Majesté, s'il a été livré personnellement au représentant ministériel, ou s'il a été envoyé par la poste, par télex ou par télécopieur au représentant ministériel, à l'adresse indiquée à l'alinéa A1.2.1.
- 11.3 Tout avis, consentement, ordre, décision, directive ou autre communication donné conformément au paragraphe CG11.2 sera réputé avoir été reçu par l'une ou l'autre des parties :
- 11.3.1 le jour où il a été livré, s'il lui a été livré personnellement; ou
- 11.3.2 le jour de sa réception ou le sixième jour après son envoi par la poste, selon la première de ces deux dates, s'il lui a été envoyé par la poste, et
- 11.3.3 dans les 24 heures suivant sa transmission, s'il lui a été envoyé par télex ou par télécopieur.
- 11.4 S'il est livré personnellement, un avis donné en vertu de l'alinéa CG38.1.1 et des articles CG40 et CG41 sera remis à l'Entrepreneur ou, si l'Entrepreneur est une société, une firme, une co-entreprise ou une corporation, à un agent de l'administration ou à un cadre supérieur.

CG12 Matériaux, outillage et biens immobiliers fournis par Sa Majesté

- 12.1 Sous réserve du paragraphe CG12.2, l'Entrepreneur est responsable envers Sa Majesté de toute perte ou dommage, aux matériaux, à l'outillage ou aux biens immobiliers que Sa Majesté a fournis ou placés sous la garde et le contrôle de l'Entrepreneur aux fins du Contrat, que la perte ou le dommage soit attribuable ou non à des causes indépendantes de la volonté de l'Entrepreneur.
- 12.2 L'Entrepreneur n'est pas responsable envers Sa Majesté de toute perte ou dommage aux matériaux, à l'outillage ou aux biens immobiliers dont il est question au paragraphe CG12.1, si

cette perte ou ce dommage est imputable et directement attribuable à l'usure causée par un usage raisonnable.

- 12.3 L'Entrepreneur doit utiliser les matériaux, l'outillage ou les biens immobiliers dont il est question au paragraphe CG12.1, uniquement pour l'exécution du Contrat et pour aucune autre fin.
- 12.4 Lorsqu'après avoir été requis de le faire par le représentant ministériel, l'Entrepreneur n'a pas, dans un délai raisonnable, indemnisé Sa Majesté pour une perte ou un dommage dont il est responsable en vertu du paragraphe CG12.1, le représentant ministériel peut y pouvoir aux frais de l'Entrepreneur, et ce dernier est dès lors responsable envers Sa Majesté des frais en l'occurrence qu'il devra sur demande payer à Sa Majesté.
- 12.5 L'Entrepreneur doit tenir des registres que le représentant ministériel peut de temps à autre exiger des matériaux, de l'outillage et des biens immobiliers visés par le paragraphe CG12.1 et doit, lorsque le représentant ministériel le l'exige, établir à la satisfaction de ce dernier que les matériaux, l'outillage et les biens immobiliers sont à l'endroit et dans l'état dans lequel ils devraient être.

CG13 Matériaux, outillage et biens immobiliers devenus propriété de Sa Majesté

- 13.1 Sous réserve du paragraphe CG14.7, tous les matériaux et l'outillage, de même que tout droit de l'Entrepreneur sur tous les biens immobiliers, permis, pouvoirs et privilèges achetés, ou utilisés par l'Entrepreneur pour les travaux deviennent, à compter de l'époque où ils ont été achetés ou utilisés, la propriété de Sa Majesté aux fins des travaux et continuent de l'être :
- 13.1.1 dans le cas des matériaux, jusqu'à ce que le représentant ministériel déclare qu'ils ne sont plus requis pour les travaux; et
- 13.1.2 dans le cas de l'outillage, des biens immobiliers, des permis, des pouvoirs et des privilèges, jusqu'à ce que le représentant ministériel déclare que le droit dévolu à Sa Majesté en l'espèce n'est plus requis pour les travaux.
- 13.2 Les matériaux ou l'outillage appartenant à Sa Majesté en vertu du paragraphe CG13.1 ne doivent pas être enlevés des lieux des travaux, utilisés ou aliénés, sauf pour les travaux, sans le consentement écrit du représentant ministériel.
- 13.3 Sa Majesté n'est pas responsable de toute perte ou de tout dommage aux matériaux ou à l'outillage visés par le paragraphe CG13.1 quelle qu'en soit la cause et l'Entrepreneur est responsable de toute perte ou de tout dommage bien que ces matériaux ou outillage appartiennent à Sa Majesté.

CG14 Permis et taxes payables

- 14.1 L'Entrepreneur doit, dans les 30 jours de la date du Contrat, offrir à l'administration municipale, un montant égal à tous les droits et frais qui seraient payables à l'administration municipale pour les permis de construction, si les travaux étaient exécutés pour une personne autre que Sa Majesté.

- 14.2 Dans les dix jours qui suivent l'offre mentionnée au paragraphe CG14.1, l'Entrepreneur avise le représentant ministériel de sa démanche et du montant de cette offre et lui fait savoir si elle a été acceptée ou non par l'administration municipale.
- 14.3 Si l'administration municipale n'a pas accepté la somme offerte aux termes du paragraphe CG14.1, l'Entrepreneur remet ce montant à Sa Majesté dans les six jours suivant l'expiration du délai fixe au paragraphe CG14.2.
- 14.4 Aux fins des paragraphes CG14.1 et CG14.3, l'expression « administration municipale » signifie une administration qui aurait compétence pour autoriser la construction de l'ouvrage si le propriétaire n'en était pas Sa Majesté.
- 14.5 Nonobstant le lieu de résidence de l'Entrepreneur, l'Entrepreneur versera toute taxe applicable découlant de l'exécution des travaux visés par le Contrat.
- 14.6 Conformément à la déclaration mentionnée au paragraphe MP4.9, l'Entrepreneur dont ni le lieu de résidence ni la place d'affaires n'est dans la province où sont effectués les travaux visés par le Contrat, fournira à Sa Majesté une preuve d'enregistrement auprès des autorités provinciales responsables de la taxe de vente dans ladite province.
- 14.7 Aux fins du paiement de la taxe applicable ou de la fourniture d'une garantie de paiement de la taxe applicable découlant de l'exécution des travaux visés par le Contrat, l'Entrepreneur doit, malgré le fait que tous les matériaux et outillage, de même que des droits de l'Entrepreneur sur tous les biens immobiliers, permis, pouvoirs et privilèges, sont devenus la propriété de Sa Majesté après la date d'achat, payer, en tant qu'utilisateur ou consommateur, toute taxe applicable payable au moment de l'utilisation desdits matériaux, outillage ou droits de l'Entrepreneur à titre d'utilisateur, conformément aux lois pertinentes, ou fournir une garantie de paiement à cet égard.

CG15 Exécution des travaux sous la direction du représentant ministériel

- 15.1 L'Entrepreneur doit :
- 15.1.1 permettre au représentant ministériel d'avoir accès aux travaux et au chantier en tout temps au cours de l'exécution du Contrat;
 - 15.1.2 communiquer au représentant ministériel tous renseignements qu'il demande concernant l'exécution du Contrat; et
 - 15.1.3 fournir au représentant ministériel toute l'assistance possible dans l'accomplissement de son devoir de veiller à ce que les travaux soient exécutés conformément au Contrat, de même que dans l'accomplissement de tout autre devoir et dans l'exercice de tout pouvoir qui lui incombe ou qui lui est conféré par le Contrat.

CG16 Coopération avec d'autres Entrepreneurs

- 16.1 Lorsque, de l'avis du représentant ministériel, il est nécessaire d'affecter aux travaux ou au chantier d'autres entrepreneurs ou ouvriers, avec ou sans outillage et matériaux, l'Entrepreneur doit, à la satisfaction du représentant ministériel, leur donner accès aux travaux et coopérer avec

eux dans l'accomplissement de leurs fonctions et obligations.

16.2 Si :

16.2.1 l'affectation aux travaux d'autres entrepreneurs ou ouvriers en vertu du paragraphe CG16.1 ne pouvait être raisonnablement prévue par l'Entrepreneur au moment de la conclusion du Contrat; et

16.2.2 de l'avis du représentant ministériel, l'Entrepreneur a encouru des dépenses additionnelles afin de se conformer au paragraphe CG16.1; et

16.2.3 l'Entrepreneur a donné au représentant ministériel un avis écrit de sa réclamation avant l'expiration d'un délai de 30 jours à compter de l'affectation d'autres entrepreneurs ou ouvriers aux travaux ou au chantier;

Sa Majesté rembourse à l'Entrepreneur les frais encourus, calculés conformément aux articles CG48 à CG50, pour le travail, de l'outillage et des matériaux additionnels requis.

CG17 Vérification des travaux

17.1 Si, à un moment quelconque après le début des travaux mais avant l'expiration de la période de garantie, le représentant ministériel a des motifs de croire que les travaux en partie de ceux-ci n'ont pas été exécutés conformément au Contrat, il peut demander qu'une vérification de ces travaux soit effectuée par un expert qu'il désigne.

17.2 Si, par suite d'une vérification conformément au paragraphe CG17.1, il est établi que les travaux n'ont pas été exécutés suivant le Contrat, l'Entrepreneur doit, sur demande, payer à Sa Majesté tous les coûts et toutes les dépenses raisonnables que cette vérification lui aura occasionnés, en plus et sans préjudice aux droits et recours de Sa Majesté sous le Contrat, en droit ou en équité.

CG18 Déblaiement de l'emplacement

18.1 L'Entrepreneur garde les travaux et leur emplacement propres, sans rebus, ni débris, et respecte à cet égard toute directive du représentant ministériel.

18.2 Avant l'émission du Certificat provisoire mentionné au paragraphe CG44.2, l'Entrepreneur enlève tout l'outillage et tous les matériaux non requis à l'exécution du reste des travaux. Il enlève également tous rebus et débris et fait en sorte que les travaux et leur emplacement soient propres et convenables pour leur occupation par les employés de Sa Majesté, sauf indication contraire dans le Contrat.

18.3 Avant l'émission du Certificat définitif d'achèvement mentionné au paragraphe CG44.1, l'Entrepreneur retire des travaux et leur emplacement, l'excédant de l'outillage et des matériaux, de même que tous les rebus et débris.

18.4 Les obligations qu'imposent à l'Entrepreneur les paragraphes CG18.1 à CG18.3 ne s'appliquent pas aux rebus et aux débris laissés par les employés de Sa Majesté, ou par les autres entrepreneurs et leurs employés visés au paragraphe CG16.1.

CG19 Surintendant de l'Entrepreneur

- 19.1 L'Entrepreneur désigne sans délai un surintendant après l'adjudication du Contrat.
- 19.2 L'Entrepreneur communique sans délai au représentant ministériel le nom, l'adresse et le numéro de téléphone du surintendant désigné en vertu du paragraphe CG19.1.
- 19.3 Le surintendant désigné en vertu du paragraphe CG19.1 à l'entière responsabilité des opérations de l'Entrepreneur dans l'exécution des travaux et il est en outre autorisé à recevoir au nom de l'Entrepreneur, tous avis, consentement, ordre, directive, décision ou toute autre communication qui peut lui être donné en vertu du Contrat.
- 19.4 Pendant les heures de travail et jusqu'à l'achèvement des travaux, l'Entrepreneur doit garder sur les lieux des travaux un surintendant compétent.
- 19.5 À la demande du représentant ministériel, l'Entrepreneur retire tout surintendant qui, de l'avis du représentant ministériel, est incompetent ou s'est conduit de façon malséante, et il remplace sans délai le surintendant ainsi retiré par un autre surintendant que le représentant ministériel estime acceptable.
- 19.6 Sous réserve du paragraphe CG19.5, l'Entrepreneur ne peut remplacer le surintendant sans le consentement écrit du représentant ministériel.
- 19.7 En cas de contravention par l'Entrepreneur au paragraphe CG19.6, le représentant ministériel peut refuser l'émission de tout Certificat mentionné à l'article CG44 jusqu'à ce que le surintendant ait été réintégré dans ses fonctions ou qu'un autre surintendant acceptable au représentant ministériel l'ait remplacé.

CG20 Sécurité nationale

- 20.1 Si le Ministre estime que la sécurité nationale le requiert, il peut ordonner à l'Entrepreneur :
- 20.1.1 de lui fournir tout renseignement sur des personnes engagées ou devant l'être aux fins du Contrat, et
- 20.1.2 de retirer des travaux et de leur emplacement toute personne dont l'emploi peut en l'occurrence, de l'avis du Ministre, comporter un risque pour la sécurité nationale.
- 20.2 Les contrats que l'Entrepreneur pourra conclure avec les personnes qui seront affectées à l'exécution des travaux, doivent contenir des dispositions qui lui permettront de s'acquitter de toute obligation qui lui incombent en vertu des articles CG19, CG20 et CG21.
- 20.3 L'Entrepreneur doit obéir à tout ordre donné par le Ministre suivant le paragraphe CG20.1.

CG21 Ouvriers inaptes

- 21.1 À la demande du représentant ministériel, l'Entrepreneur retire des travaux toute personne engagée par l'Entrepreneur aux fins des travaux qui, de l'avis du représentant ministériel, est incompétente ou s'est conduite de façon malséante et l'Entrepreneur refuse l'accès à l'emplacement des travaux à une personne ainsi retirée.

CG22 Augmentation ou diminution des coûts

- 22.1 Le montant établi dans les Articles de convention doit être ni augmenté, ni diminué en raison d'une augmentation ou d'une diminution du coût des travaux résultant d'une augmentation ou d'une diminution du coût du travail, de l'outillage, des matériaux ou des rajustements salariaux énoncés ou prescrits dans les Conditions de travail.
- 22.2 Nonobstant le paragraphe CG22.1 et l'article CG35, le montant énoncé dans les Articles de convention doit faire l'objet d'un redressement de la manière prévue au paragraphe CG22.3, en cas de modification à une taxe imposée en vertu de la Loi sur l'accise, de la Loi sur la taxe d'accise, de la Loi sur la sécurité de la vieillesse, de la Loi sur les douanes, du Tarif des douanes ou de toute loi provinciale sur la taxe de vente imposant une taxe de vente au détail sur l'achat de biens personnels corporels incorporés dans les biens immobiliers :
- 22.2.1 survenant après la date à laquelle l'Entrepreneur a présenté une soumission pour le Contrat,
- 22.2.2 s'appliquant aux matériaux; et
- 22.2.3 influant sur le coût de ces matériaux pour l'Entrepreneur.
- 22.3 En cas de changement fiscal suivant le paragraphe CG22.2, tout montant pertinent indiqué dans les Articles de convention sera augmenté ou diminué d'un montant égal qui, sur examen des registres mentionnés à l'article CG51, représente l'augmentation ou la diminution, selon le cas, des coûts directement attribuables à ce changement.
- 22.4 Aux fins du paragraphe CG22.2, lorsqu'une taxe fait l'objet d'un changement après la date à laquelle l'Entrepreneur a présenté une soumission mais alors que le ministre des Finances en avait donné avis public avant la date de présentation de la soumission, le changement fiscal est censé être survenu avant la date à laquelle la soumission a été présentée.

CG23 Main-d'œuvre et matériaux canadiens

- 23.1 L'Entrepreneur emploie pour l'exécution des travaux, de la main-d'œuvre et des matériaux canadiens dans toute la mesure où ils sont disponibles, compte tenu des exigences économiques et de la nécessité de poursuivre une exécution diligente des travaux.
- 23.2 Sous réserve du paragraphe CG23.1, l'Entrepreneur emploie, dans la mesure où elle est disponible, la main-d'œuvre de la localité où les travaux sont exécutés, et il recourt aux bureaux des Centres d'emploi du Canada pour recruter les ouvriers, là où la chose est réalisable.
- 23.3 Sous réserve des paragraphes CG23.1 et CG23.2, l'Entrepreneur emploie une proportion raisonnable d'ouvriers qui ont été en service actif dans les Forces armées canadiennes et qui en

ont reçu une libération honorable.

CG24 Protection des travaux et des documents

- 24.1 L'Entrepreneur garde et protège les travaux, l'emplacement des travaux, le Contrat, les devis, les plans, les dessins, les renseignements, les matériaux, l'outillage et les biens immobiliers, fournis ou non par Sa Majesté à l'Entrepreneur, contre toute perte ou dommage de quelque nature et ne peut les utiliser, donner, démolir ou en disposer sans le consentement écrit du Ministre, sauf si cela est indispensable à l'exécution des travaux.
- 24.2 Si une cote de sécurité est attribuée aux documents ou renseignements donnés ou dévoilés à l'Entrepreneur, l'Entrepreneur prend toutes les mesures que lui enjoint le représentant ministériel pour assurer le degré de sécurité conforme à cette cote.
- 24.3 L'Entrepreneur fournit tous dispositifs de sécurité et aide toute personne à laquelle le Ministre a donné l'autorisation d'inspecter ou de prendre les mesures de sécurité qui s'imposent à l'égard des travaux et de l'emplacement des travaux.
- 24.4 Le représentant ministériel peut ordonner à l'Entrepreneur de faire telles choses et d'effectuer tels travaux additionnels qui, de l'avis du représentant ministériel, sont raisonnables et nécessaires pour assurer l'observation des paragraphes CG24.1 à CG24.3, ou pour rectifier une violation de ces paragraphes.

CG25 Cérémonies publiques et enseignes

- 25.1 L'Entrepreneur ne permet pas de cérémonie publique relativement aux travaux, sans la permission du Ministre.
- 25.2 L'Entrepreneur n'érige pas ou ne permet pas l'érection d'enseignes ou de panneaux publicitaires sur les travaux ou l'emplacement des travaux sans l'approbation du représentant ministériel.

CG26 Précautions contre les dommages, la transgression des droits, les incendies, et les autres dangers

- 26.1 L'Entrepreneur doit, à ses propres frais, faire le nécessaire pour s'assurer
- 26.1.1 que nulle personne n'est blessée, nul bien endommagé et nul droit, servitude ou privilège enfreint en raison de l'activité de l'Entrepreneur en vertu du Contrat;
 - 26.1.2 que la circulation à pied ou autrement sur les chemins ou cours d'eau publics ou privés n'est pas indûment entravée, interrompue ou rendue dangereuse par les travaux ou l'outillage;
 - 26.1.3 que les dangers d'incendie sur le chantier ou l'emplacement des travaux sont éliminés et que, sous réserve de tout ordre qui peut être donné par le représentant ministériel, tout incendie est promptement maîtrisé;

- 26.1.4 que la santé et sécurité des personnes occupées aux travaux ne sont pas menacées par les méthodes ou les moyens mis en œuvre;
- 26.1.5 que des services médicaux suffisants sont offerts en tout temps pendant les heures de travail, à toutes personnes occupées aux travaux;
- 26.1.6 que des mesures sanitaires suffisantes sont prises à l'égard des travaux et l'emplacement des travaux; et
- 26.1.7 que tous les jalons, bouées et repères placés sur les travaux ou l'emplacement des travaux par le représentant ministériel ou sur son ordre sont protégés et ne sont pas enlevés, abimés, changés ou détruits.

- 26.2 Le représentant ministériel peut ordonner à l'Entrepreneur de faire toute chose et de construire tout ouvrage additionnel qui, de l'avis du représentant ministériel, est raisonnable ou nécessaire pour assurer l'observation du paragraphe CG26.1 ou pour rectifier une infraction audit paragraphe.
- 26.3 L'Entrepreneur se conforme, à ses propres frais, à tout ordre que le représentant ministériel émet conformément au paragraphe CG26.2.

CG27 Assurances

- 27.1 L'Entrepreneur souscrit et maintient, à ses propres frais, des polices d'assurance relativement aux travaux et en fournit la preuve au représentant ministériel conformément aux exigences des Conditions d'assurance « E ».
- 27.2 Les polices d'assurance mentionnées au paragraphe CG27.1 doivent être :
 - 27.2.1 en la forme et nature, au montant, pour la durée et suivant les termes et conditions prévus aux Conditions d'assurance « E »; et
 - 27.2.2 prévoir le remboursement des demandes de règlement, conformément à l'article CG28.

CG28 Indemnité d'assurance

- 28.1 Dans le cas d'une demande de règlement en vertu d'une police d'assurance tous risques chantier (y compris les installations) que maintient l'Entrepreneur conformément à l'article CG27, les sommes dues à l'égard d'un sinistre seront remboursées directement à Sa Majesté, et :
 - 28.1.1 les sommes ainsi versées seront retenues par Sa Majesté aux fins du contrat; ou
 - 28.1.2 si Sa Majesté en décide ainsi, seront conservées par Sa Majesté, et le cas échéant, deviendront sa propriété de façon absolue.
- 28.2 Dans le cas d'une demande de règlement en vertu d'une police responsabilité civile générale que maintient l'Entrepreneur conformément à l'article CG27, l'assureur remboursera directement au

demandeur les sommes dues à l'égard d'un sinistre.

- 28.3 Si le Ministre choisit conformément au paragraphe CG28.1 de conserver l'indemnité d'assurance, il peut faire effectuer une vérification de la comptabilité de l'Entrepreneur et de Sa Majesté relativement à la partie des travaux perdue, endommagée ou détruite, afin d'établir la différence, s'il en est, entre
- 28.3.1 l'ensemble du montant des pertes ou dommages subis par Sa Majesté, incluant tous frais encourus pour le déblaiement et le nettoyage des travaux et l'emplacement des travaux et de toute autre somme payable par l'Entrepreneur à Sa Majesté en vertu du Contrat, moins toute somme retenue conformément à l'alinéa CG28.1.2; et
- 28.3.2 l'ensemble des sommes payables par Sa Majesté à l'Entrepreneur en vertu du Contrat à la date où la perte ou les dommages ont été subis.
- 28.4 Toute différence établie conformément au paragraphe CG28.3 doit être payée sans délai par la partie débitrice à la partie créancière.
- 28.5 Suite au paiement prévu au paragraphe CG28.4, Sa Majesté et l'Entrepreneur sont réputés libérés de tous droits et obligations en vertu du Contrat, à l'égard seulement de la partie des travaux qui a fait l'objet d'une vérification mentionnée au paragraphe CG28.3.
- 28.6 S'il n'est pas exercé de choix en vertu du paragraphe CG28.1.2, l'Entrepreneur, sous réserve du paragraphe CG28.7, déblaie et nettoie les travaux et l'emplacement des travaux et il restaure et remplace à ses frais la partie des travaux qui a été perdue ou endommagée, comme si ces travaux n'avaient pas encore été exécutés.
- 28.7 Lorsque l'Entrepreneur exécute les obligations prévues au paragraphe CG28.6, Sa Majesté lui rembourse, jusqu'à concurrence des sommes mentionnées au paragraphe CG28.1, les frais de déblaiement, nettoyage, restauration et remplacement en question.
- 28.8 Sous réserve du paragraphe CG28.7, tout paiement par Sa Majesté en exécution des obligations prévues au paragraphe CG28.7 est effectué conformément aux dispositions du Contrat, mais chaque paiement doit représenter 100% du montant réclamé, nonobstant les alinéas MP4.4.1 et MP4.4.2.

CG29 Garantie du contrat

- 29.1 L'Entrepreneur obtient et dépose auprès du représentant ministériel une ou des garanties conformément aux conditions de garantie du contrat.
- 29.2 S'il est déposé une garantie auprès du représentant ministériel en vertu du paragraphe CG29.1 constituant en tout ou en partie en un dépôt de garantie, ce dépôt sera traité conformément aux articles CG43 et CG45 des Conditions générales.
- 29.3 Si la garantie en vertu du paragraphe CG29.1 consiste, en partie, en un cautionnement (bond) pour le paiement de la main-d'œuvre et des matériaux, l'Entrepreneur affiche une copie de ce cautionnement sur l'emplacement des travaux.

CG30 Modifications aux travaux

- 30.1 Sous réserve de l'article CG5, le représentant ministériel peut, à tout moment avant de délivrer son Certificat définitif d'achèvement :
- 30.1.1 exiger des travaux ou des matériaux en sus de ceux qui ont été prévus dans les Plans et devis; et
 - 30.1.2 supprimer ou modifier les dimensions, le caractère, la quantité, la qualité, la description, la situation ou la position de la totalité ou d'une partie des travaux ou matériaux prévus dans les Plans et devis ou exigés en conformité de l'alinéa CG30.1.1.
- à condition que ces travaux ou matériaux supplémentaires, ou que ces suppressions ou modifications soient, selon lui compatibles avec l'intention du Contrat.
- 30.2 L'Entrepreneur exécute les travaux conformément aux ordres, suppressions et modifications émis de temps à autre par le représentant ministériel en vert du paragraphe CG30.1, comme s'ils faisaient partie des Plans et devis.
- 30.3 Le représentant ministériel décide si ce que l'Entrepreneur a fait ou omis de faire conformément à un ordre, une suppression ou une modification en vertu du paragraphe CG30.1 a augmenté ou diminué le coût des travaux pour l'Entrepreneur.
- 30.4 Si le représentant ministériel décide, conformément au paragraphe CG30.3, qu'il y a eu augmentation du coût pour l'Entrepreneur, Sa Majesté paie à l'Entrepreneur le coût accru que l'Entrepreneur a nécessairement encouru pour les travaux supplémentaires, calculé conformément aux articles CG49 ou GB50.
- 30.5 Si le représentant ministériel décide, conformément au paragraphe CG30.3, qu'il y a eu réduction du coût pour l'Entrepreneur, Sa Majesté réduit le montant payable à l'Entrepreneur en vertu du Contrat d'un montant égal à la réduction du coût occasionné par toute suppression ou modification ordonnée conformément au paragraphe CG30.1.2, calculé conformément à l'article CG49.
- 30.6 Les paragraphes CG30.3 à CG30.5 s'appliquent seulement à un contrat ou partie d'un contrat comportant, suivant le Contrat, une Entente à prix fixe.
- 30.7 Tout ordre, suppression ou modification mentionné au paragraphe CG30.1 doit être par écrit, porter la signature du représentant ministériel et être communiqué à l'Entrepreneur conformément au paragraphe CG11.

CG31 Interprétation du Contrat par le représentant ministériel

- 31.1 Avant la délivrance par le représentant ministériel du Certificat définitif d'achèvement mentionné au paragraphe CG44.1, le représentant ministériel tranche tout question concernant l'exécution des travaux ou les obligations de l'Entreteneur en vertu du Contrat et en particulier, mais sans limiter la portée générale de ce qui précède, concernant :

- 31.1.1 la signification de quoi que ce soit dans les Plans et devis;
 - 31.1.2 l'Interprétation des Plans et devis au cas d'erreur, omission, obscurité ou divergence dans leur texte ou intention;
 - 31.1.3 le respect des exigences du Contrat quant à la quantité ou la qualité des matériaux ou du travail que l'Entrepreneur fournit ou se propose de fournir;
 - 31.1.4 la suffisance de la main-d'œuvre, de l'outillage ou des matériaux que l'Entrepreneur fournit pour la réalisation des travaux et du Contrat, pour assurer l'exécution des travaux suivant le Contrat et l'exécution du Contrat conformément à ses dispositions;
 - 31.1.5 la qualité de tout genre de travail effectué par l'Entrepreneur; ou
 - 31.1.6 l'échéancier et la programmation des diverses phases de l'exécution des travaux;
- et la décision du représentant ministériel est sans appel, pour ce qui est des travaux.
- 31.2 L'Entrepreneur exécute les travaux conformément aux décisions et directives du représentant ministériel en vertu du paragraphe CG31.1 et conformément à toute décision et directive du représentant ministériel que en découlent.

CG32 Garantie et rectification des défauts des travaux

- 32.1 Sans restreindre les garanties implicites ou explicites de la loi ou du Contrat, l'Entrepreneur doit, à ses propres frais
- 32.1.1 rectifier toute défectuosité et corriger tout vice qui se manifeste dans les travaux ou qui est signalé au Ministre quant aux parties du travail acceptées relativement au Certificat provisoire d'achèvement mentionné au paragraphe CG44.2 dans les 12 mois qui suivront la date d'émission du Certificat provisoire d'achèvement.
 - 32.1.2 rectifier toute défectuosité et corriger tout vice qui se manifeste dans les travaux ou qui est signalé au Ministre relativement aux parties des travaux décrites dans le Certificat provisoire d'achèvement mentionné au paragraphe CG44.2 dans les 12 mois qui suivent la date d'émission du Certificat définitif d'achèvement mentionné au paragraphe CG44.1.
- 32.2 Le représentant ministériel peut ordonner à l'Entrepreneur de rectifier ou corriger toute défectuosité ou tout vice mentionné au paragraphe CG32.1 ou couvert par toute autre garantie implicite ou explicite.
- 32.3 L'ordre mentionné au paragraphe CG32.2.1 doit être par écrit; il peut préciser le délai dans lequel l'Entrepreneur doit rectifier ou corriger la défectuosité ou le vice et il doit être donné à l'Entrepreneur conformément à l'article CG11.
- 32.4 L'Entrepreneur doit rectifier la défectuosité ou corriger le vice mentionné dans l'ordre donné en conformité du paragraphe CG32.2 dans le délai qui y est stipulé.

CG33 Défaut de l'Entrepreneur

- 33.1 Si l'Entrepreneur omet de se conformer à une décision ou directive rendue ou émise par le représentant ministériel en vertu des articles CG18, CG24, CG26, CG31 ou CG32, le représentant ministériel peut recourir aux méthodes qui lui semblent opportunes pour exécuter ce que l'Entrepreneur a omis d'exécuter.
- 33.2 L'Entrepreneur paie à Sa Majesté, sur demande, la totalité de tous les frais, dépenses et dommages encourus par Sa Majesté en raison du défaut de l'Entrepreneur de se conformer à toute décision ou directive stipulée au paragraphe CG31.1 et en raison de toute méthode utilisée en l'occurrence par le représentant ministériel conformément au paragraphe CG33.1.

CG34 Protestations des décisions du représentant ministériel

- 34.1 L'Entrepreneur peut contester, dans les dix jours de sa réception, une décision ou directive mentionnée aux paragraphes CG30.3 ou CG33.1.
- 34.2 Toute contestation mentionnée au paragraphe CG34.1 doit être par écrit, indiquer tous les motifs de la contestation, être signée par l'Entrepreneur et communiquée à Sa Majesté par l'entremise du représentant ministériel.
- 34.3 Si l'Entrepreneur proteste conformément au paragraphe CG34.2, le fait pour lui de se conformer à la décision ou à la directive qu'il conteste ne sera pas interprété comme une reconnaissance du bienfondé de cette décision ou de cette directive et ne pourra constituer une fin de non-recevoir quant à toute poursuite qu'il estimera appropriée dans les circonstances.
- 34.4 Tout protêt de l'Entrepreneur en vertu du paragraphe CG34.2 ne le dispense de se conformer à la décision ou directive en question.
- 34.5 Sous réserve du paragraphe CG34.6, l'Entrepreneur doit, sous peine de déchéance, intenter toute poursuite judiciaire mentionnée au paragraphe CG34.3 dans les trois mois suivant la date d'émission du Certificat définitif d'achèvement mentionné au paragraphe CG44.1.
- 34.6 L'Entrepreneur doit, sous peine de déchéance, intenter dans les trois mois suivant la fin d'une période de garantie, toute poursuite judiciaire mentionnée au paragraphe CG34.3 et découlant d'un ordre donné en vertu de l'article CG32.
- 34.7 Sous réserve du paragraphe CG34.8, si Sa Majesté tient la contestation de l'Entrepreneur comme bien fondée, elle doit lui rembourser le coût des travaux, de l'outillage et des matériaux additionnels nécessaires à l'exécution de l'ordre ou de la directive ayant fait l'objet du protêt.
- 34.8 Les couts mentionnés au paragraphe CG34.7 doivent être calculés conformément aux dispositions des articles CG48 à CG50.

CG35 Changement des conditions du sol – Négligence ou retard de la part de Sa Majesté

- 35.1 Sous réserve du paragraphe CG35.2, nul paiement autre qu'un paiement expressément stipulé au Contrat n'est fait par Sa Majesté à l'Entrepreneur en raison de quelque dépense supplémentaire

encourue ou pour quelque perte ou dommage subi par l'Entrepreneur.

35.2 Si l'Entrepreneur encourt des frais supplémentaires ou subit des pertes ou dommages directement attribuables :

35.2.1 à un écart substantiel entre les renseignements sur les conditions du sol à l'emplacement des travaux, dans les Plans et devis ou d'autre documents fournis à l'Entrepreneur pour l'établissement de sa soumission, ou à un écart substantiel entre une présomption raisonnable de l'Entrepreneur fondée sur lesdits renseignements et les conditions réelles rencontrées par l'Entrepreneur à l'emplacement des travaux lors de leur exécution; ou

35.2.2 à la négligence ou à un retard de la part de Sa Majesté après la date du Contrat, à fournir tout renseignement ou à tout acte auquel Sa Majesté est expressément obligée par le Contrat ou que les usages de l'industrie dicteraient ordinairement à tout propriétaire;

il doit dans les dix jours qui suivent la date de la constatation des conditions du sol décrites à l'alinéa CG35.2.1 ou la date de la négligence ou du retard décrit au paragraphe CG35.2.2, en donner avis par écrit au représentant ministériel et lui signifier son intention d'exiger le remboursement des frais supplémentaires encourus ou le coût de toutes pertes ou dommages subis.

35.3 Lorsque l'Entrepreneur a donné au représentant ministériel l'avis mentionné au paragraphe CG35.3, il doit sous peine de déchéance dans les 30 jours suivant la date de l'émission du Certificat définitif mentionné au paragraphe CG44.1, remettre au représentant ministériel une demande écrite de remboursement des frais supplémentaires ou du coût de toutes pertes ou dommages subis.

35.4 La demande de remboursement mentionnée au paragraphe CG35.3 devra contenir une description suffisante des faits et circonstances qui motivent la demande afin que le représentant ministériel puisse déterminer si cette demande est justifiée ou non, et l'Entrepreneur doit, à cette fin, fournir tout autre renseignement que le représentant ministériel peut exiger.

35.5 Si, de l'avis du représentant ministériel, la demande de remboursement mentionnée au paragraphe CG35.3 est bien fondée, Sa Majesté doit verser à l'Entrepreneur un supplément calculé en conformité des articles CG47 à CG49.

35.6 Si, de l'avis du représentant ministériel, le cas décrit à l'alinéa CG35.2.1 se traduit pour l'Entrepreneur par une économie dans l'exécution du Contrat, le montant établi dans les Articles de convention est, sous réserve du paragraphe CG35.7, réduit d'un montant égal à l'économie réalisée.

35.7 Le montant à être déduit en vertu du paragraphe CG35.6 doit être déterminé selon les dispositions des articles CG47 à CG49.

35.8 Si l'Entrepreneur néglige de donner l'avis mentionné au paragraphe CG35.2 et de présenter la demande de remboursement mentionnée au paragraphe CG35.3 dans le délai prescrit, aucun supplément ne doit lui être versé en l'occurrence.

CG36 Prolongation de délai

- 36.1 Sous réserve du paragraphe CG36.2, le représentant ministériel peut, s'il estime que l'achèvement en retard des travaux est attribuable à des causes indépendantes de la volonté de l'Entrepreneur et sur demande présentée par l'Entrepreneur avant le jour fixe par les Articles de convention pour l'achèvement des travaux ou avant toute autre date fixée auparavant conformément au présent article, prolonger le délai d'achèvement des travaux.
- 36.2 Toute demande mentionnée au paragraphe CG36.1 doit être accompagnée du consentement écrit de la compagnie dont le cautionnement constitue une partie de la garantie du contrat.

CG37 Dédommagement pour retard d'exécution

- 37.1 Aux fins du présent article :
- 37.1.1 les travaux sont censés être achetés le jour ou le représentant ministériel délivre le Certificat provisoire d'achèvement mentionné au paragraphe CG44.2; et
- 37.1.2 « période de retard » signifie la période commençant le jour fixé par les Articles de convention pour l'achèvement des travaux et se terminant le jour précédant immédiatement le jour de l'achèvement, à l'exclusion cependant de tout jour faisant partie d'une période de prolongation accordée en vertu du paragraphe CG36.1 et de tout autre jour où, de l'avis du représentant ministériel, l'achèvement des travaux a été retardé par des causes indépendantes de la volonté de l'Entrepreneur.
- 37.2 Si l'Entrepreneur n'achève pas les travaux au jour fixé par les Articles de convention mais achève ces travaux par la suite, l'Entrepreneur paie à Sa Majesté un montant égal à l'ensemble :
- 37.2.1 de tous les salaires, gages et frais de déplacement versés par Sa Majesté aux personnes surveillant les travaux pendant la période de retard;
- 37.2.2 des coûts encourus par Sa Majesté en conséquence de l'impossibilité pour Sa Majesté de faire usage des travaux achevés pendant la période de retard; et
- 37.2.3 de tous les autres frais et dommages encourus ou subis par Sa Majesté pendant la période de retard par suite de l'inachèvement des travaux à la date prévue.
- 37.3 S'il estime que l'intérêt public le commande, le Ministre peut renoncer au droit de Sa Majesté à la totalité ou partie d'un paiement exigible en conformité du paragraphe CG37.2.

CG38 Travaux retirés à l'Entrepreneur

- 38.1 Le Ministre peut dans les cas suivants et à son entière discrétion, en donnant un avis par écrite à l'Entrepreneur conformément à l'article CG11, retirer à l'Entrepreneur la totalité ou une partie des travaux et recourir aux moyens qui lui semblent appropriés pour achever les travaux si l'Entrepreneur :
- 38.1.1 fait défaut ou retarde à commencer les travaux ou à exécuter les travaux avec diligence et à la satisfaction du représentant ministériel, dans les six jours suivant la réception par

l'Entrepreneur d'un avis par écrite du Ministre ou du représentant ministériel, conformément à l'article CG11 :

- 38.1.2 a négligé d'achever quelque partie des travaux dans le délai imparti par le Contrat;
 - 38.1.3 est devenu insolvable :
 - 31.1.4 a commis un acte de faillite;
 - 31.1.5 a abandonné les travaux;
 - 31.1.6 a fait cession du Contrat sans le consentement requis au paragraphe CG3.1; ou
 - 31.1.7 a de quelque autre façon fait défaut d'observer ou d'accomplir l'une quelconque des dispositions du Contrat.
- 38.2 Si la totalité ou une partie quelconque des travaux a été retirée à l'Entrepreneur en vertu de paragraphe CG38.1.
- 38.2.1 l'Entrepreneur n'a droit, sauf dispositions du paragraphe CG38.4, à aucun autre paiement dû et exigible.
 - 38.2.2 l'Entrepreneur est tenu de payer à Sa Majesté, sur demande, un montant égal à la totalité des pertes et dommages que Sa Majesté aura subis en raison de défaut de l'Entrepreneur d'achever les travaux.
- 38.3 Si la totalité ou partie des travaux retirés à l'Entrepreneur en vertu du paragraphe CG38.1 est achevée par Sa Majesté, le représentant ministériel établit le montant, s'il y en a, de toute retenue ou demande d'acompte de l'Entreteneur existant au moment où les travaux lui ont été retirés et dont, selon le représentant ministériel, on n'a pas besoin pour assurer exécution des travaux ou pour rembourser à Sa Majesté les pertes ou dommages subis en raison du défaut de l'Entrepreneur.
- 38.4 Sa Majesté peut verser à l'Entrepreneur le montant qu'on jugera non requis suivant le paragraphe CG38.3.

CG39 Effet du retrait des travaux à l'Entrepreneur

- 39.1 La retrait de la totalité ou d'une partie des travaux à l'Entrepreneur en conformité de l'article CG38, n'a pas pour effet de libérer l'Entrepreneur d'une obligation quelconque découlant pour lui du Contrat ou de la loi, sauf quant à l'obligation pour lui de continuer l'exécution de la partie des travaux qui lui fut ainsi retirée.
- 39.2 Si la totalité ou partie des travaux est retirée à l'Entrepreneur en conformité de l'article CG38, tous les matériaux et outillage, ainsi que l'intérêt de l'Entrepreneur dans tous les biens immobiliers, permis, pouvoirs et privilèges acquis, utilisés ou fournis par l'Entrepreneur pour les travaux, continuent d'être la propriété de Sa Majesté sans indemnisation de l'Entrepreneur.
- 39.3 Si le représentant ministériel certifie que tout matériau, outillage ou un intérêt quelconque

mentionné au paragraphe CG39.2 n'est plus requis pour les travaux et qu'il n'est plus dans l'intérêt de Sa Majesté de retenir lesdits matériaux, outillage ou intérêt, ils sont remis à l'Entrepreneur.

CG40 Suspension des travaux par le Ministre

- 40.1 Le Ministre peut, lorsqu'il estime que l'intérêt public le commande, sommer l'Entrepreneur de suspendre l'exécution des travaux pour une durée déterminée ou indéterminée, en lui communiquant par écrit un avis à cet effet, conformément à l'article CG11.
- 40.2 Sur réception suivant l'article CG11 de la sommation mentionnée au paragraphe CG40.1, l'Entrepreneur suspend toutes les opérations sauf celles qui, de l'avis du représentant ministériel, sont nécessaires à la garde et à la préservation des travaux, de l'outillage et des matériaux.
- 40.3 Pendant la période de suspension, l'Entrepreneur ne peut enlever de l'emplacement, sans le consentement du représentant ministériel, quelque partie des travaux, de l'outillage et des matériaux.
- 40.4 Si la période de suspension est de 30 jours ou moins, l'Entrepreneur reprend l'exécution des travaux dès l'expiration de la période de suspension et il a droit au paiement des frais, calculés en conformité des articles CG48 à CG50, du travail, de l'outillage et des matériaux nécessairement encourus en conséquence de la suspension des travaux.
- 40.5 Si, à l'expiration d'une période de suspension de plus de 30 jours, le Ministre et l'Entrepreneur conviennent que l'exécution des travaux sera continuée par l'Entrepreneur, ce dernier reprend les opérations sous réserve des termes et conditions convenus entre lui et le Ministre.
- 40.6 Si, à l'expiration d'une période de suspension de plus de 30 jours, le Ministre et l'Entrepreneur ne conviennent pas que les travaux seront continués par l'Entrepreneur ou ne s'entendent pas sur les termes et conditions suivant lesquels l'Entrepreneur poursuivra l'exécution des travaux, l'avis de suspension est censé être un avis de résiliation et conformément de l'article CG41.

CG41 Résiliation du Contrat

- 41.1 Le Ministre peut, à n'importe quel moment, résilier le Contrat en donnant avis par écrit à cet effet à l'Entrepreneur conformément à l'article CG11.
- 41.2 Sur réception suivant l'article CG11 de l'avis mentionné au paragraphe CG41.1, l'Entrepreneur cesse toutes opérations dans l'exécution du Contrat, sous réserve de toutes conditions énoncées dans l'avis.
- 41.3 Si le Contrat est résilié conformément au paragraphe CG41.1, Sa Majesté paie à l'Entrepreneur, sous réserve du paragraphe CG41.4, un montant égal :
 - 41.3.1 au coût de tout le travail, l'outillage et les matériaux qu'aura fournis l'Entrepreneur en vertu du Contrat à la date de résiliation, en exécution d'un contrat ou d'une partie de contrat relativement auquel une Entente à prix unitaire est précisée dans le Contrat; ou

41.3.2 au moins :

41.3.2.1 du montant, calculé conformément aux Modalités de paiement, qui aurait été payable à l'Entrepreneur s'il avait achevé les travaux; et

41.3.2.2 du montant que l'on reconnaît devoir à l'Entreteneur en vertu de l'article CG49, concernant un contrat ou une partie de contrat pour lequel le Contrat prévoit une Entente à prix fixe;

moins l'ensemble de tous les montants qui furent payés à l'Entrepreneur par Sa Majesté et de tous les montants dont l'Entrepreneur est redevable envers Sa Majesté en vertu du Contrat.

41.4 Si Sa Majesté et l'Entrepreneur ne peuvent convenir du montant mentionné au paragraphe CG41.3, ce montant sera déterminé suivant la méthode indiquée à l'article CG50.

CG42 Réclamations contre et obligations de la part de l'Entrepreneur ou d'un sous-entrepreneur

42.1 Afin d'acquitter toutes obligations légales de l'Entrepreneur ou d'un sous-entrepreneur ou de satisfaire à toutes réclamations légales contre eux résultant de l'exécution du Contrat, Sa Majesté peut payer tout montant qui est dû et payable à l'Entrepreneur en vertu du Contrat, directement aux créanciers de l'Entrepreneur ou du sous-entrepreneur, ou aux réclamants en l'occurrence. Toutefois, ce montant que paie Sa Majesté, le cas échéant, ne doit pas excéder le montant que l'Entrepreneur aurait été tenu de verser au réclamant si les dispositions des lois relatives aux privilèges dans les provinces et territoires ou, dans le cas de la province de Québec, de la loi à cet effet dans le Code civil, avaient été applicables aux travaux. Le réclamant n'a pas à respecter les dispositions des lois relatives aux privilèges qui établissent les démarches à suivre au moyen d'avis, d'enregistrements ou d'autre façon, comme il aurait pu être nécessaire de le faire pour conserver ou valider toute réclamation à l'égard de liens émanant du réclamant.

42.2 Sa Majesté n'effectue pas de paiement tel qu'il est décrit au paragraphe CG42.1 à moins que le réclamant lui remette :

42.2.1 un jugement ou une ordonnance exécutoire d'un tribunal compétent établissant le montant qu'aurait eu à verser l'Entrepreneur au réclamant en vertu des dispositions de la loi provinciale ou territoriale relative aux privilèges pertinente ou, dans le cas de la province de Québec, de la loi à cet effet dans le Code civil, si ces lois s'appliquaient aux travaux, ou

42.2.2 une sentence arbitrale définitive et exécutoire établissant le montant qu'aurait eu à verser l'Entrepreneur au réclamant en vertu des dispositions de la loi provinciale ou territoriale relative aux privilèges pertinente ou, dans le cas de la province de Québec, de la loi à cet effet dans le Code civil, si ces lois s'appliquaient aux travaux; ou

42.2.3 le consentement de l'Entrepreneur autorisant le paiement.

Pour déterminer les droits du réclamant en vertu des alinéas CG42.2.1 et CG42.2.2, l'avis exigé au paragraphe CG42.8 sera réputé remplacer l'enregistrement ou la prestation d'un avis après l'achèvement des travaux exigé par les lois applicables, et aucune réclamation ne sera réputée être

expirée, annulée ou non exécutoire parce que le réclamant n'a pas intenté de poursuites dans les délais prescrits par la loi applicable.

- 42.3 Lorsqu'il accepte d'exécuter un Contrat, l'Entrepreneur est réputée avoir consenti de soumettre à l'arbitrage obligatoire, à la demande d'un réclamant, toutes les questions auxquelles il faut répondre pour déterminer si le réclamant a droit au paiement conformément aux dispositions du paragraphe CG42.1. Les parties à l'arbitrage seront, entre autres, le sous-traitant à qui le réclamant a fourni des matériaux ou de l'équipement ou pour qui il a effectué du travail, si le sous-traitant le désire. L'État ne constitue pas une partie à l'arbitrage et, à moins d'une entente contraire entre l'Entrepreneur et le réclamant, l'arbitrage se déroulera conformément à la loi provinciale ou territoriale régissant l'arbitrage applicable dans la province ou le territoire où les travaux sont exécutés.
- 42.4 Une paiement effectuée en conformité du paragraphe CG42.1 comporte quittance de l'obligation de Sa Majesté envers l'Entrepreneur sous le contrat, jusqu'à concurrence du montant payé et peut être déduit d'un montant dû à l'Entrepreneur en vertu du Contrat.
- 42.5 Dans la mesure où les circonstances entourant l'exécution des travaux pour le compte de Sa Majesté le permettent, l'Entrepreneur se conforme à toutes les lois en vigueur dans la province ou le territoire où les travaux sont exécutés quant aux périodes de paiement, aux retenus obligatoires, à la création et à la mise en vigueur de lois concernant les privilèges des fournisseurs ou des constructeurs ou de lois semblables ou, s'il s'agit de la province de Québec, aux dispositions de la loi qui concerne les privilèges.
- 42.6 L'Entrepreneur acquitte toutes ses obligations légales et fait droit à toutes les réclamations légales qui lui sont adressées en conséquence de l'exécution des travaux, au moins aussi souvent que le Contrat oblige Sa Majesté à acquitter ses obligations envers l'Entrepreneur.
- 42.7 Sur demande du représentant ministériel, l'Entrepreneur fait une déclaration attestant de l'existence et de l'état de toutes les obligations et réclamations mentionnées au paragraphe CG42.6.
- 42.8 Le paragraphe CG42.1 ne s'applique qu'aux réclamations et aux obligations :
- 42.8.1 pour lesquelles le représentant ministériel a reçu un avis par écrit avant qu'un paiement n'ait été effectué à l'Entrepreneur conformément au paragraphe MP4.10 et dans les 120 jours suivant la date à laquelle le réclamant :
- 42.8.1.1 aurait dû être payé en totalité conformément au contrat qui le lie à l'Entrepreneur ou à un sous-traitant, s'il s'agit d'une réclamation pour des deniers dont il est légalement requis qu'ils soient retenus du réclamant; ou
- 42.8.1.2 s'est acquitté des derniers services ou travaux ou à fourni les derniers matériaux exigés par le contrat qui le lie à l'Entrepreneur ou à un sous-traitant, s'il ne s'agit pas d'une réclamation mentionnée au sous-alinéa CG42.8.1.1; et
- 42.8.2 pour lesquelles les procédures visant à établir les droits à un paiement, conformément au paragraphe CG42.2, ont commencé dans l'année suivant la date à laquelle l'avis mentionné à l'alinéa CG42.8.1 a été reçu par le représentant ministériel; et

l'avis exige à l'alinéa CG42.8.1 doit faire état du montant réclamé et du principal responsable selon le Contrat.

- 42.9 Sur réception d'un avis de réclamation en vertu de l'alinéa CG42.8.1, Sa Majesté peut retenir de tout montant dû et payable à l'Entrepreneur en vertu du Contrat un partie ou la totalité du montant de la réclamation.
- 42.10 Le représentant ministériel doit aviser l'Entrepreneur par écrit de la réception de toute réclamation mentionné à l'alinéa CG42.8.1 et de l'intention de Sa Majesté de retenir des fonds conformément au paragraphe CG42.9, et l'Entrepreneur peut, à tout moment par la suite et jusqu'à ce que le paiement soit effectué au réclamant, déposer, auprès de Sa Majesté, une garantie acceptable par Sa Majesté dont le montant est équivalent à la valeur de la réclamation. L'avis d'un tel dépôt doit être reçu par le représentant ministériel et, sur réception d'une telle garantie, Sa Majesté doit dégager à l'intention de l'Entrepreneur tous les fonds qui auraient été payables autrement à l'Entrepreneur et qui ont été retenus conformément aux dispositions du paragraphe CG42.9 à l'égard de la réclamation d'un réclamant pour laquelle la garantie a été déposée.

CG43 Dépôt de garantie – Confiscation ou remise

43.1 Si :

43.1.1 les travaux sont retirés à l'Entrepreneur conformément à l'article CG38;

43.1.2 le Contrat est résilié en vertu de l'article CG41; ou

43.1.3 l'Entrepreneur a violé ou n'a pas rempli ses engagements en vertu du Contrat;

Sa Majesté peut s'approprier le dépôt de garantie, s'il en est.

- 43.2 Si Sa Majesté s'approprie le dépôt de garantie conformément au paragraphe CG43.1, le montant obtenu en l'occurrence est censé être une dette payable à l'Entrepreneur par Sa Majesté en vertu du Contrat.
- 43.3 Tout solde du montant mentionné au paragraphe CG43.2, s'il en est, après paiement de toutes pertes dommages ou réclamations de Sa Majesté ou quelqu'un autre, sera payé par Sa Majesté à l'Entrepreneur si, dans l'opinion du représentant ministériel, il n'est pas requis pour les fins du Contrat.

CG44 Certificats du représentant ministériel

44.1 Le jour :

44.1.1 où les travaux sont achevés; et

44.1.2 où l'Entrepreneur s'est conformé au Contrat et à tous les ordres et directives donnés conformément au Contrat;

à la satisfaction du représentant ministériel, le représentant ministériel délivre à l'Entrepreneur un Certificat définitif d'achèvement.

- 44.2 Si le représentant ministériel est convaincu que les travaux sont suffisamment achevés, il peut, à tout moment avant la délivrance d'un Certificat définitif d'achèvement mentionné au paragraphe CG44.1 délivrer à l'Entrepreneur un Certificat provisoire d'achèvement, et :
- 44.2.1 aux fins du paragraphe CG44.2, les travaux seront jugés suffisamment achevés
- 44.2.1.1 lorsqu'une partie considérable ou la totalité des travaux visés par le Contrat sont, de l'avis du représentant ministériel, prêts à être utilisés par Sa Majesté ou sont utilisés aux fins prévues; et
- 44.2.1.2 lorsque les travaux qui restent à effectuer en vertu du Contrat peuvent, de l'avis du représentant ministériel, être achevés ou rectifiés à un coût n'excédant pas
- 44.2.1.2.1 -3 p. 100 des premiers 500 000 \$; et
- 44.2.1.2.2 -2 p 100 des prochains 500 000 \$; et
- 44.2.1.2.3 -1 p. 100 du reste
- de la valeur du Contrat au moment du calcul de ce coût.
- 44.3 Aux fins uniquement du sous-alinéa 44.2.1.2, lorsque les travaux ou une partie considérable des travaux sont prêts à être utilisés ou sont utilisés aux fins prévues et que le reste ou une partie des travaux ne peut être achevé pour des raisons indépendantes de la volonté de l'Entrepreneur ou, lorsque le représentant ministériel et l'Entrepreneur conviennent de ne pas achever les travaux dans les délais prescrits, le coût de la partie des travaux que l'Entrepreneur n'a pu terminer pour des raisons indépendantes de sa volonté ou que le représentant ministériel et l'Entrepreneur ont convenu de ne pas terminer dans les délais précisés sera déduit de la valeur du contrat mentionnée au sous-alinéa CG44.2.1.2 et ledit coût ne fera pas partie du coût des travaux qui restent à effectuer aux fins de la détermination de l'achèvement réel.
- 44.4 Le Certificat provisoire d'achèvement mentionné au paragraphe CG44.2 doit décrire les parties des travaux qui n'ont pas été achevées à la satisfaction du représentant ministériel et préciser tout ce que l'Entrepreneur doit faire :
- 44.4.1 avant que le Certificat définitif d'achèvement mentionné au paragraphe CG44.1 puisse être délivré; et
- 44.4.2 avant le début de la période de 12 mois mentionnée au paragraphe CG32.1.2 pour lesdites parties et toutes autres choses.
- 44.5 Le représentant ministériel peut, en plus des points indiqués dans le Certificat provisoire d'achèvement mentionné au paragraphe CG44.2, obliger l'Entrepreneur à rectifier toutes autres parties des travaux qui n'ont pas été achevées à sa satisfaction et faire effectuer toutes autres choses nécessaires pour l'achèvement satisfaisant des travaux.

- 44.6 Si le Contrat ou l'une de ses parties a fait l'objet d'une Entente à prix unitaire, le représentant ministériel mesure et consigne dans un registre les quantités de travail exécuté d'outillage fourni par l'Entrepreneur et de matériaux utilisés pour l'exécution des travaux, et informe, sur demande, l'Entrepreneur au sujet de ces mesurages.
- 44.7 L'Entrepreneur aide le représentant ministériel et coopère avec lui dans l'exécution des tâches précisées au paragraphe CG44.6 et a le droit de prendre connaissance de tout registre tenu par le représentant ministériel suivant le paragraphe CG44.6.
- 44.8 Une fois que le représentant ministériel a délivré le Certificat définitif d'achèvement mentionné au paragraphe CG44.1, il doit, si le paragraphe CG44.6 s'applique, délivrer un Certificat définitif de mesurage.
- 44.9 Le Certificat définitif de mesurage mentionné au paragraphe CG44.8 :
- 44.9.1 indique le total des mesurages des quantités mentionnées au paragraphe CG44.6, et
- 44.9.2 lie de façon péremptoire Sa Majesté et l'Entrepreneur quant aux mesurages des quantités qui y sont consignées.

CG45 Remise du dépôt de garantie

- 45.1 Après la délivrance du Certificat provisoire d'achèvement mentionné au paragraphe CG44.2 et à condition que l'Entrepreneur n'ait pas violé ses engagements en vertu du Contrat ou omis de les remplir, Sa Majesté retourne à l'Entrepreneur la totalité ou partie du dépôt de garantie, s'il en est, qui de l'avis du représentant ministériel, n'est pas requise aux fins du Contrat.
- 45.2 Au moment de la délivrance du Certificat définitif d'achèvement mentionné au paragraphe CG44.1, Sa Majesté retourne à l'Entrepreneur tout le solde du dépôt de sécurité, sauf stipulation contraire du Contrat.
- 45.3 Si le dépôt de garantie a été versé au Trésor, Sa Majesté doit payer à l'Entrepreneur l'intérêt sur ledit dépôt à un taux établi de temps à autre en vertu du paragraphe 21(2) de la Loi sur la gestion des finances publiques.

CG46 Précision du sens des expressions figurant aux articles CG47 à CG50

- 46.1 Dans les articles CG47 à CG50 :
- 46.1.1 l'expression « Tableau des prix unitaires » signifie le tableau figurant dans les Articles de convention, et
- 46.1.2 l'expression « outillage » ne comprend pas les outils habituellement fournis par les hommes de métier dans l'exercice de leurs fonctions.

CG47 Additions ou modifications au Tableau des prix unitaires

- 47.1 Le représentant ministériel et l'Entrepreneur peuvent convenir par écrit, lorsqu'une Entente à prix unitaire s'applique au Contrat ou à l'une de ses parties :
- 47.1.1 d'ajouter au Tableau des prix unitaires des catégories de travail, d'outillage ou de matériaux, des unités de mesurage, de prix par unité et des estimations de quantités lorsque certains travaux, outillage et matériaux devant apparaître dans le Certificat définitif de mesurage mentionné au paragraphe CG44.8 ne figurent dans aucune des catégories de travail, d'outillage ou de matériaux établies au Tableau des prix unitaires; ou
 - 47.1.2 sous réserve des paragraphes CG47.2 et CG47.3, de modifier le prix par unité établi au Tableau des prix unitaires à l'égard d'une quelconque catégorie de travail, d'outillage ou de matériaux y figurant, lorsqu'une quantité a été estimée à l'égard de cette catégorie de travail, d'outillage ou de matériaux, et que le Certificat définitif de mesurage mentionné au paragraphe CG44.8 indique ou est susceptible d'indiquer que la quantité totale de cette catégorie de travail exécuté, d'outillage fourni ou de matériaux utilisés par l'Entrepreneur, pour l'exécution des travaux, est :
 - 47.1.2.1 inférieur à 85% de la quantité estimée; ou
 - 47.1.2.2 supérieure à 115% de la quantité estimée.
- 47.2 Le coût total d'un article figurant au Tableau des prix unitaires qui a été modifié conformément au sous-alinéa 47.1.2.1 ne doit, en aucun cas, excéder le montant qui aurait été payable à l'Entrepreneur si la quantité totale estimative de travail avait été exécutée, la quantité totale estimative d'outillage avait été fournie ou la quantité totale estimative de matériaux, utilisée.
- 47.3 Toute modification rendue nécessaire par le sous-alinéa CG47.1.2.2 ne s'appliquera qu'aux quantités supérieures à 115%.
- 47.4 Si le représentant ministériel et l'Entrepreneur ne s'entendent pas suivant le paragraphe CG47.1, le représentant ministériel détermine la catégorie et l'unité de mesurage du travail, de l'outillage et des matériaux et, sous réserve des paragraphes CG47.2 et CG47.3, le prix par unité est déterminé conformément à l'article CG50.

CG48 Établissement du coût – Tableau des prix unitaires

- 48.1 Chaque fois qu'il est nécessaire, aux fins du Contrat, d'établir le coût du travail, de l'outillage et des matériaux, on multiplie la quantité de ce travail de cet outillage ou de ces matériaux, exprimée par l'unité énoncée à la colonne 3 du Tableau des prix unitaires, par le prix énoncé en regard de cette unité à la colonne 5 du Tableau des prix unitaires.

CG49 Établissement du coût – Négociation

- 49.1 Si le mode d'établissement du coût prévu à l'article CG48 ne peut être utilisé parce que le genre ou la catégorie de travail, d'outillage et de matériaux en cause ne figurent pas au Tableau des prix unitaires, le coût du travail, de l'outillage ou des matériaux, aux fins du Contrat est le montant

convenu de temps à autre entre l'Entrepreneur et le représentant ministériel.

- 49.2 Aux fins du paragraphe CG49.1, l'Entrepreneur remet au représentant ministériel lorsque ce dernier le requiert, tout renseignement nécessaire sur ce qu'il lui en coûte en travail, outillage et matériaux mentionnés au paragraphe CG49.1.

CG50 Établissement du coût en cas d'échec des négociations

- 50.1 Si l'on ne parvient pas à établir le coût du travail, de l'outillage et des matériaux conformément aux méthodes prévues aux articles CG47, CG48 ou CG49, pour les fins mentionnées dans ceux-ci, le coût sera égal à l'ensemble de :

- 50.1.1 tous les montants justes et raisonnables effectivement dépensés ou légalement payables par l'Entrepreneur pour le travail, l'outillage et les matériaux couverts par une des catégories de dépenses prévues au paragraphe CG50.2, qui sont directement attribuables à l'exécution du Contrat;
- 50.1.2 une somme égale à 10% du total des dépenses de l'Entrepreneur mentionnées à l'alinéa CG50.1.1, représentant une indemnité pour profit et pour tous les autres coûts et dépenses, incluant les frais de financement et les intérêts, les frais généraux, dépenses du siège social, et tous autres frais ou dépenses, mais non les coûts et dépenses mentionnés à l'alinéa CG50.1.1 ou CG50.1.3 ou pour une catégorie mentionnée au paragraphe CG50.2;
- 50.1.3 l'intérêt sur les coûts déterminés en vertu des alinéas CG50.1.1 et CG50.1.2, intérêt qui sera calculé conformément à l'article MP9,

pourvu que le coût total d'un article figurant au Tableau des prix unitaires, auquel s'appliquent les dispositions de l'alinéa CG47.1.2.1, n'est pas supérieur au montant qui aurait été payable à l'Entrepreneur si la quantité totale dudit article aurait été effectivement produite, utilisée ou fournie.

- 50.2 Aux fins de l'alinéa CG50.1.1, les catégories de dépenses admissibles dans l'établissement du coût du travail, de l'outillage et des matériaux, sont :
- 50.2.1 les paiements faits aux sous-entrepreneurs;
- 50.2.2 les traitements, salaires et frais de voyage versés aux employés de l'Entrepreneur affectés, proprement dit, à l'exécution des travaux, à l'exception des traitements, salaires, gratifications, frais de subsistance et de voyage des employés de l'Entrepreneur travaillant généralement au siège social ou à un bureau général de l'Entrepreneur, à moins que lesdits employés ne soient affectés à l'emplacement des travaux avec la approbation du représentant ministériel;
- 50.2.3 les cotisations exigibles en vertu d'un texte statutaire relativement aux indemnités des accidents du travail, à l'assurance-chômage, au régime de retraite et aux congés rémunérés;
- 50.2.4 les frais de location d'outillage ou un montant équivalent aux frais de location si l'outillage appartient à l'Entrepreneur qui était nécessaire et qui a été utilisé pour

l'exécution des travaux, à condition que lesdits frais ou la somme équivalente soient raisonnables et que l'utilisation dudit outillage ait été approuvée par le représentant ministériel;

- 50.2.5 les frais d'entretien et de fonctionnement de l'outillage nécessaire à l'exécution des travaux et des frais de réparation à tel outillage qui, de l'avis du représentant ministériel, sont nécessaires à la bonne exécution du Contrat, à l'exclusion de toutes réparations provenant de défauts existant avant l'affectation de l'outillage aux travaux;
- 50.2.6 les paiements relatifs aux matériaux nécessaires et incorporés aux travaux, ou nécessaires à l'exécution du Contrat et utilisés à cette fin; et
- 50.2.7 les paiements relatifs à la présentation, à la livraison, à l'utilisation, à l'érection, à l'installation, à l'inspection, à la protection et à l'enlèvement de l'outillage et des matériaux nécessaires à l'exécution du Contrat et utilisés à cette fin; et
- 50.2.8 tout autre paiement fait par l'Entrepreneur avec l'approbation du représentant ministériel et nécessaire à l'exécution du Contrat.

CG51 Registres à tenir par l'Entrepreneur

- 51.1 L'Entrepreneur :
 - 51.1.1 tient des registres complets du coût estimatif et réel des travaux, des appels d'offres, des prix cotés, des contrats, de la correspondance, des factures, des reçus et des pièces justificative s'y rapportant;
 - 51.1.2 met à la disposition du Ministre et du sous-receveur général du Canada ou des personnes qu'ils délèguent pour vérification et inspection tous les documents mentionnés à l'alinéa CG51.1.1;
 - 51.1.3 permet à toutes personnes mentionnées à l'alinéa 51.1.2 de faire des copies ou extraits de tous registres et documents mentionnés à l'alinéa CG51.1.1; et
 - 51.1.4 fournit aux personnes mentionnées à l'alinéa CG51.1.2 tous les renseignements qu'elles peuvent exiger de temps à autre au sujet de ces registres et documents.
- 51.2 Les registres tenus par l'Entrepreneur conformément à l'alinéa CG51.1.1, sont conservés intact pendant deux ans à compter de la date de la délivrance du Certificat définitif d'achèvement mentionné au paragraphe CG44.1, ou jusqu'à l'expiration de toute autre période que le Ministre peut fixer.
- 51.3 L'Entrepreneur oblige tous sous-entrepreneurs, et toutes autres personnes qu'il contrôle directement ou indirectement ou qui lui sont affiliés, de même que toutes personnes qui contrôlent l'Entrepreneur directement ou indirectement, à se conformer aux paragraphes CG51.1 et CG51.2 comme s'ils étaient l'Entrepreneur.

CG52 Conflits d'intérêts

- 52.1 Le présent Contrat stipule qu'aucun ancien titulaire de charge publique qui ne se conforme pas au Code régissant la conduite des titulaires de charge publique en ce qui concerne les conflits d'intérêts et l'après-mandat ne peut retirer des avantages directs du présent Contrat.

CG53 Situation de l'Entrepreneur

- 53.1 L'Entrepreneur sera retenu en vertu du Contrat à titre d'entrepreneur indépendant.
- 53.2 L'Entrepreneur et tout employé dudit entrepreneur n'est pas retenu en vertu du Contrat à titre d'employé, d'agent ou de mandataire de Sa Majesté.
- 53.3 Aux fins des paragraphes CG53.1 et CG53.2, l'Entrepreneur sera à lui seul responsable de tous les paiements et de toutes les retenues exigées par la loi, y compris ceux exigés par le Régime de pensions du Canada, le Régime des rentes du Québec, l'assurance-chômage, les accidents du travail ou l'impôt sur le revenu.



CONDITIONS GÉNÉRALES

- CA 1 Preuve du contrat d'assurance**
- CA 2 Gestion des risques**
- CA 3 Paiement de franchise**
- CA 4 Assurance d'assurance**

EXIGENCES DE GARANTIES D'ASSURANCE

- EGA 1 Assuré**
- EGA 2 Période d'assurance**
- EGA 3 Preuve du contrat d'assurance**
- EGA 4 Avis**

ASSURANCE DE LA RESPONSABILITÉ CIVILE DES ENTREPRISES

- ARC 1 Portée de l'assurance**
- ARC 2 Garanties/Dispositions**
- ARC 3 Risques additionnels**
- ARC 4 Indemnité d'assurance**
- ARC 5 Franchise**

ASSURANCE DES CHANTIERS – RISQUES D'INSTALLATION – TOUS RISQUES

- AC 1 Portée de l'assurance**
- AC 2 Biens assurés**
- AC 3 Indemnités d'assurance**
- AC 4 Montant d'assurance**
- AC 5 Franchise**
- AC 6 Subrogation**
- AC 7 Exclusion**

ATTESTATION D'ASSURANCE DE L'ASSUREUR



CONDITIONS GÉNÉRALES

CA 1 Preuve du contrat d'assurance (02/12/03)

Dans un délai de trente (30) jours après l'acceptation de la soumission de l'entrepreneur, ce dernier, à moins d'avis contraire par écrit de l'agent d'approvisionnement, doit remettre à l'agent d'approvisionnement, l'Attestation d'assurance d'un assureur dans la forme apparaissant dans le présent document et, si demandé par l'agent d'approvisionnement, remettre à ce dernier les originaux ou les copies certifiées conformes de tous les contrats d'assurance auxquels l'entrepreneur a souscrit conformément aux Exigences des garanties d'assurance décrites ci-après.

CA 2 Gestion des risques (01/10/94)

Les dispositions des Exigences des garanties d'assurance des présentes n'ont pas pour but de couvrir toutes les obligations de l'entrepreneur en vertu de l'article CG8 des Conditions générales « C » du marché. L'entrepreneur est libre, à condition d'en assumer le coût, de prendre des mesures additionnelles de gestion des risques ou des garanties d'assurance complémentaires qu'il juge nécessaire pour remplir ses obligations conformément à l'article CG8.

CA 3 Paiement de franchise (01/10/94)

L'entrepreneur doit assumer le paiement de toutes sommes d'argent en règlement d'un sinistre, jusqu'à concurrence de la franchise.

CA 4 Assurance d'assurance (02/12/03)

L'entrepreneur a déclaré qu'il détient une assurance de responsabilité civile appropriée et habituelle qui est en vigueur conformément aux présentes Conditions d'assurance et il a garanti qu'il obtiendra, en temps opportune et avant le commencement des travaux, l'assurance de biens appropriée et habituelle conformément aux présentes Conditions d'assurance et qu'en outre il maintiendra en vigueur toutes les polices d'assurance requises conformément aux présentes Conditions d'assurance.

EXIGENCES DE GARANTIES D'ASSURANCE

PARTIE I

EXIGENCES GÉNÉRALES D'ASSURANCE (EGA)

EGA 1 Assuré (02/12/03)

Chaque contrat d'assurance doit assurer l'entrepreneur et doit inclure à titre d'Assuré dénommé additionnel, Sa Majesté la Reine du chef du Canada, représentée par le Conseil national de recherches Canada.



**EGA 2 Période d'assurance
(02/12/03)**

Moins d'avis contraire par écrit de l'agent d'approvisionnement ou d'indication contraire ailleurs dans les présentes Conditions d'assurance, les contrats d'assurance exigés dans les présentes doivent prendre effet le jour de l'attribution du marché et demeurer en vigueur jusqu'au jour de la délivrance du Certificat définitif d'achèvement du représentant ministériel.

**EGA 3 Preuve du contrat d'assurance
(01/10/94)**

Dans un délai de vingt-cinq (25) jours après l'acceptation de la soumission de l'entrepreneur, l'assureur, à moins d'avis contraire écrit de l'entrepreneur, doit remettre à l'entrepreneur l'Attestation d'assurance d'un assureur dans la forme apparaissant dans le présent document et, si demandé, les originaux ou les copies certifiées conformes de tous les contrats d'assurance auxquels l'entrepreneur a souscrit conformément aux présentes Exigences de présentes garanties d'assurance.

**EGA 4 Avis
(01/10/94)**

Chaque contrat d'assurance doit renfermer une disposition selon laquelle trente (30) jours avant de procéder à toute modification importante visant la garantie d'assurance, ou à l'annulation de ladite garantie d'assurance, un avis par écrit doit être envoyé par l'assureur à Sa Majesté. Tout avis de cette nature que reçoit l'entrepreneur doit être transmis sans délai à Sa Majesté.

**PARTIE II
ASSURANCE DE LA RESPONSABILITÉ CIVILE DES ENTREPRISES**

**ARC 1 Portée de l'assurance
(01/10/94)**

Le contrat d'assurance doit être établi sur un formulaire similaire à celui connu et désigné dans l'industrie de l'assurance sous l'appellation Assurance de la responsabilité civile des entreprises (base d'événement) – BAC 2100, et doit accorder un montant de garantie d'au moins 2 000 000 \$ (tous dommages confondus) pour des dommages corporels et matériels imputables au même événement ou à une série d'événements ayant la même origine. Les frais de justice ou autres déboursés de défense par suite de sinistre ou de réclamation ne viendront pas en déduction du montant de garantie.

**ARC 2 Garanties/Dispositions
(01/10/94)**

Le contrat d'assurance doit inclure les garanties/dispositions suivantes sans toutefois nécessairement s'y limiter :

- 2.1 La responsabilité découlant de la propriété, de l'existence de l'entretien ou de l'utilisation de lieux par l'entrepreneur et les activités nécessaires ou connexes à l'exécution du présent contrat.
- 2.2 L'extension de la garantie « Dommages matériels et/ou privation de jouissance ».



- 2.3 L'enlèvement ou l'affaiblissement d'un support soutenant des bâtiments ou terrains, que ce support soit naturel ou non.
- 2.4 La responsabilité découlant des appareils de levage et des monte-charge (y compris les escaliers roulants).
- 2.5 La responsabilité civile indirecte des entrepreneurs.
- 2.6 Les responsabilités contractuelles et assumées en vertu du présent contrat.
- 2.7 La responsabilité civile découlant des risques après travaux. En regard de la présente garantie, ainsi que toutes les autres garanties de cette Partie II des présentes Conditions d'assurance, l'assurance doit demeurer en vigueur pendant au moins un (1) an à partir de la date de délivrance du Certificat d'achèvement du représentant ministériel.
- 2.8 Responsabilité réciproque – La clause doit être rédigée comme suit :

Responsabilité réciproque – L'assurance telle que garantie par le présent contrat s'applique à toute demande d'indemnité faite à ou à toute action intentée contre n'importe quel assuré par n'importe quel autre assuré. La garantie d'assurance s'applique de la même façon et dans la même mesure que si un contrat distinct avait été établi à chacun d'eux. L'inclusion de plus d'un assuré n'augmente pas le montant de garantie de l'assureur.

- 2.9 Individualité des intérêts – La clause doit être rédigée comme suit :

Individualité des intérêts – La présente assurance, sous réserve des montants de garantie, s'applique séparément à chaque assuré de la même façon et dans la même mesure que si un contrat distinct avait été établi à chacun d'eux. L'inclusion de plus d'un assuré n'augmente pas le montant de garantie de l'assureur.

ARC 3 Risques additionnels (02/12/03)

Le contrat d'assurance doit couvrir ou être amendé pour couvrir les risques suivants, si l'entreprise y est soumise :

- 3.1 Dynamitage;
- 3.2 Battage de pieux et travail par caisson;
- 3.3 Reprise en sous-œuvre;
- 3.4 Risques associés aux activités de l'entrepreneur dans un aéroport en service;
- 3.5 Contamination par radioactivité par suite de l'utilisation d'isotopes commerciaux;
- 3.6 Endommagement à la partie d'un bâtiment existant hors de la portée directe d'un marché de rénovation, d'addition ou d'installation;
- 3.7 Risques maritimes reliés à la construction de jetés, quais et docks.



**ARC 4 Indemnités d'assurance
(01/10/94)**

Toute indemnité en vertu de la présente assurance est habituellement versée à un tiers réclamant.

**ARC 5 Franchise
(02/12/03)**

Le contrat d'assurance doit être établie avec une franchise d'au plus 10 000 \$ événement quant aux sinistres causés par dommages matériels.

**PART III
ASSURANCE DES CHANTIERS – RISQUES D'INSTALLATION – TOUS RISQUES**

**AC 1 Portée de l'assurance
(01/10/94)**

Le contrat d'assurance doit être établi pour assurer l'entreprise sur un base « Tous risques » donnant un couverture d'assurance identique à celle qui est fournie par les formulaires connues et désignées dans l'industrie des assurances sous les noms de l' « Assurances des Chantiers – Formule globale » ou « Risques d'installation – Tous Risques ».

**AC 2 Biens assurés
(01/10/94)**

Les biens assurés doivent comprendre :

- 2.1 les travaux, ainsi que tous les biens, équipement et matériaux devant être incorporés à l'entreprise achevée à l'endroit du projet, avant, durant et après leur installation, érection ou construction, y compris les essais;
- 2.2 les frais de déblaiement du chantier occasionnés par un sinistre couvert y ayant laissé des débris provenant de biens couverts par la présente assurance, y compris la démolition des biens endommagés, l'enlèvement de la glace et l'assèchement.

**AC 3 Indemnité d'assurance
(01/10/94)**

- 3.1 Toutes indemnités en vertu du contrat d'assurance doit être payées conformément à l'article CG28 des Conditions générales « C » du contrat.
- 3.2 Le contrat d'assurance doit stipuler que toute indemnité en vertu d'icelle doit être payé à Sa Majesté ou selon les directives du Ministre.
- 3.3 L'entrepreneur doit faire toutes choses et exécuter tous documents requis pour le paiement de l'indemnité d'assurance.

AC 4 Montant d'assurance



(01/10/94)

Le montant de l'assurance doit égalier au moins la somme de la valeur du contrat plus la valeur déclarée (s'il y a lieu) dans les documents du marché de tout le matériel et équipement fourni par Sa Majesté sur le chantier pour être incorporé à l'entreprise achevée et en faire partie.

AC 5 Franchise
(02/12/94)

La police doit être établie avec une franchise d'au plus 10 000 \$.

AC 6 Subrogation
(01/10/94)

La clause suivante doit être incluse dans le contrat d'assurance :

« Tous droits de subrogation ou transfert de droits sont par les présentes abandonnées contre toutes les personnes physiques ou morales ayant droit au bénéfice de la présente assurance. »

AC 7 Exclusion
(01/10/94)

Le contrat d'assurance peut comporter les exclusions normales sous réserve des exceptions suivantes :

- 7.1 Peuvent être exclus les frais inhérents à la bonne exécution des travaux, et rendus nécessaires par des défauts dans les matériaux, la main d'œuvre ou la conception, l'assurance produisant néanmoins ses effets en ce qui concerne les sinistres entraînés par voie de conséquence.
- 7.2 La perte ou les dommages causés par la contamination de matériaux radioactifs, sauf la perte ou les dommages résultant de l'utilisation d'isotopes commerciaux pour la mesure, l'inspection, le contrôle de la qualité, la radiographie ou la photographie industriels.
- 7.3 La mise en service et l'occupation de l'entreprise, en totalité ou en partie, doivent être permis pour les fins auxquels l'entreprise est destiné à son achèvement.



ATTESTATION D'ASSURANCE DE L'ASSUREUR
(À ÊTRE COMPLÈTE PAR L'ASSUREUR (NON PAR LE COURTIER) ET LIVRÉE AU CONSEIL NATIONAL DE RECHERCHES CANADA DANS LES TRENTE JOURS SUIVANT L'ACCEPTATION DE LA SOUMISSION)

MARCHÉ

DESCRIPTION DES TRAVAUX	NUMÉRO DE MARCHÉ	DATE D'ADJUDICATION
ENDROIT		

ASSUREUR

NOM
ADRESSE

COURTIER

NOM
ADRESSE

ASSURÉ

NOM DE L'ENTREPRENEUR
ADRESSE

ASSURÉ ADDITIONNEL

SA MAJESTÉ LA REINE DU CHEF DU CANADA REPRÉSENTÉE PAR LE CONSEIL NATIONAL DE RECHERCHES CANADA
--

LE PRÉSENT DOCUMENT ATTESTE QUE LES POLICES D'ASSURANCE SUIVANTES SONT PRÉSENTEMENT EN VIGUEUR ET COUVRENT TOUTES LES ACTIVITÉS DE L'ASSURÉ, EN FONCTION DU MARCHÉ DU CONSEIL NATIONAL DE RECHERCHES CANADA CONCLU ENTRE L'ASSURÉ DÉNOMMÉ ET LE CONSEIL NATIONAL DE RECHERCHES CANADA SELON LES CONDITIONS D'ASSURANCE « E ».

POLICE					
GENRE	NUMÉRO	DATE D'EFFET	DATE D'EXPIRATION	LIMITES DE GARANTIE	FRANCHISE
RESPONSABILITÉ CIVILE DES ENTREPRISES					
ASSURANCE DES CHANTIERS « TOUS RISQUES »					
RISQUES D'INSTALLATION « TOUS RISQUES »					

L'ASSUREUR CONVIENT DE DONNER UN PRÉAVIS DE TRENTE JOURS AU CONSEIL NATIONAL DE RECHERCHES CANADA EN CAS DE TOUTE MODIFICATION VISANT LA GARANTIE D'ASSURANCE OU LES CONDITIONS OU DE L'ANNULATION DE N'IMPORTE QUELLE POLICE OU GARANTIE QUI FONT PARTIE INTÉGRANTE DU CONTRAT.

NOM DU CADRE OU DE LA PERSONNE AUTORISÉE	SIGNATURE	DATE :
		NUMÉRO DE TÉLÉPHONE :



CGC1 Obligation de fournir une garantie de contrat

- 1.1 L'Entrepreneur doit, à ses propres frais, fournir une ou plusieurs des garanties de contrat mentionnées à l'article CGC2.
- 1.2 L'Entrepreneur doit fournir au représentant ministériel la garantie de contrat mentionnée au paragraphe CGC1.1 dans les 14 jours suivant la date à laquelle l'Entrepreneur reçoit un avis lui signifiant l'acceptation de sa soumission par Sa Majesté.

CGC2 Types et montants acceptables de garanties de contrat

- 2.1 L'Entrepreneur fournit au représentant ministériel conformément à l'article CGC1 :
 - 2.1.1 un cautionnement d'exécution et un cautionnement pour le paiement de la main-d'œuvre et des matériaux, représentant chacun au moins 50% du montant payable indiqué dans les Articles de convention; ou
 - 2.1.2 un cautionnement pour le paiement de la main-d'œuvre et des matériaux, représentant au moins 50% du montant payable indiqué dans les Articles de convention, et un dépôt de garantie représentant :
 - 2.1.2.1 au moins 10% du montant indiqué dans les Articles de convention, si ce montant n'excède pas 250 000 \$; ou
 - 2.1.2.2 25 000 \$, plus 5% de la partie du montant du Contrat indiqué dans les Articles de convention qui excède 250 000 \$; ou
 - 2.1.3 un dépôt de garantie représentant le montant prescrit à l'alinéa CGC2.1.2, majoré d'un supplément représentant 10% du montant du Contrat indiqué dans les Articles de convention.
- 2.2 Le cautionnement d'exécution et le cautionnement pour le paiement de la main-d'œuvre et des matériaux mentionnés au paragraphe CGC2.1 doivent être dans une forme approuvée et provenir d'une compagnie dont les cautionnements sont acceptés par Sa Majesté.
- 2.3 Le montant maximum du dépôt de garantie requis en vertu de l'alinéa CGC2.1.2 ne doit pas excéder 250 000 \$, quel que soit le montant du Contrat indiqué dans les Articles de convention.
- 2.4 Le dépôt de garantie mentionné aux alinéas CGC2.1.2 et CGC2.1.3 consiste en :
 - 2.4.1 une lettre de change payable à l'ordre du receveur général du Canada et certifiée par une institution financière approuvée ou tirée par une institution financière approuvée sur son propre compte; ou
 - 2.4.2 des obligations du gouvernement du Canada ou des obligations garanties inconditionnellement quant au capital et aux intérêts par le gouvernement du Canada.
- 2.5 Aux fins du paragraphe CGC2.4 :



- 2.5.1 une lettre de change est un ordre inconditionnel donné par écrit par l'Entrepreneur à une institution financière agréée et obligeant ladite institution à verser, sur demande et à une certaine date, une certaine somme au receveur général du Canada ou à l'ordre de ce dernier; et
- 2.5.2 si une lettre de change est certifiée par une institution financière autre qu'une banque à charte, elle doit être accompagnée d'une lettre ou d'une attestation estampillée confirmant que l'institution financière appartient à au moins l'une des catégories mentionnées à l'alinéa CGC2.5.3 ;
- 2.5.3 une institution financière agréée est :
- 2.5.3.1 une société ou institution qui est membre de l'Association canadienne des paiements,
- 2.5.3.2 une société qui accepte des dépôts qui sont garantis par la Société d'assurance-dépôts du Canada ou la Régie de l'assurance-dépôts du Québec jusqu'au maximum permis par la loi,
- 2.5.3.3 une caisse de crédit au sens de l'alinéa 137(6)(b) de la *Loi de l'impôt sur le revenu*,
- 2.5.3.4 une société qui accepte du public des dépôts dont le remboursement est garanti par Sa Majesté du chef d'une province, ou
- 2.5.3.5 la Société canadienne des postes.
- 2.5.4 les obligations mentionnées à l'alinéa CGC2.4.2 doivent être :
- 2.5.4.1 payables au porteur ;
- 2.5.4.2 accompagnées d'un document de transfert dûment exécuté à l'ordre du receveur général du Canada, dûment exécuté et dans la forme prescrite par le Règlement concernant les obligations intérieures du Canada; ou
- 2.5.4.3 enregistrées quant au capital ou quant au capital et aux intérêts au nom du receveur général du Canada, conformément au Règlement concernant les obligations intérieures du Canada; et
- 2.5.4.4 fournies à leur valeur courante sur le marché à la date du Contrat.



Government of Canada

Gouvernement du Canada

Contract Number / Numéro du contrat

Security Classification / Classification de sécurité

unclass

SECURITY REQUIREMENTS CHECK LIST (SRCL)
LISTE DE VÉRIFICATION DES EXIGENCES RELATIVES À LA SÉCURITÉ (LVERS)

PART A - CONTRACT INFORMATION / PARTIE A - INFORMATION CONTRACTUELLE

1. Originating Government Department or Organization / Ministère ou organisme gouvernemental d'origine National Research Council
2. Branch or Directorate / Direction générale ou Direction ASPM/SAGI

3. a) Subcontract Number / Numéro du contrat de sous-traitance
3. b) Name and Address of Subcontractor / Nom et adresse du sous-traitant

4. Brief Description of Work / Brève description du travail
Replace HVAC equipment and chiller @ U66

5. a) Will the supplier require access to Controlled Goods? Le fournisseur aura-t-il accès à des marchandises contrôlées? [X] No Non [] Yes Oui

5. b) Will the supplier require access to unclassified military technical data subject to the provisions of the Technical Data Control Regulations? Le fournisseur aura-t-il accès à des données techniques militaires non classifiées qui sont assujetties aux dispositions du Règlement sur le contrôle des données techniques? [X] No Non [] Yes Oui

6. Indicate the type of access required / Indiquer le type d'accès requis

6. a) Will the supplier and its employees require access to PROTECTED and/or CLASSIFIED information or assets? Le fournisseur ainsi que les employés auront-ils accès à des renseignements ou à des biens PROTÉGÉS et/ou CLASSIFIÉS? [X] No Non [] Yes Oui

6. b) Will the supplier and its employees (e.g. cleaners, maintenance personnel) require access to restricted access areas? No access to PROTECTED and/or CLASSIFIED information or assets is permitted. Le fournisseur et ses employés (p. ex. nettoyeurs, personnel d'entretien) auront-ils accès à des zones d'accès restreintes? L'accès à des renseignements ou à des biens PROTÉGÉS et/ou CLASSIFIÉS n'est pas autorisé. [] No Non [X] Yes Oui

6. c) Is this a commercial courier or delivery requirement with no overnight storage? S'agit-il d'un contrat de messagerie ou de livraison commerciale sans entreposage de nuit? [X] No Non [] Yes Oui

7. a) Indicate the type of information that the supplier will be required to access / Indiquer le type d'information auquel le fournisseur devra avoir accès
Canada [X] NATO / OTAN [] Foreign / Étranger []

7. b) Release restrictions / Restrictions relatives à la diffusion
No release restrictions / Aucune restriction relative à la diffusion [X]
All NATO countries / Tous les pays de l'OTAN []
Not releasable / À ne pas diffuser []
Restricted to: / Limité à: Specify country(ies) / Préciser le(s) pays: []

7. c) Level of information / Niveau d'information
PROTECTED A / PROTÉGÉ A []
PROTECTED B / PROTÉGÉ B []
PROTECTED C / PROTÉGÉ C []
CONFIDENTIAL / CONFIDENTIEL []
SECRET / SECRET []
TOP SECRET / TRÈS SECRET []
TOP SECRET (SIGINT) / TRÈS SECRET (SIGINT) []
NATO UNCLASSIFIED / NATO NON CLASSIFIÉ []
NATO RESTRICTED / NATO DIFFUSION RESTREINTE []
NATO CONFIDENTIAL / NATO CONFIDENTIEL []
NATO SECRET / NATO SECRET []
COSMIC TOP SECRET / COSMIC TRÈS SECRET []
PROTECTED A / PROTÉGÉ A []
PROTECTED B / PROTÉGÉ B []
PROTECTED C / PROTÉGÉ C []
CONFIDENTIAL / CONFIDENTIEL []
SECRET / SECRET []
TOP SECRET / TRÈS SECRET []
TOP SECRET (SIGINT) / TRÈS SECRET (SIGINT) []



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Unclass

PART A (continued) / PARTIE A (suite)

8. Will the supplier require access to PROTECTED and/or CLASSIFIED COMSEC information or assets?
Le fournisseur aura-t-il accès à des renseignements ou à des biens COMSEC désignés PROTÉGÉS et/ou CLASSIFIÉS?
If Yes, indicate the level of sensitivity:
Dans l'affirmative, indiquer le niveau de sensibilité :

Form with checkboxes for No/Yes and Non/Oui, with 'No' and 'Non' selected.

9. Will the supplier require access to extremely sensitive INFOSEC information or assets?
Le fournisseur aura-t-il accès à des renseignements ou à des biens INFOSEC de nature extrêmement délicate?

Form with checkboxes for No/Yes and Non/Oui, with 'No' and 'Non' selected.

Short Title(s) of material / Titre(s) abrégé(s) du matériel :
Document Number / Numéro du document :

PART B - PERSONNEL (SUPPLIER) / PARTIE B - PERSONNEL (FOURNISSEUR)

10. a) Personnel security screening level required / Niveau de contrôle de la sécurité du personnel requis

- Grid of checkboxes for screening levels: RELIABILITY STATUS, CONFIDENTIAL, SECRET, TOP SECRET, etc.

Special comments:

Commentaires spéciaux :

NOTE: If multiple levels of screening are identified, a Security Classification Guide must be provided.

REMARQUE : Si plusieurs niveaux de contrôle de sécurité sont requis, un guide de classification de la sécurité doit être fourni.

10. b) May unscreened personnel be used for portions of the work?
Du personnel sans autorisation sécuritaire peut-il se voir confier des parties du travail?

Form with checkboxes for No/Yes and Non/Oui, with 'No' and 'Non' selected.

If Yes, will unscreened personnel be escorted?
Dans l'affirmative, le personnel en question sera-t-il escorté?

Form with checkboxes for No/Yes and Non/Oui, with 'No' and 'Non' selected.

PART C - SAFEGUARDS (SUPPLIER) / PARTIE C - MESURES DE PROTECTION (FOURNISSEUR)

INFORMATION / ASSETS / RENSEIGNEMENTS / BIENS

11. a) Will the supplier be required to receive and store PROTECTED and/or CLASSIFIED information or assets on its site or premises?
Le fournisseur sera-t-il tenu de recevoir et d'entreposer sur place des renseignements ou des biens PROTÉGÉS et/ou CLASSIFIÉS?

Form with checkboxes for No/Yes and Non/Oui, with 'No' and 'Non' selected.

11. b) Will the supplier be required to safeguard COMSEC information or assets?
Le fournisseur sera-t-il tenu de protéger des renseignements ou des biens COMSEC?

Form with checkboxes for No/Yes and Non/Oui, with 'No' and 'Non' selected.

PRODUCTION

11. c) Will the production (manufacture, and/or repair and/or modification) of PROTECTED and/or CLASSIFIED material or equipment occur at the supplier's site or premises?
Les installations du fournisseur serviront-elles à la production (fabrication et/ou réparation et/ou modification) de matériel PROTÉGÉ et/ou CLASSIFIÉ?

Form with checkboxes for No/Yes and Non/Oui, with 'No' and 'Non' selected.

INFORMATION TECHNOLOGY (IT) MEDIA / SUPPORT RELATIF À LA TECHNOLOGIE DE L'INFORMATION (TI)

11. d) Will the supplier be required to use its IT systems to electronically process, produce or store PROTECTED and/or CLASSIFIED information or data?
Le fournisseur sera-t-il tenu d'utiliser ses propres systèmes informatiques pour traiter, produire ou stocker électroniquement des renseignements ou des données PROTÉGÉS et/ou CLASSIFIÉS?

Form with checkboxes for No/Yes and Non/Oui, with 'No' and 'Non' selected.

11. e) Will there be an electronic link between the supplier's IT systems and the government department or agency?
Disposera-t-on d'un lien électronique entre le système informatique du fournisseur et celui du ministère ou de l'agence gouvernementale?

Form with checkboxes for No/Yes and Non/Oui, with 'No' and 'Non' selected.



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PART C (continued) / PARTIE C (suite)

For users completing the form manually use the summary chart below to indicate the category(ies) and level(s) of safeguarding required at the supplier's site(s) or premises.
 Les utilisateurs qui remplissent le formulaire manuellement doivent utiliser le tableau récapitulatif ci-dessous pour indiquer, pour chaque catégorie, les niveaux de sauvegarde requis aux installations du fournisseur.

For users completing the form online (via the Internet), the summary chart is automatically populated by your responses to previous questions.
 Dans le cas des utilisateurs qui remplissent le formulaire en ligne (par Internet), les réponses aux questions précédentes sont automatiquement saisies dans le tableau récapitulatif.

SUMMARY CHART / TABLEAU RÉCAPITULATIF

Category / Catégorie	PROTECTED / PROTÉGÉ			CLASSIFIED / CLASSIFIÉ			NATO				COMSEC					
	A	B	C	CONFIDENTIAL	SECRET	TOP SECRET	NATO RESTRICTED	NATO CONFIDENTIAL	NATO SECRET	COSMIC TOP SECRET	PROTECTED / PROTÉGÉ			CONFIDENTIAL	SECRET	TOP SECRET
				CONFIDENTIAL		TRÈS SECRET	NATO DIFFUSION RESTREINTE	NATO CONFIDENTIEL		COSMIC TRÈS SECRET	A	B	C	CONFIDENTIEL		TRÈS SECRET
Information / Assets / Renseignements / Biens / Production	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
IT Media / Support TI	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
IT Link / Lien électronique	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

12. a) Is the description of the work contained within this SRCL PROTECTED and/or CLASSIFIED?
 La description du travail visé par la présente LVERS est-elle de nature PROTÉGÉE et/ou CLASSIFIÉE? No / Non Yes / Oui

If Yes, classify this form by annotating the top and bottom in the area entitled "Security Classification".
 Dans l'affirmative, classifiez le présent formulaire en indiquant le niveau de sécurité dans la case intitulée « Classification de sécurité » au haut et au bas du formulaire.

12. b) Will the documentation attached to this SRCL be PROTECTED and/or CLASSIFIED?
 La documentation associée à la présente LVERS sera-t-elle PROTÉGÉE et/ou CLASSIFIÉE? No / Non Yes / Oui

If Yes, classify this form by annotating the top and bottom in the area entitled "Security Classification" and indicate with attachments (e.g. SECRET with Attachments).
 Dans l'affirmative, classifiez le présent formulaire en indiquant le niveau de sécurité dans la case intitulée « Classification de sécurité » au haut et au bas du formulaire et indiquez qu'il y a des pièces jointes (p. ex. SECRET avec des pièces jointes).



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PART D - AUTHORIZATION / PARTIE D - AUTORISATION

13. Organization Project Authority / Chargé de projet de l'organisme

Name (print) - Nom (en lettres moulées) Derek Foot	Title - Titre Construction Project Manager	Signature
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Telephone No. - N° de téléphone 613-991-4451	Facsimile No. - N° de télécopieur	E-mail address - Adresse courriel derek.foot@nrc.gc.ca	Date January 12, 2017
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14. Organization Security Authority / Responsable de la sécurité de l'organisme

Name (print) - Nom (en lettres moulées) Richard Bramucci	Analyst, Security in Contracting Analyste, Sécurité des contrats	Signature
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Telephone No. - N° de téléphone (613) 991-1093	Facsimile No. - N° de télécopieur (613) 990-0946	E-mail address - Adresse courriel BRAMUCCI@NRC.CA	Date
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15. Are there additional instructions (e.g. Security Guide, Security Classification Guide) attached?
Des instructions supplémentaires (p. ex. Guide de sécurité, Guide de classification de la sécurité) sont-elles jointes?

JAN 20 2017 Non Yes / Oui

16. Procurement Officer / Agent d'approvisionnement

Name (print) - Nom (en lettres moulées) Collin Long	Title - Titre Procurement Officer	Signature
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Telephone No. - N° de téléphone 613-993-0431	Facsimile No. - N° de télécopieur	E-mail address - Adresse courriel collin.long@nrc-cnrc.gc.ca	Date Feb. 7, 2017
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17. Contracting Security Authority / Autorité contractante en matière de sécurité

Name (print) - Nom (en lettres moulées)	Title - Titre	Signature
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Telephone No. - N° de téléphone	Facsimile No. - N° de télécopieur	E-mail address - Adresse courriel	Date
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