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Construction Management Services **TERMS OF REFERENCE**

Resolute Program of Work

For
**Polar Continental Shelf Program
Complex
Resolute, Nunavut**

September 30, 2015

MHPM doc 830498-0009(1.0)



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1. PROJECT DESCRIPTION

1.1 GENERAL

1.1.1 PURPOSE

- .1 These Terms of Reference (TOR) have been developed to engage the services of a Construction Manager (CM) to provide advisory and general contractor and support services for the Resolute Program of Work for various buildings and to ensure that the CM has a clear understanding of the project scope, procedures and performance requirements.
- .2 The TOR describes project specific requirements, services and deliverables for the construction management of the Resolute Program of Work for various buildings.

1.1.2 THE PWGSC GENERAL PROCEDURES AND STANDARDS DOCUMENT (GP&S) FOR CM SERVICES

- .1 The TOR document must be used in conjunction with the GP&S, as the two documents are complementary.
- .2 The TOR describes project-specific requirements, services and deliverables while the GP&S document outlines minimum standards and procedures common to all projects.
- .3 In the case of a conflict between the two documents, the requirements of the TOR override the GP&S Document.

1.1.3 PROJECT INFORMATION

Project Information	
Project Title:	Resolute Program of Work
Project Location:	Resolute, NU
PWGSC Project Number:	R.076692.001
NRCan Project Leader	To be announced
PWGSC Project Manager:	To be announced
Project Management Support Services (PMSS) Project Manager:	To be announced

1.2 BACKGROUND INFORMATION

1.2.1 NEED AND GOALS

- .1 National Resources Canada has a need to complete a number of upgrade projects at the Polar Continental Shelf Program complex in Resolute, NU. The second northern most community in Canada, Resolute Bay is located in the High Arctic on the south coast of Cornwallis Island. The gateway to the High Arctic, Resolute Bay is the major stopover for expeditions to the North Pole and to Quttinirtdaaq (Ellesmere Island) National Park, and a base for scientific research. The projects, grouped by building and discipline are noted below. Note that any project may require some level of multi-disciplinary input.



- .1 Sub-Project #01 - Multiple Buildings Alarm Systems and Detection:
 - .1 The existing fire alarm systems and devices in buildings XR-03 PCSP Operations Centre Building & XR-14 CFATC Operations Centre shall be upgraded to address the current life safety requirements for these buildings.
 - .2 Carbon monoxide detectors are to be installed in all accommodation rooms of buildings XR-02 Old Accommodations Building, XR-12 ARIF Kitchen and Dining Complex, and XR-15 CFATC Accommodations Building, and are to be tied into the respective fire alarm panels for these buildings.
- .2 Sub-Project #02 - XR-02 Old Accommodations Building Mechanical:
 - .1 XR-02: Replace stacks and breaching:
 - .1 The existing three fuel oil fired air handling units, Furnaces FU-1 & 2 and (exhaust fans') associated stacks and forced draft breaching require replacement. This replacement needs to be assessed as part of assessment to replace air handling units, Furnaces FU-1 & 2 and exhaust fans in accommodation building.
 - .2 XR-02: Ventilation fans - Replace exhaust fans:
 - .1 Consider replacement of the eleven (11) original exhaust fans serving the washrooms and storage areas of the building. Evaluate the existing conditions and provide optimum mechanical and electrical design solutions.
 - .3 XR-02: Furnaces and Water Heaters:
 - .1 The existing three fuel oil fired air handling units, water heaters (2) and Furnaces FU-1 & 2, of the Accommodation building require replacement. The consultant needs to assess Furnace Condition and control options of FU-3 to verify whether the replacement of FU-3 is necessary or not.
 - .2 Ensure the electrical power requirement support new design.
 - .4 XR-02: Controls:
 - .1 The existing control system has become problematic for operations and maintenance staff due to its' complexity. The project need is to replace the existing system with a simpler and more user friendly system. The new system shall be compatible and connected with existing building automatic control system components. Analyze the site existing conditions (electrical & mechanical) and provide the suitable design solution for a new system.
- .3 Sub-Project #03 - XR-02 Old Accommodations Building Electrical:
 - .1 XR-02: Replace Secondary Switchgear and Distribution Panels,
 - .1 The Existing Electrical System shall be replaced. The consultant is to analyse the current power requirement for the client, make provisions for the future needs and future growth and design a New Electrical Distribution System including the main switchgear with new breakers for sub panels. This also includes but is not limited to:



- .1 The main switchgear with new breakers for sub panels,
 - .2 The replacement of the 9 distribution panels throughout the building complete with Arc Fault Interrupting breakers on all bedroom circuits,
 - .3 Automatic transfer Switch Replacement (ATS) for 50 kW APU,
 - .4 All relative as-built drawings for XR-02 Old Accommodations Building is to be updated,
 - .5 Provide an updated electrical line diagram, drawings and panel schedules. 2 hard copies and 1 electronic copy are to be provided to the client,
- .4 Sub-Project #04 Waste Incinerator: Design location and Infrastructure:
- .1 An incinerator has been deemed the most suitable waste management option for the Resolute Facility. A study by RMC has determined the most suitable incinerator: ECO-Mobile, ECO M2TN (see Appendix). The goal is to design, develop and construct a suitable location with all required infrastructure for the installation of the incinerator of choice which is to be purchased separately.
- .5 Sub-Project #05 - XR-03 PCSP Operations Centre Building Mechanical:
- .1 XR-03: Controls - Replace electric controls:
 - .1 The associated control system for the HVAC replacement within the PCS Operations Center building requires upgrade. (Refer to Replace AHU's and Furnace, below, for more information)
 - .2 Provide Electronic Control design suitable for the digital control of building systems.
 - .2 XR-03: Replace stacks and breaching:
 - .1 There are two (2) existing air handling units, Five (5) Exhaust/relief fans; and Four (4) oil fired furnaces have reached end of their life cycle and require replacement. Consequently, their stack and breaching require replacement as well. One abandoned chimney to be removed (having served old water heater since removed).
 - .2 This replacement needs to be assessing as part of HVAC upgrade/replacement of the XR-03 PCSP Operations Center building. (Refer to Replace AHU's, water heaters and Furnace, below, for more information)
 - .3 XR-03: Replace air handling units and furnaces:
 - .1 There are two (2) existing air handling units, five (5) Exhaust/relief fans; and four (4) oil fired furnaces which have reached the end of their life cycle and require replacement. Heating loads need to be re-assessed due to building changes since original construction.
- .6 Sub-Project #06 - XR-03 PCSP Operations Centre Building Electrical:



- .1 XR-03: Electrical Upgrade to meet Health & Safety requirements for aircraft taxi area adjacent to building XR-03. This is an immediate need and must provide for:
 - .1 Power distribution, incorporated into new bollards, for the apron area for the various aircrafts on the tarmac facing the north side of the XR-03 and XR-14 Warehouse buildings;
 - .2 Three fixed high visibility finished bollards (corrosion resistant substrate and coating), reflective banding, and top mounted obstruction light, include wind sock accessory on centre bollard;
 - .3 2 x120V /20amp GFCI outdoor power outlets with weatherproof covers per bollard;
 - .4 Trenching of the electrical cables from the exterior of XR-03 office building for the electrical distribution system to the area of bollard installation (Estimated distance of trenching to each bollard is approximately 50 meters);
 - .5 Prevent bollard displacement considering permafrost in an arctic environment.
 - .6 Complete surveying and re-grading after bollard installation for improvement in site grading and surface conditions. Consider cost/benefit for overlay of 100mm crushed and compacted aggregate.
 - .7 Provide 2 hard copies and 1 electronic copy of the survey for the client.
 - .8 XR-14 and/or XR-03 electrical as-builts are to be updated to reflect the additions to the electrical distribution system.
 - .9 Provide 2 hard copies and 1 electronic copy of the as-builts for the client.

- .7 Sub-Project #07 - XR-03 PCSP Operations Centre Building Partial Roof:
 - .1 XR-03: Partial Roof Replacement and Wall Sealing/Flashing:
 - .1 The office area was an addition to this building; its roof requires replacement.
 - .2 Flashings and sealing related to the connections to the original building, the roof drip area and the windows must also be addressed in this sub-project.

- .8 Sub-Project #08 - XR-12 ARIF Kitchen and Dining Complex:
 - .1 XR-12: Addition at Loading Dock and Cold Storage:
 - .1 Existing XR 12 loading dock area requires optimization. It is proposed to incorporate an enclosed building addition with three overhead doors and additional walk in freezer storage, located on the West side of this structure adjacent the existing water tank building. Two of the smaller loading dock overhead doors are to provide access to the loading dock for loading and unloading of material and to provide a sheltered and heated area on the



loading dock for order processing. The larger of the overhead doors on the east side of the new enclosure is to provide a ground level drive in to a storage area within the sheltered, unheated section of the enclosure to house the facility garbage truck. This area may be able to be supported on grade as long as the permafrost is not affected. Significant environmental separations will be required including foundation systems which are not detrimental to permafrost.

- .2 Provide all required consultant services to confirm and develop an appropriate design taking into account the existing building and site. Please see the Appendix for a possible concept sketch.
 - .3 Ensure that foundation and structural design are fully coordinated with optimized for site conditions, including permafrost, and existing construction. Note that many arctic site buildings have experienced foundation and slab settlements due to melting of permafrost, in winter, by high heat in buildings and garages. Investigate the existing structures and foundation and determine if there are any structural issues. If not, use the similar structures for the new building addition. If there are structural problems, analyse and provide structural solutions. Options such as Thermosyphons and ventilated floor (air flow thru/under) can be considered.
 - .4 Site design may require rework of existing roadway and drainage, as well as possible parking areas. Confirm with Departmental Representative the requirement for parking stalls and outlet plugs.
 - .5 Design to include signage and any other related features.
- .9 Sub-Project #09 - XR-15 CFATC Accommodations Building:
- .1 Project 10111 Cooling System for XR 15:
 - .1 The intent is to provide a cooling system for server and telecommunication rooms (122 and 201) to ensure the Telecommunication, and HF Radio and computer will maintain 20°C and 25°C temperature. The consultant is to assess and advise of options including passive systems as well as ensure that the electrical power systems will be able to reliably support any mechanical cooling system. Room areas are approximately 11 m² (122) and 15 m² (201).

1.2.2 USER DEPARTMENT

- .1 The User Department referred to throughout the TOR is Polar Continental Shelf program (PCSP).
- .2 The Polar Continental Shelf Program (PCSP) is an organization within Natural Resources Canada who provides logistical support to over 1100 Canadian Arctic researchers annually. The overall goal of the PCSP is to provide safe, efficient and



cost-effective logistical support to researchers from government, non-government and foreign organizations conducting field work throughout the Canadian Arctic.

.3 Mission:

- .1 PCSP supports the responsible development of Canada's resources in a manner that advances the country's global standing as a leader on the environment, and uses its knowledge and expertise of Canada's landmass to support the safety and security of citizens.
- .2 PCSP seeks to improve the quality of life of Canadians through creation of a sustainable resource advantage by working to improve the competitiveness of the natural resource sectors and to grow their contribution to Canada's economy.
- .3 To deliver on its responsibilities, PCSP relies on science and technology to help address priorities and to plan for the future. It develops policies, programs, and regulations that help create a sustainable resource advantage, supporting strong, competitive natural resource sectors that are environmentally and socially responsible.
- .4 More broadly, the Department plays a critical role in Canada's future, contributing to high-paying jobs, business investment and overall economic growth in Canada's natural resource sectors.

1.2.3 EXISTING CONDITIONS

- .1 The main characteristics of the site are: remote, varied and with extreme climate challenges.
- .2 A summary of existing conditions for each project are noted below:
 - .1 Fire Alarm and Detection Systems – Multiple Buildings
 - .1 Current systems are observed to be non-compliant with latest Codes to varying degrees in terms of reliability, operability and compatibility. More detailed investigation is required and reasonable upgrades proposed.
 - .2 XR-02 Old Living Accommodations:
 - .1 XR-02: Stacks & Breaching:
 - .1 The associated stack and breaching require replacement due to age and serviceability.
 - .2 (Refer to item 1.2.3.2.2.2 and 1.2.3.2.2.3 for more information)
 - .2 XR-02: Replace ventilation fans:
 - .1 The ventilation fans consist of eleven (11) exhaust fans serving the washrooms and storage areas of the building. These components are also original to the building, are in poor condition and require replacement.
 - .3 XR-02: Replace air handling units, water heaters and furnaces:
 - .1 There are three fuel oil fired air handling units located within the accommodation building that are original to the building. Each of these has reached the end of its life cycle and requires replacement. In addition, there are three (3) Furnaces FU-1, FU-2 and FU-3 within the building. FU-1 and FU-2 are original to the building and require



replacement; FU-3 was replaced but needs assessment for current condition and controls. In addition the FU-1& FU-2 associated stack and breaching require replacement.

- .4 XR-02: Controls:
 - .1 The Honeywell control system that serve the air handling units, furnaces, exhaust fans, and fuel oil pumps are based on electromechanical relays. In addition, there is a control monitoring and alarm system for the building.
 - .2 The existing control system is overly complex for operations staff on site and should ideally be replaced with a simpler and user friendly that can be operated and maintained by on site staff. The new control system must be tied into the existing Les Control A.C. BAS system that is located in the manager's office, Room 117 of XR-12 ARIF Kitchen & Dining Building. (Appendix)
- .5 XR-02: Replace Secondary Switchgear, ATS and Distribution Panels:
 - .1 The existing Electrical Distribution System has reached the industry recommended life expectancy for providing the quality power for the client. The system efficiency has been compromised, the losses on wiring and transformers, and harmonics is questionable to ensure a reliable power supply. Existing Grounding impedance is another safety factor that must be investigated.
- .6 XR-02: Facility waste management:
 - .1 Waste management is problematic in these types of locations. An incinerator has been deemed to provide an adequate solution. An incinerator unit has been selected and will be purchased separately; an appropriate location and required infrastructure needs to be determined and developed.
- .3 XR-03 PCSP Operations Centre Building
 - .1 XR-03: Air Handling Unit and Furnace Replacement:
 - .1 There are two existing air handling units, Five (5) exhaust/relief fans within XR-03 Operations Centre Warehouse, which are in poor condition and require replacement. Also, there are five (5) Exhaust fans and two return fans that are in poor condition and require replacement. The exhaust fans serve the garage, parts room, washroom, and storage rooms. The two return fans serve the space between the insulated exterior wall and the inner gypsum board walls; all units to be located to one half of the existing space along with the furnaces as per .3 below.
 - .2 There are four, (4) oil fired furnaces located in the 1st floor mechanical room which supply air to the main floor and second floor offices as well as the mechanical room. These furnaces are original to the building and require replacement, while reducing from four (4) to two (2) furnaces relocated as per .3 below.
 - .3 Included in the replacement is a necessary redesign of the existing mechanical room furnace placement, related fuel delivery system and



- all AHU components, in order to minimize space usage required for the mechanical equipment, and accommodate the future creation of a small carpentry workshop from one half of the existing mechanical room. The actual carpentry shop design is not part of this project.
- .2 XR-03: Stack and breaching replacement:
 - .1 The associated stack and breaching are beyond service life and require replacement.
 - .3 XR-03: Replace electric controls:
 - .1 The control systems that serve the air handling units, furnaces, and exhaust fans, of the XR-03 Operations Centre Warehouse require replacement.
 - .2 The new control system must be tied into the existing Les Control A.C. BAS system that is located in the manager's office, Room 117 of XR-12 ARIF Kitchen & Dining Building.
 - .4 XR-03: Electrical Upgrade to meet Health & Safety requirements for the macadam aircraft taxi area adjacent to building XR-03 (immediate need):
 - .1 The main 120/208 volt 3 phase 4 wire distribution for the building is fed from a pole mounted transformer to a 600 amp main distribution board. The main switchgear is square D and is located in electrical room 144 of XR-14 ATC Operations Centre Warehouse.
 - .2 Existing electrical system distribution does not meet the present requirements of the client. Some of the areas of the ramp facing the north side of the XR-03 and XR-14 Warehouse buildings do not have safe and proper access to electrical power for the various aircraft stationed on the apron; some outdoor power outlets and power installation will be required.
 - .3 Verify the power capacity of the existing distribution system and the impedance of the grounding system to ensure safety
 - .5 XR-03: Office Area Roof and Wall:
 - .1 The office area was an addition to this building; connections between these structures and the addition itself are problematic, including the small addition roof, the addition roof edge condition, the adjacent flashings and closures to the original building and the window flashings .
 - .2 Flashing and caulking at the lower roof over the entrance need replacement with a better system between the wall and torch on roof.
 - .3 The entire roof line above the lean-to offices needs better drip edge flashing or an interceptor flashing like heavy duty eaves-trough to keep melt water from the roof wicking into the many seams, siding profile corrugations and screw heads on the exposed wall.
 - .4 XR-12: ARIF Kitchen and Dining Complex:
 - .1 Existing loading dock facilities are deficient in terms of providing appropriate enclosed delivery of goods and waste handling,
 - .2 There is a shortage of freezer storage space,



- .3 Existing loading dock and bollards will need to be salvaged and re-used or surplus,
 - .4 Existing Tank Room access door and adjacent ventilation hoods (and related ductwork) will need to be relocated to maintain current functions,
 - .5 Existing foundation and structure will need to be reviewed.
- .5 XR-15 CFATC Accommodations Building:
- .1 Cooling is necessary for existing server/communications rooms to ensure operations are not compromised.
 - .2 Telecommunication, and HF Radio Equipment Rooms, rooms 122 and 201 of the accommodation building contain telecommunications; computer equipments, and HF Radio equipment.
 - .3 These equipment need to be maintained within 20°C and 25°C temperature range at all times.
 - .4 There are 2 boilers in room 121 below the HF Radio room which also may add somewhat of a heat load to room 201.
 - .5 Passive systems may be feasible and should be reviewed.
- .3 Please refer to additional documentation available as indicated in the Appendices and the Supplemental Information section.

1.2.4 STRATEGY

- .1 This Terms of Reference is comprised of a number of upgrade work items, some of which are unrelated other than location.
- .2 A Consultant will be required to begin design on the work items immediately, in a priority sequence determined in conjunction with the Construction Manager, so that tendering of the packages, and consequently construction, may start as soon as possible.
- .3 The Construction Manager (CM) selected via this TOR will manage the tendering and construction of each of the tender packages

1.2.5 PROJECT CONSTRAINTS AND CHALLENGES

- .1 The Construction Manager will be required to become familiar with the remote project site and obtain local information as required.
- .2 Time and quality control are of the essence with this project.
 - .1 The work must be substantially complete on or before February 28, 2017.
- .3 All site visits must be arranged through the Departmental Representative.
- .4 The work will be carried out, when the facility is fully occupied and operational.
- .5 Subject to further clarification by the User Department, the construction on the project site will mostly be performed during normal working hours while the facilities are in full operation. Project phasing must be planned to ensure that disruption to the daily operation of the facilities is kept to a minimum, acknowledging that there will be some shutdowns required (with appropriate notice).
- .6 The site is typically closed from mid-September to January each year. The building temperatures are maintained at a minimum to preserve the asset but services are not intended to support occupants during that time.



- .7 Environmental conditions must be kept under control during all phases of the work.
- .8 Material disposal must be in accordance with the guidelines of the Hamlet of Resolute. All hazardous materials or other materials which cannot be disposed of locally must be retrograded to a qualified southern facility for proper recycling or disposal
- .9 The work items must be constructed and be substantially as noted in the Project Milestone List.
- .10 The project scope must be tailored to meet the User Department's budget. Diligent cost estimating and cost control is required.
- .11 Explore options for best value for dollar considering life cycle costs and Government of Canada's desire for increased sustainability.
- .12 Provide for financial accounting of each of the identified work items separately to PWGSC.
- .13 The Design team and the Construction Manager are tasked to accelerate the implementation of the program to the extent possible and if possible exceed the indicated schedules.
- .14 Provision of labour is limited to available local sources and that which can be brought in by the limited air and sea travel facilities.
- .15 Provision of materials is restricted to that which can be brought in by the limited air service and seasonal shipping facilities.

1.3 **PROJECT DELIVERY APPROACH**

1.3.1 **PROJECT DELIVERY OBJECTIVES AND REQUISITE**

- .1 Under this project delivery approach, responsibility of the CM shall include advisory, support services and General Contractor (GC) work.
 - .1 The primary reason for this approach is that a Construction Manager (CM) will provide PWGSC with valuable construction advice and the flexibility to implement and coordinate multiple projects and sub-projects and phases and expedite the schedule of completion of the work.
 - .2 Having one construction manager to oversee all sub-projects on this project provides advantages of coordination, quality assurance, efficiency and scale.



- .2 The CM shall provide;
 - .1 Construction management services throughout the project phases and demonstrate leadership,
 - .2 Delivery of the project according to the Project Milestones and within the approved budget and on scope,
 - .3 A continuous risk management program to address the risks associated with designing and renovating occupied facilities,
 - .4 A quality management plan that includes quality reviews on a construction management project delivery approach, and
 - .5 Contingency plans to mitigate potential delays arising from logistic and weather related challenges.
 - .6 Ensure co-ordination of services with other consultants/contractors hired by PWGSC.
 - .1 A third party commissioning agent will be retained by the design consultant. The agent will lead commissioning activities. CM to provide support as required.

1.3.2 DESIGN PHASES

- .1 For the design phases of this Project, an Architectural or Engineering firm (referred to herein as the Consultant) is being engaged to complete the design and will direct and co-ordinate all phases of the design work for this Project.
- .2 During design phase,
 - .1 Architectural and Engineering services including all cross discipline coordination work will be provided by the Consultant Team.
 - .2 The CM shall provide advisory and support services to the design team and provide quality reviews on the constructability of proposed designs and tender packages. Written comments shall be submitted before any construction work begins.
- .3 Hazardous material abatement (if required):
 - .1 Engage a Hazardous Abatement Professional consultant to develop tender documents for the hazardous material abatement and make ready the site for the new Work.
 - .1 Utilize industry standard client (CM)-consultant (Hazardous Abatement) agreement providing full services.
 - .2 Hazardous Abatement Professional consultant is to provide advisory services to the project delivery team.
 - .1 Develop the abatement scope of work,
 - .2 Evaluate the impact of hazardous material abatement against the merits of design options developed by the Consultant Team.
- .4 The Consultant Team will work closely with the CM to develop the design and ensure that all information is made available to the CM. The CM shall provide advice on:
 - .1 Construction costs;
 - .2 Material delivery & construction schedules;
 - .3 Constructability;
 - .4 Suitability and availability of materials and components; and



- .5 Sustainable design, construction, and operation principles and practices.
- .6 Commissioning activities.

1.3.3 CONSTRUCTION PHASE

- .1 The CM shall provide services as the General Contractor during the construction phase of the project.
 - .1 The CM shall provide the Crown with flexibility to implement and coordinate multiple tender packages, and phases and shall expedite the schedule of completion of the Work.
 - .2 The CM shall oversee all construction tender packages on the building site and provide coordination, quality assurance and efficiency.
 - .3 The CM, in consultation with the Consultant Team and Departmental Representative, will help determine the number of tender packages required for the project. This is to enable the Consultant Team to prepare the tender packages in a timely manner and ensure full co-ordination of the work of all disciplines.

1.3.4 WORK PACKAGES

- .1 There are 9 sub-projects that will be delivered using multiple tender packages. These work items will be grouped into tender packages as determined by the Departmental Representative, Construction Manager and Design Consultant. It is anticipated that 10 to 16 separate tender packages will be required for this project with the possible addition of a hazardous material abatement project.

1.4 SUMMARY OF PERSONNEL AND QUALIFICATIONS

1.4.1 GENERAL

- .1 The CM shall provide a Construction Management team with the following specialists/ subject matter experts:
 - .1 Risk Management Specialist;
 - .2 Schedule Management Specialist;
 - .3 Budgeting Specialist;
 - .4 Waste Management Specialist;
 - .5 Quantity Surveying Specialist;
 - .6 Commissioning Process Manager;
 - .7 Hazardous Abatement Consultant;
 - .8 Construction Project Manager;
 - .9 Construction Site Superintendent;
 - .10 Construction Quality Management Specialist.
- .2 The CM shall report directly to the PWGSC Departmental Representative.

1.5 PROJECT SCHEDULE

1.5.1 GENERAL

- .1 Time is of the essence. Project is required to be substantially complete, commissioned and ready for occupancy in accordance with the Project Milestone List identified below.



- .2 Completion dates shown are relative to an assumed start date of January, 2016 for the CM scope of work.
- .3 Prepare a Project Schedule, in accordance with the milestone list.

1.5.2 PROJECT MILESTONE LIST

Project Phase	Milestone Completion Date
CM Contract Award	January 2015
Preliminary Design	On-going as needed per package
66% Design	On-going as needed per package
100% Design	On-going as needed per package
Construction Documents	On-going as needed per package
Final Construction Documents	On-going as needed per package
Construction Start	On-going as needed per package
Substantial Completion of Construction	March 2017
Commissioning , Final Inspection and Acceptance	May 2017
Post Construction Warranty Evaluation	February 2018

1.6 PROJECT BUDGET

1.6.1 ESTIMATED CONSTRUCTION COSTS

- .1 The maximum construction budget (excluding GST) for the project is **\$2,200,000**.
 - .1 The construction cost estimates do not include Administration costs; Project Management fees; Design Consultant or Risk Allowance.
 - .2 The construction cost estimate is in 'Budget-Year (Current)' dollars and it includes General Contractor Services and an allowance for escalation and contingencies.
- .2 Appendix A includes details on the work items in the project.
- .3 The Crown will not accept scope creep or cost escalation of selected Proponent's proposal, except in the limited situations as stipulated in the terms of the contract.

1.6.2 CASH FLOW

- .1 It is anticipated that the cash flow expenditures will be:
 - .1 \$300,000 for Fiscal Year 2015/2016;
 - .2 \$1,900,000 for Fiscal Year 2016/2017.

1.7 EXISTING DOCUMENTATION

1.7.1 DISCLAIMER

- .1 Reference information will be available in the language in which it is written.
- .2 Construction tender documents, as prepared by the Consultant are for reference only. This Request for Proposal is for construction management services.



1.7.2 DOCUMENTS AVAILABLE TO THE SUCCESSFUL PROPONENT IN ENGLISH ONLY;

- .1 Copies of all pertinent documentation will be made available to the successful CM.
- .2 In addition to information in the Appendices, limited as-built drawings and Operation & Maintenance Manuals will be available. CM will be responsible for verifying the accuracy of the information incorporated into the design.
- .3 The Consultant will be provided with AutoCAD scaled floor plans of XR-12 Kitchen and Dining Building and PDF's or AutoCAD drawings of the other buildings and site.

1.8 CODES, ACTS, STANDARDS, GUIDELINES AND REGULATIONS

1.8.1 GENERAL

- .1 A listing of Codes, Acts, Standards and Guidelines applicable to this project are referenced in the Consultant's TOR document.
- .2 The Authorities Having Jurisdiction (AHJ) on this project are:
 - .1 The local AHJs;
 - .2 Treasury Board of Canada– as engaged through the Departmental Representative.
- .3 The CM must identify, analyze and manage the construction of the project in accordance with the requirements of all AHJs and all applicable Codes, Acts, Standards and Guidelines and Legislation.
 - .1 The applicability of various Codes, Acts, Standards and Guidelines listed in the Consultant's TOR document arise out of direct and indirect references in documents which apply to Federal buildings, such as the Canada Labour Code.
- .4 The CM team must be fully versed with the legislation and requirements that are unique to Federal Government projects tendered through Public Works & Government Services Canada.



2. REQUIRED SERVICES

2.1 GENERAL REQUIREMENTS

2.1.1 GENERAL

- .1 The CM, in consultation the Departmental Representative shall:
 - .1 Perform the role of CM for the Project respecting the approved scope, quality, budget and schedule; and
 - .2 Develop partnership and communication between all members of the project delivery team and stakeholders throughout all phases of the project life.
- .2 All Services and duties listed and allocated to the CM throughout the Required Services section are:
 - .1 The full responsibility of the CM; and
 - .2 Are not exhaustive and do not preclude alternative or supplementary approaches as may be suggested by the CM for consideration by the Departmental Representative and vice versa.

2.1.2 SECURITY CLEARANCES

- .1 Personnel employed on this project may be subject to security check.
 - .1 Depending on the time of work and access required, personnel working on site may be escorted to provide the required access.

2.1.3 SUMMARY OF SERVICES

- .1 Level of effort associated with the Required Services will vary as per the project delivery life cycle (simplified) diagram below.



- .2
- .3 Services required for this project as follows:
 - .1 Provided as required in Advisory Support Services or Construction Support Services;
 - .1 Scope Management Services,
 - .2 Cost Management Services,
 - .3 Schedule Management Services,
 - .4 Risk Management Services,
 - .5 Quality Management Services,
 - .6 Hazardous Abatement Services,
 - .7 Cost Control Services,
 - .8 Schedule Control Services,
 - .9 Risk Control Services,
 - .10 Quality Control Services,
 - .11 Commissioning Services,
 - .12 CM Tendering Services,



- .13 CM General Contractor Services, and
- .14 CM General Construction and Contract Administration Services.

2.2 **ADVISORY SUPPORT SERVICES**

2.2.1 **GENERAL**

- .1 The CM, as expert in matters of construction, counsels PWGSC and the Consultant Team by providing advisory and support services throughout the design and construction phases of the project.
- .2 Consider mitigating potential risk to the project schedule by advance tendering Hazardous Material Abatement prior to delivering on new work results.

2.2.2 **SCOPE AND ACTIVITIES**

- .1 The CM shall:
 - .1 Analyze and become familiar with all the Project background documents and reports;
 - .2 Review site conditions, with respect to technical and implementation issues affecting this project;
 - .3 Review the program for all potential tender packages included in the project;
 - .4 Prepare a construction schedule;
 - .5 Develop a list of recommended construction trades and tender packages;
 - .6 Prepare estimates for each tender package;
 - .7 Prepare a detailed construction budget;
 - .8 Participate in all integrated design sessions and provide advice on;
 - .1 Constructability of the design and details contained in the contract documents,
 - .2 Scheduling of the Work, and
 - .3 Costing, pricing and bid suitability.
 - .9 Assist in providing liaison and coordination with Government Authorities for various reviews and approvals;
 - .10 Develop and maintain the Project Procedures Manual (PPM) and all documents triggered by the PPM;
 - .11 Advise on construction related matters for the Departmental Representative, the User Department, the Consultant Team and members of the CM's Project Delivery Team;
 - .12 Coordinate participation of Hazardous Material Abatement consultant in IDP workshops.
 - .13 Prepare and submit a report on the impact of Hazardous Material Abatement on new work items.
 - .14 Effective control measures and management of;
 - .1 Project costs and expenditures,
 - .2 Project schedule and progress,
 - .3 Scope & quality of the Work,
 - .4 Change management and change order control, and
 - .5 Risk management and claims avoidance.
 - .15 Mitigate potential conflict and overlap, with respect to;
 - .1 The design services performed by the Consultant Team, and



- .2 The work to be performed by the various Sub-Trades.
- .16 Provide quality control methodologies with respect to;
 - .1 Availability and cost comparisons of construction materials,
 - .2 Methods of construction and constructability,
 - .3 Scope and quality of construction materials and systems,
 - .4 Alternative approaches to completing the Work,
 - .5 Risk Management,
 - .6 Life Cycle Cost analysis,
 - .7 Sustainability, and
 - .8 Value Engineering.
- .17 Develop procurement strategies and construction implementation phasing;
- .18 Determine appropriate construction tender packages;
- .19 Determine the potential impact to the Project of applicable labour conditions and availability of materials;
- .20 Advise on the preparation of a Commissioning Plan and Schedules for commissioning of all operating building components, systems and integrated systems at the appropriate phases of construction, so as to ensure coordinated, effective and efficient building operation (in conformance with the Commissioning Process);
- .21 Obtain and administer project guarantees Warrantees and manufacturer's guarantees; and
- .22 Provide advice on methods of construction as may be required from time to time by the Consultant Team.
- .2 The above listing of Services is neither complete nor exhaustive and the full scope of Advisory Services required shall include the entire content of the TOR, in concert with the terms and General Conditions of the Contract.

2.2.3 DOCUMENT DELIVERABLES

- .1 Project Procedures Manual
 - .1 The CM shall develop a Project Procedures Manual in consultation with the Departmental Representative for the execution of Project activities.
 - .2 The Manual will provide a description of procedures, roles, responsibilities, levels of authority and the documentation for the execution of the Project, including details of the processes and sample outlines.
 - .3 The Manual will include the process and methods to:
 - .1 Maintain Project records;
 - .2 Implement a quality assurance program;
 - .3 Prepare, update, monitor and maintain the Master Schedule;
 - .4 Update, monitor and maintain the Cost Plan, Progress Payments, Change Orders and Cash Flow;
 - .5 Manage communications as directed by the Departmental Representative between Project Delivery Team participants based upon the documented roles, responsibilities and authority of Team members, and maintain a listing of meetings, frequency, type, etc.;
 - .6 Manage correspondence, reports and performance records;
 - .7 Distribute correspondence electronically;



- .8 Process Shop Drawings;
 - .9 Document the process for reviews and approvals of Tender Package Contracts and change orders; and
 - .10 Maintain a decision log during the construction of the project, recording participants, date and place of all decisions affecting schedule, budget, scope, or quality.
- .2 Project Monitoring and Reporting
- .1 Provide a system for documentation and project monitoring and reporting through each stage of project delivery, for review and acceptance by the Departmental Representative.
 - .2 Prepare and submit, at the start of the project, a sample of the report outline for all reports for review by the Departmental Representative. Sample report outline is contained in Part 6 of the GP&S document.
 - .1 Resubmit as may be required.
 - .2 The date of issue of the CM Monthly Report shall be established.
 - .3 The structure of the CM Monthly Report shall be used for all subsequent project stages.
 - .3 Prepare and submit quarterly reports to address:
 - .1 Milestone reporting on Estimating and Cost Planning;
 - .2 Updated Project Procedures Manual; and
 - .4 Prepare and submit monthly progress reports during the Design Development and Construction Document Stages, in an outline approved by the Departmental Representative.
 - .1 The purpose of the report shall be to review and monitor the progress of the Services by the CM. The report shall:
 - .1 Identify the progress of Advisory Support and Construction Support Services;
 - .2 Identify Progress Claims and Payments to date (including change orders) in a form that compares the original budgets for each Tender Package with the expected costs;
 - .3 Identify all instances where the schedule is not being met and identify impact on scheduled completion date;
 - .1 Outline remedial measures being taken or planned to be undertaken to ensure the scheduled completion date; and
 - .4 Identify any anticipated or potential problems to be addressed.
 - .5 Prepare and submit monthly reports during construction to address status and variances with respect to schedule, budget, quality, and scope:
 - .1 The actual report outline shall be acceptable to the Departmental Representative, and shall provide the following:
 - .1 An executive summary of key points,
 - .2 General progress of the Work and modifications to reflect changes in project parameters as may be identified throughout the project life,
 - .3 Construction Cost Plan Report including an overview of cost issues as outlined in this TOR,
 - .4 Master Schedule Update and narrative report including an overview of schedule issues as outlined in this TOR,



- .1 Monitor changes to the Master Schedule at least once a month and submit written reports to the Departmental Representative on any deviations or delays from the master schedule, and identify possible remediation measures required to maintain the Master Schedule Completion date.
 - .2 Monthly reports must identify not only reasons for delay but also offer suggestions, where possible, on how to bring the project back on track.
 - .5 Identification of risks and proposed strategies for mitigation, including scope creep as well as quality control outlined in this TOR,
 - .6 Waste Management Report as including an overview of Waste Management Strategies for construction,
 - .7 Health and Safety status Report, including narrative on the application or adjustment to the CM's Health and Safety Plans as well as any incidents and resulting actions, and
 - .8 Commissioning Plan progress report.
- .3 Hazardous Material Abatement:
- .1 Impact report of Hazardous Material Abatement on new work items.
 - .2 Reviewed and accepted Tender Documents related to Hazardous Material Abatement.
 - .3 Deliverables per the CM Tendering Services and CM General Construction and Contract Administration Services sections of this TOR.
 - .4 Deliverables per Divisions 01 and 02.

2.3 COST MANAGEMENT SERVICES

2.3.1 GENERAL

- .1 PWGSC manages all funding for the Project, including budgeting, expenditures and Progress Payment approvals.
 - .1 General information regarding Cost Management applicable to this project is contained in Part 2 of the GP&S document.

2.3.2 SCOPE AND ACTIVITIES

- .1 The CM shall:
 - .1 Provide advice and recommendations on;
 - .1 Costs related to construction feasibility, availability of materials and labour, time requirements for installation and construction,
 - .2 Budget costs of systems, assemblies, equipment, materials and specialty labour,
 - .3 Current pricing levels and trends in associated activities relating to the project,
 - .4 The selection, availability and pricing of goods and services,
 - .5 Insurance and bonding requirements.
 - .2 Provide suggestions and/or alternatives for cost reductions or acceleration of the Construction Schedule if requested by the PWGSC Departmental Representative.



- .1 Evaluate costs for alternative materials, construction techniques and installation methods,
- .3 Revise and refine the initially approved Master Cost Plan as the project progresses, incorporate approved changes as they occur and develop cash flow reports and forecasts as required by the Departmental Representative.
- .4 Advise of deviations from the Master Cost Plan and obtain written authorization from the Departmental Representative. Seek and report on authorization as per the Departmental Representatives change process.
- .5 Monitor Project costs and expenditures against the approved Construction Cost Limit and identify variances between actual and budgeted or estimated costs.
 - .1 Notify the Departmental Representative in the event that the CM considers that the Construction Cost Estimate will exceed the Construction Cost Limit.
 - .2 Provide recommendations for remedial action to maintain and keep the estimates within the Construction Cost Limit.
- .6 Track costs so that PWGSC can manage the budget.

2.3.3 DELIVERABLES

- .1 Prepare and submit to the Departmental Representative for review and acceptance, a Master Cost Plan within 14 calendar days of award of contract and maintain the Plan throughout the life of the Project.
 - .1 Include all CM projected costs, Construction Cost Estimates and Construction Cost Limits.
 - .2 Develop budgets for the work of each work package.
 - .1 Prepare tender package budgets as soon as major project requirements have been identified.
 - .2 Update at the milestone review stages for PWGSC acceptance.
 - .3 Address all costs in Federal Fiscal Year (FY) format (April 01 to March 31 of the following year).
 - .4 Prepare estimated costs, (including summary plus full back-up showing items of work, quantities, unit prices and amounts) at:
 - .1 The Design Development Stage (Class B); and
 - .2 The time of tendering each tender package (Class A).
- .2 Update at monthly intervals as agreed with the Departmental Representative.

2.4 SCHEDULE MANAGEMENT SERVICES

2.4.1 GENERAL

- .1 The CM shall provide Schedule Management Services for the project.



- .1 General information regarding Schedule Management applicable to this project is contained in GP&S document.

2.4.2 SCOPE AND ACTIVITIES

- .1 The CM must:
 - .1 Provide advice and recommendations on;
 - .1 A procurement strategy for any equipment or materials, which should be pre-ordered to meet the Master Schedule, and
 - .2 Means to minimize disruption to User Department during construction.
 - .2 If changes to the Schedule become necessary, indicate the impact and the reasons for such changes and submit proposed amendments to the Departmental Representative for review and acceptance.

2.4.3 DELIVERABLES

- .1 Prepare and submit to the Departmental Representative for review and acceptance, a draft Master Schedule (within 14 calendar days of contract award) and maintain the Plan throughout the life of the Project.
 - .1 Prepare the Schedule using Microsoft Project to develop detailed network diagrams, with work breakdown structures and Key milestones listings.
 - .2 Develop Critical Paths for all key activities, with key milestone dates and lead times for each activity.
 - .3 Identify anticipated start and completion dates for all design and construction activities, linked by interdependence on activities that must be completed prior to the start of a subsequent activity.
 - .4 Prepare separate schedules for each tender package and incorporated into the Master Schedule.
- .2 Ensure that the schedule has the capability of tracking changes.

2.5 RISK MANAGEMENT SERVICES

2.5.1 GENERAL

- .1 PWGSC's Departmental Representative prepares the Risk Management Plan for the Project.

2.5.2 SCOPE AND SERVICES

- .1 The CM must:
 - .1 Review, comment and advise on the PWGSC Risk Management Plan;
 - .2 Advise on Project Risks specific to the project and recommend mitigation options to the Departmental Representative;
 - .3 Advise on issues of risk that integrate project planning with procurement planning and construction;
 - .4 Identify and implement methodologies aimed at mitigating and minimizing the impact of construction activities on occupants and user department operations during construction; and
 - .5 Implement a claims avoidance program.
 - .6 Monitor risk as outlined in the risk management plan.

2.5.3 DELIVERABLES

- .1 Submit a monthly report on Project Risks to the Departmental Representative.



2.6 **QUALITY CONTROL SERVICES**

2.6.1 **GENERAL**

- .1 The responsibility for construction quality control remains with the CM.
- .2 The CM's Team shall work to:
 - .1 Adopt project delivery processes such as Risk Management and advising on methods to obtain best value; and
 - .2 Ensure that Health, Safety, Security and Sustainable Development requirements are adhered to.
 - .3 Report all site health and safety incidents to Departmental Representative.



2.6.2 SCOPE AND SERVICES

- .1 The CM shall apply quality assurance reviews during the design and construction phases, including participation in reviews of the systems, components, construction tools and techniques of the proposed design.
- .2 The CM shall be responsible for ensuring that the CM's Subcontractors adhere to:
 - .1 Industry standard practices following the requirements of the Construction Documents; and
 - .2 Professional conduct in all phases of the project, employing best practices for budget, schedule, quality, and scope management.
- .3 The CM shall Participate in Integrated Design Process (IDP) Workshops.
 - .1 The Consultant Team shall facilitate IDP Workshops through the design stage. The CM's Construction Project Manager shall attend 3 IDP workshops for the purpose of providing advice to the Consultant Team on Constructability of various options that the Consultant Team is considering including:
 - .1 Selection of materials, building systems and equipment;
 - .2 Constructability; and
 - .3 Coordination between all design disciplines.
- .4 Review construction drawings and specifications for each tender package at various stages acceptable to the Departmental representative.
 - .1 Normally, reviews are conducted at 66% and 99% stages, however, some tender packages may require fewer reviews, due to the nature of the work involved.

2.6.3 DELIVERABLES

- .1 Submit to the Departmental representative (within 14 calendar days of award of contract) a Quality Control Plan including, but not limited to:
 - .1 Identification and definition of key activities and deliverables;
 - .2 Description of internal controls;
 - .3 Methodologies and procedures to be utilized to deliver a quality project that meets the established Standards; and
 - .4 Deliverable verification plan.
- .2 Submit a written summary of the design and construction document reviews to the Departmental Representative.

2.7 COMMISSIONING SERVICES

2.7.1 GENERAL

- .1 Refer to Part 5 of the GP&S document for Roles and Responsibilities Matrix.
- .2 The CM is expected to provide a limited integrated building commissioning service, relative to the building systems affected in each sub-project, on the basis of CSA Z320-11, Canadian Standards Association, Building Commissioning Standard and Check Sheets.
- .3 The CM shall provide a Commissioning Process Manager (CPM).
- .4 Develop and implement a Commissioning Plan and as lead of the Commissioning Team, Assist the Team throughout the project to ensure that all new building systems work together and with existing, to produce a functional and integrated facility.



2.7.2 SCOPE AND SERVICES

- .1 Services are categorized into four Stages;
 - .1 Preliminary Design,
 - .2 Design,
 - .3 Construction, and
 - .4 Occupancy and Operations.

2.7.3 PRELIMINARY DESIGN STAGE

.1 Overview

- .1 The Owner Project Requirements (OPR) and the Basis of Design (BOD) are dynamic, continuously updated document serving both as documentation of the design process as well as commissioning bench marks.
 - .1 In collaboration with the Departmental Representative confirm commissioning requirements and comment on the commissioning component of the OPR document.
 - .2 Assist the Design Consultant and User Department in determining the BOD document.
- .2 Participate in a commissioning focused review of preliminary design options including;
 - .1 Risks associated with level of commissioning and project complexity.

2.7.4 DESIGN STAGE

.1 Overview

- .1 Review and comment/evaluate throughout the design phases on the Design Consultant's BOD updates for conformance to the OPR (and any OPR updates) and the original User Department's design goals.
- .2 Develop a Cx Issues and Tracking Log per plan for use by the CPM, Owner and Design Consultant.
- .3 Develop Verification Checklists for review by Departmental Representative and approval by Design Consultant.
- .4 In collaboration with the Design Consultant update Cx Plan to include list of all equipment to be commissioned, delineate roles and responsibilities, and detail scope, timelines and deliverables through the Cx Process for Owner's review.
- .5 Comment on commissioning requirements specifications to be approved and finalized by the Design Consultant. Complete Sections and/or Articles to, at the minimum, support a level of detail associated with the Design Consultant's progress submission.
 - .1 Commissioning requirements to include review comments by the Cx Team on the CPM's progressive submissions regarding;
 - .1 Cx Plan,
 - .2 O&M Manual requirements,
 - .3 Owner training requirements, and
 - .4 Construction Verification Procedures and Checklists.
 - .2 To reflect the CSA Z320 minimum standards and implementation guidelines, the NMS Commissioning specifications masters require significant edits and new Sections to be developed in collaboration with the CPM and Design Consultant.



- .6 In collaboration with the Design Consultant outline O&M Manual and training requirements for Owner's review.
- .2 **Reviews and Workshops**
 - .1 Participate in regularly scheduled bi-weekly design meetings via teleconference, web conferencing or in person as required.
 - .2 Participate Integrated Design Workshops to be led by the Design Consultant.
 - .3 Review Consultant's updated BOD.



2.7.5 CONSTRUCTION PHASE

.1 Overview

- .1 Coordinate and direct the Commissioning Activities in a logical, sequential and efficient manner per the commissioning plan.
- .2 Provide on-going consultation with design and construction teams in support of their specified commissioning deliverables.
- .3 Conduct site visits and attend site construction meetings to assist in identifying discrepancies and remedies.
- .4 Review request for information and change order for impact on commissioning.
- .5 Document all reviews and submit to Departmental Representative:
 - .1 Updated Cx Issues Log.
- .6 As a member of the Commissioning Team assist the Team:
 - .1 On a construction phase basis, where systems and areas are required to be operational, provide assistance to the Design Consultant, in certifying that installations have been completed and function as per the Cx Plan;
 - .2 As per the Cx Plan assist Design Consultant with managing the Contractor's execution and contract closeout submissions, such as, manuals, warranties, extended warranties, and manufacturer's guarantees - dependent on the construction phase;
 - .3 Contractor's submittals,
 - .1 CPM will be copied on submittals concurrently, with the Design Consultant,
 - .2 Verify submittals such as,
 - .1 Coordination drawings, shop drawings, O&M Manuals, product samples, schedules and any other project submittals.
 - .3 Co-ordinate review comments with the Design Consultant.
 - .4 100% of the equipment must be tested and inspected. Representative sampling for equipment commissioning is not acceptable.
 - .5 Provide, as per CSA Z320-11, Interim Acceptance and Facility Turnover recommendation document.

.2 Review and Meetings

- .1 Conduct an on-site pre-construction commissioning meeting with the Cx Team including the consultant team and appropriate contractors. Agenda to include:
 - .1 Cx Plan;
 - .1 Compare CPM's schedule with the Contractor's schedule, and
 - .2 Updated Commissioning Issues Log.
 - .2 Detailed Roles and responsibilities matrix; and
 - .1 OPR, and
 - .2 BOD.
- .2 Coincidental with construction meetings, organize and lead regularly scheduled on-site bi-weekly commissioning meetings including:
 - .1 Field reviews complete with reports verifying installation of systems and assemblies in accordance with OPR and Cx Plan;
 - .2 Conduct on-site bi-weekly commissioning meetings as per the CPM's Commissioning Plan; and



- .3 Review with the Design Consultant the Contractor's standard submittals for enhanced commissioning.

.3 Testing and Verification

- .1 Oversee, in collaboration with the Design Consultant, Contractor's coordination of all equipment, systems and assembly site testing and verification processes.
 - .1 Ensure activities are in accordance with the Cx Plan and the Cx Schedule.
- .2 Provide testing and verification services such as:
 - .1 Witness all site commissioning tests for all equipment, systems and assemblies identified in the Commissioning Plan;
 - .2 Review all factory test reports and data for compliance with the Owner's Project Requirements and the Commissioning Plan;
 - .3 Review and verify all commissioning test results and reports;
 - .4 Ensure all test procedures and results are recorded and documented in compliance with the Commissioning Plan;
 - .5 In collaboration with Design Consultant, support Contractor, as may be deemed suitable, to organize and lead testing and balancing activities;
 - .6 Verify submittals from Contractor, at each construction phase;
 - .7 Provide verification of final reports upon completion of the entire project; and
 - .8 Coordinate seasonal commissioning for those systems that have been functionally tested and/or handed over in seasons where retesting and commissioning will be required during the opposite season.

.4 Training

- .1 In collaboration with the User Department ("Owner"), Design Consultant and Contractor co-ordinate a training plan and training schedule. Incorporate a complete system and assembly review of operational procedures, set points and maintenance requirements.
- .2 Assist the coordination between the Design Consultant and the Contractor with their provision of draft O&M Manuals (or complete Manuals as available) for the purposes of the training sessions.
- .3 In collaboration with the PWGSC Cx Advisor oversee and evaluate the Contractor's, training sessions between the Contractor and the Owner's facility management and operations personnel.
 - .1 Ensure attendees sign an attendance sign-in sheet.
 - .2 Verify that training is provided by the appropriate equipment manufacturer's representative.
 - .3 Verify the training requirements have been met.
- .4 Oversee, in collaboration with the Design Consultant, the Contractor's development of a training manual (electronic & hard copy) including applicable videos and photos for existing and future personnel to use for future training seminars.
 - .1 Material to be user friendly, electronically searchable, contain indexes and provide component, system and interrelated system references including the necessary maintenance requirements.

.5 Substantial Completion



- .1 In collaboration with the Cx agent, facilitate the Cx Team's Interim Acceptance Report sign off, at the minimum, on items, such as, those outlined in CSA Z320-11.
 - .1 Include control sequence documentation.
- .2 For expected number of commissioned Partial Interim Acceptances refer to Construction Options Analysis Report, Option 3. Partial Substantial Completion must coordinate with the completed and occupied Work phases.
- .6 Facility Turnover**
 - .1 In collaboration with the Cx agent, facilitate the Cx Team's Facility Turnover recommendation sign off, at the minimum, on items, such as, those outlined in CSA Z320-11.
- .7 Substantial Cx Report**
 - .1 Provide a Commissioning Report documenting all of the commissioning work, testing, and results achieved during the project construction. Commissioning Report must at a minimum contain:
 - .1 Identification of any systems or assemblies that do not perform in accordance with the OPR;
 - .2 Test procedures and results;
 - .3 Deferred tests complete with schedule;
 - .4 Static Verification/Field Review check lists for all equipment, systems and assemblies;
 - .5 Start-up check lists for all equipment, systems and assemblies;
 - .6 Functional Performance check lists for all systems, inter-related systems and assemblies;
 - .7 Factory test reports complete with CPM review comments;
 - .8 All commissioning Site Inspection review reports;
 - .9 All commissioning Issues Logs and Progress Reports;
 - .10 Training records and training material submittals;
 - .11 Substantial Completion version of the Commissioning Plan;
 - .12 Final version of the commissioning related OPR;
 - .13 Submit draft version of the Interim Acceptance Commissioning Report for review and comment; and
 - .14 Submit final version of the Interim Acceptance Commissioning Report.
- .8 Deliverables**
 - .1 Provide the following updated monthly documents resulting from changes due to addenda and construction contract amendments:
 - .1 Cx Issues Log.
 - .2 Provide Cx meeting minutes.
 - .3 Distribute minutes to Departmental Representative and Design Consultant for any further redistribution as may be required.
 - .4 Provide construction checklists for commissioned equipment and systems.
 - .5 Provide Commissioning Schedule updates.
 - .6 Publish, in MS Project, regularly updated schedule of commissioning activities as part of the regular monthly report on the Cx Plan. Notwithstanding CSA Z320-11 Cx Plan definition, the Cx Schedule must include:



- .1 Cx Team meetings;
 - .2 Start and substantial/interim completion of each construction phase;
 - .3 Systems and related assembly completion and testing;
 - .4 Training sessions;
 - .5 Deferred Cx testing;
 - .6 Warranty start date(s);
 - .7 Occupancy dates for each construction phase;
 - .8 Schedule, planned vs. actual.
- .7 Provide Interim Acceptance Cx Report.
- .1 Outline and content as per CSA Z320-1.

2.7.6 OCCUPANCY OPERATIONS AND ACCEPTANCE PHASE

.1 Overview

- .1 Oversee and document deferred seasonal testing by the Contractor.
- .2 In collaboration with the Design Consultant coordinate corrections and re-testing as necessary until performance is in compliance with construction documents.
- .3 Throughout the occupancy and acceptance phase consult with Owner's operational personnel at appropriate intervals to determine that commissioned systems are operating properly and evaluate if additional personnel training may be required.
- .4 Oversee the Design Consultants and Contractors post-occupancy Functional Performance Testing to evaluate and document energy and operational performance as compared to designed performance defined in the BOD and Construction Documents. Evaluations will occur at:
 - .1 Three (3) months; and
 - .2 Ten (10) months of warranty expiration.
- .5 Oversee resolution of any warranty issues on commissioned systems during the warranty period.
- .6 Prepare Final Commissioning Process Report for use by Owner and Design Team at end of warranty period. Final Commissioning Report shall incorporate review comments by Owner and Design Team on Commissioning Report, the results of all post-occupancy testing and evaluations, and document resolutions to all items on the Commissioning Issues and Tracking Log.
- .7 Collaborate with the PWGSC Cx Advisor on the development of the PWGSC Cx Evaluation Report.

.2 Ongoing Consultation

- .1 Provide ongoing consultation with the design and construction teams in support of their project closeout activities and submittals related to systems and assemblies commissioning specific deliverables in compliance to the Commissioning Plan, Commissioning Specifications and Owner's Project Requirements (OPR).
- .2 Attend regularly scheduled proposed bi-weekly construction closeout meetings including consultants, contractors, subcontractors and suppliers.
- .3 Finalize the Commissioning Report based on;
 - .1 Final training sessions,



- .2 Post occupancy changes,
- .3 Deferred commissioning, and
- .4 Information not available or incomplete at Interim Acceptance.
- .4 Provide assistance to the Prime Consultant in certifying that all installations have been completed and function in accordance with the Cx Plan, OPR and the Prime Consultant's Basis of Design (BOD).
 - .1 Design Consultant will update BOD as required.
- .5 As per the Commissioning Plan, assist Design Consultant in ensuring that all completed operating and maintenance manuals, warranties, guarantees and other required submittals are turned over to the User Department (Owner).
- .6 Update the OPR and the Commissioning Plan to record any final changes or adjustments after occupancy, for inclusion in the final Commissioning Report.
- .7 Submit final Commissioning Manual with, at the minimum, updated contents as outlined in CSA Z320-11.
- .3 Deferred Testing**
 - .1 Coordinate deferred commissioning for those systems that have been functionally tested and/or turned over where retesting and commissioning is required.
 - .2 Witness on site deferred testing as per the Commissioning Plan.
- .4 Deferred Training**
 - .1 As per the training plan and in consultation with the User Department, coordinate post occupancy training for any systems and assemblies where there are for example seasonal differences in operating parameters and/or where deferred testing is required.
 - .2 Incorporate into the Training plan a complete system and assembly review of operational procedures, set-points and maintenance.
 - .3 Confirm training sessions are co-ordinated between the Design Consultant, Contractor and the Owner's facility managers and operations personnel.
 - .4 Ensure attendees sign an attendance sheet.
 - .5 Verify that training is provided by the appropriate equipment manufacturer's representative.
 - .6 Verify the training requirements have been met.
- .5 Lessons Learned**
 - .1 Collaborate with Design Consultant to arrange a Lessons Learned work shop.
 - .2 Develop and present Cx related material.
 - .3 Attend and assist facilitating and on-site Work Shop.
 - .1 Design Consultant remains accountable for Work Shop deliverables.
- .6 Commissioning Manual;**
 - .1 Prepare final Cx Manual with support from the Cx agent, at the minimum, those items outlined in CSA Z320-11 and in addition:
 - .1 Contractor's project "as-built" documents; and
 - .2 All necessary documentation to permit a Re-commissioning of the entire facility in future and a return to all original "as-commissioned" operating parameters.
- .7 Deliverables**



- .1 Final Cx Manual that contains the Final Commissioning Report.
- .2 Final Commissioning Plan - updated from the Interim submission outline is to also include:
 - .1 OPR;
 - .2 Compilation of the following items
 - .1 BOD,
 - .2 TAB Reports,
 - .3 All system schematics (single line drawings),
 - .4 Control strategies and set points,
 - .5 Final post-occupancy energy and operational performance results, including variances, and
 - .6 Guidelines for energy accounting.

2.8 CM TENDERING SERVICES

2.8.1 GENERAL

- .1 The CM shall review the method of tendering with the Departmental Representative to select the most appropriate method to achieve value for money. This shall include an invitation to three to five bidders experienced in the work or public advertisement to the industry using regionally acceptable advertisement methods.
 - .1 Provide Departmental Representative with advance copies of CM/Subcontractors contracts.

2.8.2 SCOPE AND SERVICES

- .1 The CM shall:
 - .1 Develop the list of specific Phased Tender Packages with the Departmental Representative and the Consultant Team;
 - .2 Review and provide commentary to the scope of all tender packages to avoid any gaps or conflicts between tender packages, the Work of the CM's Own Forces and between the Work all of the CM's Sub-Trades;
 - .3 Undertake tendering of Sub-Trade packages in accordance with the General Conditions of the contract, and as agreed upon by the Departmental representative;
 - .1 Tender all Sub-Trade tender contracts, using the agreed upon Construction Association Bid Depository, unless otherwise specified,
 - .2 Coordinate the preparation of Specifications Division 01 work and services for each tender package,
 - .3 Ensure that facilities and services being provided to Sub-Trades are clearly identified in the tender documents,
 - .4 Endeavour to ensure that a minimum of three bids are received for every tender package issued, and
 - .5 In the event that fewer than three bid are received on any tender package, PWGSC reserves the right to require the CM to re-tender the respective tender package, unless prior acceptance has been issued by the Departmental Representative.
- .4 Issue all addenda in writing (no information is to be issued orally);



- .1 Addenda to Tender Documents are to be issued through the Bid Depository to all recipients of the Tender Documents unless otherwise specified,
- .2 Ensure that Sub-Trade bidders receive all addenda, and
- .3 Endeavour to issue addenda no later than seven calendar days before the tenders close.
- .5 Receive Tenders, to be opened at the agreed upon location in the presence of the Departmental Representative;
 - .1 Analyze the bids for each tender package to determine if the work should be awarded or if changes are required to keep costs within the budget, and
 - .2 Make recommendations for alternate strategies, in the event that the low bid exceeds the budgeted amount.
- .6 If the low bid of a Sub-Trade package exceeds the CM's Construction accepted Cost Estimate (Class 'A' level) by more than 5%;
 - .1 Re-tender the Tender package if,
 - .1 No satisfactory reduction can be negotiated with the low bidder, or
 - .2 If the desired price reduction entails significant changes in the scope of work or the character of the design, and
 - .3 Requested by Departmental Representative.
 - .7 If re-tendering is required, the CM shall;
 - .1 Re-issue the package for tender.
- .2 Pre-Ordered equipment or items:
 - .1 Review all tender packages for long delivery items which may warrant pre-ordering; and
 - .2 All pre-ordered equipment or items shall be specified by the Consultant.

2.8.3 DELIVERABLES

- .1 Provide a tender summary for each package including:
 - .1 Names of all sub-contractors invited and participating;
 - .2 List of all tender documents including addenda; and
 - .3 Detailed breakdown of results including labour & hours, materials, overhead and profit on bids.

2.9 CM GENERAL CONTRACTOR SERVICES

2.9.1 GENERAL

- .1 The CM must:
 - .1 Perform all the duties of a Construction General Contractor, manage the Work of the CM's Own Forces and Sub-Trades and ensure that the Work is carried out in accordance with the requirements;
 - .1 of the General Conditions of the Contract,
 - .2 of Divisions 01 and 02,
 - .3 contained in the Construction Documents, and
 - .4 Included herein, in these Terms of Reference.

2.9.2 SCOPE AND SERVICES



- .1 For Work other than Work by Own Forces, the work shall be tendered to Sub-Trades and enter into subcontract agreements that comply with industry recommended practices and PWGSC contract administration practices (copy will be made available to the CM).
- .2 Provide and maintain full-time staff at the project site to:
 - .1 Coordinate and provide general direction of the project and progress of the Sub-Trades on the project;
 - .2 Provide quality assurance, monitoring and reporting throughout the construction stage of the project;
 - .1 Rectify issues identified by either the CM QA process or identified by the Consultant Team.
 - .3 Coordinate access as required to the existing facility to facilitate the work and assist in the coordination of access to the various parts of the facility by the contractors, working closely with Departmental Representative or designate.
 - .4 Coordinate work of this project with the Departmental Representative to ensure that daily operations of the specific site conditions are not compromised or affected.
 - .5 Establish on-site organization and lines of communications in order to carry out the work of the project as directed by the Departmental Representative.
 - .6 Ensure green demolition techniques and waste diversion reporting are utilized and met to the extent required in consultant's tender documents.



- .3 CM's "Own Forces" work.
 - .1 The CM shall identify labour and material, which is beyond bid depository trade scopes.
 - .2 This work shall be included in the Sub-Trade tenders as "Not Withstanding Clauses" only.
 - .3 The CM shall take responsibility for:
 - .1 The completeness of these tender package descriptions; and
 - .2 Delivery of the Sub-Trade packages, the generic Division 01 attached to the RFP, and construction phase responsibilities identified within this document.
 - .4 There will be no "Own Forces Work" extra to the CM's Contract.

2.9.3 **DIVISION 01 - GENERAL REQUIREMENTS, DIVISION 02 – EXISTING CONDITIONS**

- .1 In addition to adhering to the project administration requirements contained in this TOR, the CM must comply with the general requirements contained in the Divisions 01 and 02 Documents. These requirements are necessary for the smooth and safe operation and coordination of the site.

2.10 **CM GENERAL CONSTRUCTION AND CONTRACT ADMINISTRATION SERVICES**

2.10.1 **GENERAL**

- .1 Fulfill the obligations as General Contractor, responsible for all Sub-Trade Contractors, Suppliers and any maintenance or operational requirement contractors that require access to the site;
- .2 The CM's own forces shall only be permitted for individual work package coordination activities less than \$25,000 value with the specific approval of the Departmental Representative where there is fair value to Canada.

2.10.2 **SCOPE AND SERVICES**

- .1 Construction Work.
 - .1 When construction Work is duly authorized and assigned to the CM's contract agreement, the CM must:
 - .1 Provide and be responsible for the development, coordination and management of all work and services included in Division 01 in the CM Agreement;
 - .2 Provide all necessary equipment to the Project and all other resources required to perform these duties and services;
 - .3 Procure, coordinate, administer and manage all construction work and contracts in a holistic fashion;
 - .4 Prepare and execute contracts with the successful Sub-Trades;
 - .1 Coordinate and manage the respective contracts in an integrated manner to avoid any conflicts between the Work of the Sub-Trades,
 - .2 Coordinate, manage and complete all the Work of each Sub-Trade tender package in adherence to the approved drawings and specifications of each tender package, including all addenda and authorized change orders,



- .3 Deliver the sub-projects to be ready for occupancy by the agreed upon completion dates,
- .4 Develop and implement a procedure for review, certification, processing and payment of Sub-Trades in accordance with the terms and conditions of the CM Agreement,
- .5 Schedule and conduct progress meetings at which Sub-Trades, PWGSC, Consultant Team and the CM can jointly discuss such matters as procedures, progress, problems and scheduling, and
- .6 Provide timely response to correct issues as they occur,
- .7 Prepare a deficiency list for review and acceptance by the Departmental Representative,
- .8 Arrange for and correct all identified deficiencies in accordance with the schedule and advise when all items have been properly corrected.
- .5 Complete the Work of the CM's Own Forces in adherence to Division 01 and / or in accordance with the approved scope of Work.
- .2 Cost Management.
 - .1 Provide updated cost information for monthly reports, as outlined in the "Cost Management Services" heading of this Section.
- .3 Schedule Management.
 - .1 Provide updated schedule information for monthly reports, as outlined in the "Schedule Management Services" heading of this Section.
- .4 Quality Control.
 - .1 The CM shall ensure that quality assurance measures are implemented and that impacts on existing operations are minimized.
- .5 Health and Safety.
 - .1 The CM is responsible for maintaining a Healthy and Safe site at all times and shall:
 - .1 Ensure full compliance with the applicable workplace health and safety Acts and Regulations in effect in Nunavut.
 - .2 Ensure the full health and safety protection afforded under the Canada Labour Code to all visitors to the site, including workers, staff, contractors and the general public;
 - .3 Implement a safety program on site;
 - .4 Provide appropriate safeguards to ensure safe protection and security of materials and holdings on the site;
 - .5 Comply with Workplace Hazardous Materials Information System (WHMIS) and all other applicable regulations with respect to hazardous materials to ensure that;
 - .1 All designated hazardous materials are properly treated, handled and stored,
 - .2 Workers' exposure to fumes, is within acceptable health and safety limits,
 - .3 Temporary ventilation or protection, as required for products utilized, is properly provided,



- .4 Construction dust is controlled such that workers and occupants are not adversely impacted by dust from construction activities within the building or on the site, and
- .5 Ensure that shop-drawing submissions include Manufacturers Standard Data (MSD) Sheets.
- .6 Shop Drawings.
 - .1 Provide a schedule of shop drawing submissions for each tender package.
 - .2 Shop drawings must be checked and certified correct for construction by the CM and reviewed by the Consultant Team before forwarding to PWGSC for review and return to the subcontractor.
 - .1 Shop drawings must be stamped “Checked and Certified Correct for Construction” by the CM and “Reviewed” by the Consultant Team.
 - .3 The CM must:
 - .1 Review, discuss, record problems and identify agreed remedial action;
 - .2 Monitor and record the progress of shop drawing review. Record parties designated for action and follow up;
 - .3 On completion of project, forward reviewed shop drawings to the Departmental representative;
 - .4 Verify that shop drawings include the project number and are recorded in sequence;
 - .5 Verify the number of copies of shop drawings required; and
 - .1 Provide additional copies for User Department.
 - .6 Expedite the processing of Shop Drawings in a timely manner.
- .7 Information Technology (IT)
 - .1 The Consultant will produce the tender documents describing IT (cabling, voice, data).
 - .2 The CM must:
 - .1 Review the Tender Documents for IT issues (i.e. Maintaining IT service during phased moves and relocation of equipment, security aspects specific to the User, role and responsibility/capacity of the User Departments to participate in implementation);
 - .2 Have a clear understanding of the constraints of the User departments and ensure these requirements are planned for in the overall delivery;
 - .1 This will involve attendance at Integrated Design Process (IDP) meetings and close coordination with the Consultant and User Departments as required.
 - .3 Provide a detailed Report following consultation with Departmental Representative and User Departments;
 - .4 Have a clear understanding of the User Department Service Provider Agreements describing how Service Providers must be involved in the sub-project; and
 - .5 Develop a detailed schedule and Delivery Plan which will clarify roles and responsibilities, critical milestones, logistics and coordination with the overall delivery.
- .8 Sustainable Development.
 - .1 The CM must:



- .1 Co-operate with all members of the Project team in contributing to the achievement of the sustainable construction requirements.
- .9 Permits and Approvals.
 - .1 The CM shall be responsible for coordinating, paying for and obtaining all permits and approvals from local and statutory authorities and shall:
 - .1 Liaise with local and statutory authorities with respect to hoarding, traffic restrictions, services and associated diversions and/or connections.
 - .2 Inform Departmental Representative of their requirements to inform any statutory body via applications or orders.
 - .3 Ensure that all applications are filed and executed successfully.
 - .4 Verify that all necessary approvals have been obtained.
- .10 During the Post Construction and Warranty Stage the CM must:
 - .1 Coordinate Sub-Trade activity to provide final Record Documents (Operations and Maintenance Manuals, As-built drawings and specifications) as required for each sub-trade;
 - .1 Assemble Record Documents in whole packages per sub-project or as directed by the Departmental Representative, and
 - .2 Provide copies of Record Documents and updated records to PWGSC as directed by the Departmental Representative including compliance to PWGSC AutoCAD Standards.
 - .2 Review and verify the accuracy of warranties and guarantees;
 - .1 Before completion of work, collect all manufacturer's guarantees, and warranties, complete with relevant contract numbers, and submit to the Departmental Representative for review and approval, and
 - .2 Ensure that warranties and guarantees are included in the Operation and Maintenance Manuals.
 - .3 Within ten (10) months of the commencement of the warranty period, arrange for an inspection of the facility to determine all items to be corrected;
 - .1 Prepare a correction list for review and acceptance by the Departmental Representative,
 - .2 Provide a schedule indicating when correction of all items covered under the warranty will be corrected and submit to the Departmental Representative for review and acceptance,
 - .3 Arrange for and correct all identified items in accordance with the schedule and advise when all items have been properly corrected, and
 - .4 Ensure that all warranty items are properly corrected in a timely manner.
 - .4 Provide information and advice during the post construction evaluation sessions.
- .11 Arrange for of all key CM staff and representatives from the CM's key Sub-Trades to attend a one-day Post Construction Evaluation session, at a time and place to be determined with the Departmental Representative.

2.10.3 DELIVERABLES

- .1 Maintain on a current basis and make available to the Departmental Representative, all construction related documents, including:



- .1 A daily log listing, as a minimum: weather conditions, visitors, workforce, by trade and number of employees, safety issues, and any other major issues;
 - .2 Records of all project contracts and drawings;
 - .3 Copies of all project related correspondence;
 - .4 Samples, purchases, materials and equipment;
 - .5 All data from sub-trades;
 - .6 Maintenance instructions and operating manuals; and
 - .7 A current set of project record documents for the purpose of recording all approved changes that occur during construction and for completing as-built documents.
- .2 The CM must:
- .1 Arrange with the Departmental Representative for the issuance of necessary forms respecting interim and final completion of the work;
 - .2 Prepare lists of incomplete and deficient items;
 - .3 Schedule completion of these items with the Sub-Trades and distribute all lists as appropriate; and
 - .4 Distribute interim and final completion certificates.

3. APPENDICES

- a) Appendix 1: Building Locations – Aerial Photo
- b) Appendix 2: Building XR-02, Old Accommodations Building, Mechanical Operations Manual
- c) Appendix 3: Building XR-03, Operations Centre Warehouse, Mechanical Operations Manual
- d) Appendix 4: Incinerator Information,
- e) Appendix 5: XR-02 Original Electrical Distribution As-Built
- f) Appendix 6: XR-03 PCSP Operations Centre Partial Roof Information
- g) Appendix 7: XR-12 ARIF Kitchen and Dining Complex - Addition at Loading Dock and Cold Storage Concept Diagram.

Appendix 1 - Building Locations

Runway

Butler buildings
(XR19 and XR20)

Dr. Roy Koerner
Laboratory (XR04)

ATC Ops Centre/
Warehouse* (XR14)

ARIF kitchen and
dining bldg.* (XR12)

"ATCO" storage*
(XR01)

PCSP Ops Centre/
Warehouse* (XR03)

ATC accommodations
wing* (XR15)

Bayfield* (XR22)

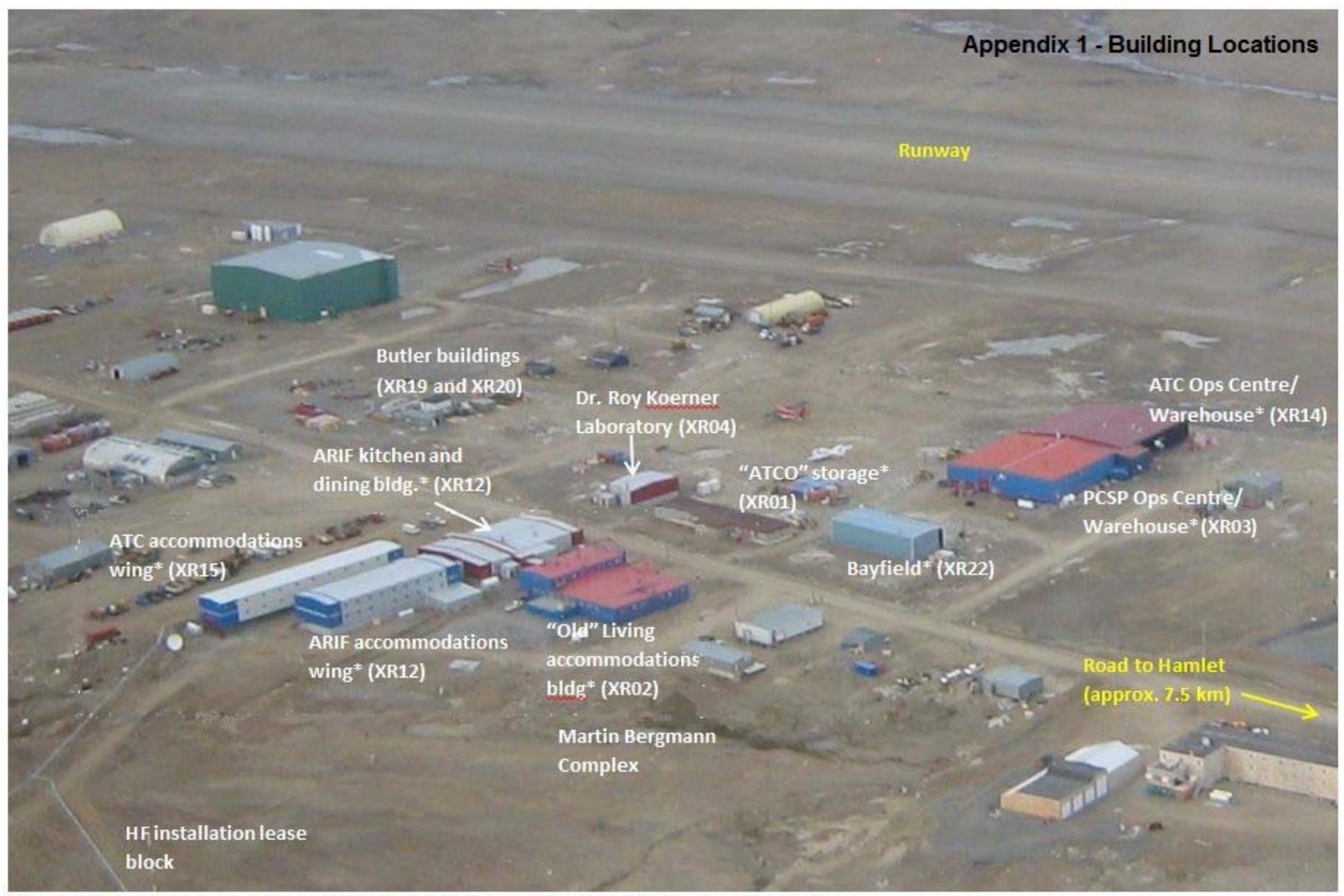
ARIF accommodations
wing* (XR12)

"Old" Living
accommodations
bldg* (XR02)

Martin Bergmann
Complex

Road to Hamlet
(approx. 7.5 km)

HF installation lease
block



2.3 MECHANICAL

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2 3 MECHANICAL

J GENERAL DESCRIPTION

2 3-1 HEATING AND VENTILATING

- 1 AHU 1
- 2 AHU-2
- 3 AHU-3
- 4 FU-1
- 5 FU-2
- 6 EF-1
- 7 EF-2
- 8 EF-3
- 9 EF-4
- 10 Kitchen Ecology Unit
- 11 EF-7 through EF-13
- 12 EF-14

2 3-2 FUEL STORAGE AND DISTRIBUTION

- 1 Day Tank TK-2
- 2 Day tank TK-7
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2 3-3 PLUMBING

- 1 Domestic water tank TK-3
- 2 TK-8
- 3 Domestic Hot Water Heater DWH 1 & DWH-2
- 4 DWH-3
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- 6 TK-9
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2 3-4 KITCHEN FACILITIES

2 3-5 VENDOR EQUIPMENT and SHOP DRAWINGS

2 3 MECHANICAL

I GENERAL DESCRIPTION

The general operation of the Living Accommodation Unit utilizes a number of mechanical systems to provide heating and ventilating, water and sanitary service, fuel delivery etc. Specifically these services include

Heating and Ventilating, Fuel oil storage and distribution, Domestic water storage and distribution, sanitary and waste water drainage, storage and disposal, special services for the Kitchen

Heating and ventilating is accomplished by a combination of Air Handling Units (AHU's), furnaces (Fu's), a selection of ventilating fans and a kitchen ecology unit

The fuel storage and distribution consists of the main bulk oil storage tank, two steel day tanks, service pumps, and distribution piping fitted with various valves, meters, and controls

Domestic water is distributed throughout the facility from the main storage tanks by a variety of pumps, and distribution piping fitted with meters, valves and controls. Pressure in the system is maintained by hydro pneumatic tanks while hot water is supplied from several oil fired hot water tanks

The sanitary and waste water disposal requirements are met by a system of pipes from the various washroom, laundry, and kitchen facilities which drain into several sewage holding tanks

2 3-1 HEATING AND VENTILATING

I GENERAL DESCRIPTION

Heating for the building is provided by three Air Heating Units (AHU's) and two Furnaces (Fu's). Heated air from these units is distributed throughout the building by low velocity duct distribution systems feeding floor registers and wall grilles. Return air duct systems carry recirculation or return air back to the respective AHU or Fu. While these units collectively provide heat for the building each one serves a specific area of the building. AHU-1 which is located in Mechanical room 146 on the main floor serves the second floor staff accommodation area. AHU-2, also in Mechanical room 146 serves the transient rooms 139 thru 142, study rooms, reading rooms, and recreation area located on the main floor. AHU-3 located in Mechanical room 117 serves the main floor transient bedroom area, washrooms and laundry room in the south end of the building. Fu-1 in Mechanical room 146 provides heat to the crawl space only while Fu-2 serves the kitchen and cafeteria area.

Electrical baseboard heating is provided in the Electrical Room 144 and the Emergency Generating Room 145.

Ventilation for the building is also provided by these same five units and their respective duct systems. In conjunction with these systems eleven exhaust fans (EF's) and one kitchen ecology unit removed fouled air from the different areas of the building. While all of these units collectively provide ventilation for the building each unit serves a particular area of the building. The AHU's and Furnaces ventilate those same areas identified previously for heating. EF-1 and the Kitchen Ecology Unit (EF-5 and EF-6) serve the kitchen and cafeteria, EF-2 serves the men's washroom on the main floor, EF-3 serves the women's washroom on the main floor, EF-4 serves the janitor's closet Rm 152 in the kitchen and EF-7 through EF-13 serve the washrooms on the second floor. Some units are also interlocked through their control systems to operate in conjunction with other units to provide enhanced ventilation to specific locations in the building.

2 3-1 1 AHU-1**I DESCRIPTION**

This unit, a Jackson and Church Flexaire packaged unit located in Mechanical room 146, supplies heating and ventilation to the second floor staff accommodations through a complete dedicated duct system. This duct system also includes a separate return air (R/A) system which circulates air back to the AHU.

The Supply Air (S/A) ducting is made up of 2m of 450x250, 2m of 750x250, 4m of 650 x 200, 3m of 500x200, 12m of 400x200, 2.5m of 200x200, 8.5m of 200x150, 16.5 of 250x150, 22m of 200x100, 9.5m of 150x150, and 5.7m of 150x100 ducting, sixteen (16) floor registers, balancing dampers, reducers and fire dampers.

The R/A ducting consists of thirteen (13) 300x150 wall grilles with fire dampers, 6.5m of 200x150, 3m of 300x200, 8m of 350x250, 3m of 300x250, and 3m of 250x200 duct.

The make up air or outside air (OA) ducting of 200x200 metal duct complete with automatically controlled dampers.

II SEQUENCE OF OPERATION – MANUAL• **START-UP**• **STOP / SHUTDOWN**

The emergency shutdown switch HS-2B located outside of room 146 activates the emergency shut down of AHU-1 and locks out the fuel supply.

III SEQUENCE OF OPERATION – AUTOMATIC• **START-UP**

Operation of the AHU burner is initiated by wall mounted thermostat (THERM-3) located in the Lounge room 225. Upon activation of the burner motor (RF-3-1) the blower motor (RF-3-2) will cycle via the fan limit control. Also the combustion air damper (DMC-3) will open upon start up of the burner and burner motor. Following a two minute time delay (RTD-3) the minimum outside air damper (DM3-1) is activated and will open to POT-3 setting.

• **SYSTEMS INTERFACE**

- normal
- emergency

The unit is also equipped with an adjustable duct stat (SAR-3) and Freezestat (FRZ-1) both located in the supply air duct.

The duct stat (SAR-3) will override the space thermostat (THERM-3) if the S/A temperature falls below 10° c.

The Freeze stat (FRZ-1) will lockout operation of AHU-1 and sound an alarm if the S/A temperature falls below 5° c.

• **SYSTEMS INTERFACE**

- normal
- emergency

IV COMPONENT LIST

One – Jackson and Church Flexaire oil fired H94721A packaged furnace unit Model No. SDF-15-02SH MB with a RIELLO burner assembly.

flue pipe with MG1-8 gas barometric damper,
supply/return air blower assembly A12-12A,
with fractional H.P. motor,

heat exchanger,
Honeywell T4051A-1003 thermostat,
Honeywell R4222D1039 relay,

Honeywell L4064B-1592 fan limit control,
 Furnas 16BE32AF starter,
 potentiometer,
 return air damper,
 Honeywell M945A-1009 damper operator motors,
 Honeywell T991A-1012 mixed air stat,
 drum type humidifier,

mixing box assembly,
 outside air damper,
 Honeywell H205A-1046 enthalpy control,
 20x25x2in EZ kleen filters,
 Other control devices (see chapter on Controls)

2 3-1 2 AHU-2

I DESCRIPTION

This unit, a Jackson and Church Flexaire packaged unit located in Mechanical room 146, provides heat to rooms 139 to 142, study and reading rooms, and the recreation area on the main floor through a dedicated duct system with both supply, return and outside air ducting

The S/A system feeds fourteen floor registers through ducting made up of 4m of 650x250 duct, 13m of 450x250 duct, 10m of 350x200 duct, 5.8m of 200 Ø duct, 2m of 200x150 duct, 3m of 150x150 duct, 2m of 100x100 duct, 3m of 300x200 duct, 6m of 250x250 duct, 3m of 200x100 duct all complete with balancing dampers and fire damper

The R/A system collects air through twelve wall and ceiling return air grilles complete with fire dampers and returns the air to the AHU through ducting made up of 5m of 700x200 duct, 4m of 650x200 duct, 2m of 250x200 duct, 6m of 150x150 duct, 9m of 650x200 duct, 2m of 250x200 duct, 2m of 200x200 duct, 6m of 150 Ø duct and 5m of 100 Ø duct

Included in the makeup of both systems are elbows, reducing sections, flexible duct, installation brackets, and miscellaneous hardware

I SEQUENCE OF OPERATION – MANUAL

- START-UP

- STOP / SHUTDOWN

The emergency shutdown switch HS-2B located outside of room 146 activates the emergency shut down of AHU-2 and locks out the fuel supply

- SYSTEMS INTERFACE

- normal
- emergency

II SEQUENCE OF OPERATION – AUTOMATIC

- Start-up

Operation of the AHU burner is initiated by wall mounted thermostat (THERM-4) located in the Recreation room 104. Upon activation of the burner motor (RF-4-1) the blower motor will be cycled by the fan limit control. Also the combustion air damper (DMC-4) will open upon start up of the burner and burner motor. Following a two minute time delay (RTD-4) the minimum outside air damper (DM4-1) is activated. If either or all of the exhaust fans EF-2, EF-3, and the Kitchen Ecology unit are operating the blower motor will run continuously, the return air damper will close to (POT-4B) setting and the outside air damper (DM4-1) will open to (POT-4A) setting

- STOP / SHUTDOWN

The unit is also equipped with an adjustable duct stat (SAR-4) and Freezestat (FRZ-4) both located in the supply air duct

The duct stat (SAR-4) will override the space thermostat (THERM-4) if the S/A temperature falls below 10° c

The Freeze stat (FRZ-5) will lockout operation of AHU-3 and sound an alarm if the S/A temperature falls below 5° c

- SYSTEMS INTERFACE
 - normal
 - emergency

IV COMPONENT LIST

One – Jackson and Church Flexaire oil fired H94721A packaged furnace unit Model No SDF-15-02SH MB with a RIELLO burner assembly

flue pipe with MG1-8 gas barometric damper,
supply/return air blower assembly A12-12A

with fractional H P motor,

Honeywell L4064B-1592 fan limit control,

Furnas 16BE32AF starter,

potentiometer,

return air damper,

Honeywell M945A-1009 damper operator motors,

Honeywell T991A-1012 mixed air stat,

drum type humidifier,

heat exchanger,

Honeywell T4051A-1003 thermostat,

Honeywell R4222D1039 relay,

mixing box assembly,

outside air damper,

Honeywell H205A-1046 enthalpy control,

20x25x2in EZ kleen filters,

Other control devices (see chapter on Controls)

2 3-1 3 AHU - 3

I DESCRIPTION

This unit, a Jackson and Church Flexaire packaged unit located in Mechanical Room 117, provides heat to the rooms and facilities located in the south end of the building through a dedicated duct system with both supply, return and outside air ducting. This includes the main floor transient bedroom area, men's and women's washrooms, and the laundry facilities.

The S/A system feeds nineteen S/A registers through ducting made up of 4m of 850x400 duct, 11.5m of 400x250 duct, 4m of 350x200 duct, 2.5m of 300x200 duct, 9m of 250x200 duct, 30m of 200x100 duct, 6m of 250x150 duct, 16m of 200x150 duct all complete with balancing dampers and fire damper.

The R/A system collects air through fifteen return air grilles complete with fire dampers, returning the air back to the AHU through ducting made up of 6m of 150x150 duct, 6m of 250x200 duct, 8m of 400x200 duct, 8.5m of 500x200 duct, 4m of 750x250 duct.

Included in the makeup of both systems are elbows, reducing sections, installation brackets, and miscellaneous hardware.

I SEQUENCE OF OPERATION – MANUAL

- START-UP

- STOP / SHUTDOWN

The emergency shutdown switch HS-1B located outside of room 117 activates the emergency shut down of AHU-3 and locks out the fuel supply.

- SYSTEMS INTERFACE
 - normal
 - emergency

I SEQUENCE OF OPERATION – AUTOMATIC• **START-UP**

Operation of the AHU burner is initiated by the wall mounted thermostat (THERM-5) located in Transient bedroom 114. Upon activation of the burner motor (RF-5-1) the blower motor (RF-5-2) will be cycled by the fan limit control. Also the combustion air damper (DMC-5) will open upon start up of the burner and burner motor. Following a two minute time delay (RTD-5) the minimum outside air damper (DM5-1) is activated. If either the exhaust fans EF-2, EF-3 are operating the blower motor will run continuously, the return air damper will close to (POT-5B) setting while the outside air damper will open to (POT-5A) setting.

• **STOP / SHUTDOWN**

The unit is also equipped with an adjustable duct stat (SAR-5) and manual set Freezestat (FRZ-5) both located in the supply air duct.

The duct stat (SAR-5) will override the space thermostat (THERM-5) if the S/A temperature falls below 10° c.

The Freeze stat (FRZ-5) will lockout operation of AHU-3 and sound an alarm if the S/A temperature falls below 5° c.

• **SYSTEMS INTERFACE**

- normal
- emergency

IV COMPONENT LIST

One – Jackson and Church Flexaire oil fired H94721AB packaged furnace unit Model No SDF-15 02SH MB with RIELLO burner assembly

flue pipe with MG1-8 gas barometric damper,
supply/return air blower assembly A12-12A
with fractional H P motor,

Honeywell L4064B-1592 fan limit control,

Furnas 16BE32AF starter,

potentiometer,

return air damper,

Honeywell M945A-1009 damper operator motors,

Honeywell T991A-1012 mixed air stat,

drum type humidifier,

heat exchanger,

Honeywell T4051A-1003 thermostat,

Honeywell R4222D1039 relay,

mixing box assembly,

outside air damper,

Honeywell H205A-1046 enthalpy control,

20x25x2in EZ kleen filters,

other control devices (see chapter on Controls)

2 3-1 4 FU – 1**J DESCRIPTION**

This unit – an Arco warm air furnace located in Mechanical Room 146 on the main floor provides heated air to the crawl space through a dedicated duct distribution system with both S/A and R/A ducting.

The S/A ducting consists of 7.5m of 400x250 duct, 27.5m of 350x200 duct, 12.5m of 250x250 duct, 4m of 200x150 duct and two balancing dampers.

The R/A ducting consists of 16m of 550x200 duct, a 760x300 R/A grille and duct stat.

I SEQUENCE OF OPERATION – MANUAL• **Start-up**• **STOP / SHUTDOWN**

The emergency shutdown switch HS-2B located outside of room 146 activates the emergency shut down of the burner motor and fuel supply valve closure.

- SYSTEMS INTERFACE
 - normal
 - emergency

II SEQUENCE OF OPERATION – AUTOMATIC

• START-UP

Operation of the FU burner is initiated by a thermostat (THERM-1) mounted in the return air duct in the crawl space. Upon activation of the burner motor, the blower motor will cycle via the fan limit control. The combustion air damper (DMC-1) will also open upon start up of the burner and burner motor. Following a two minute time delay, the minimum outside air damper (DM1-1) will open potentiometer (POT-1).

• STOP / SHUTDOWN

The unit is also equipped with an adjustable duct stat (SAR-1) located in the supply air duct and Freezestat (FRZ-1).

The duct stat (SAR-1) will override the space thermostat (THERM-1) if the S/A temperature falls below 10° c.

The Freeze stat (FRZ-1) will lockout operation of FU-1 and sound an alarm if the S/A temperature falls below 5° c.

- SYSTEMS INTERFACE
 - normal
 - emergency

IV COMPONENT LIST

One - Arco oil fired furnace complete with flue pipe and damper
blower assembly with fractional H P motor
thermostat
outside air damper operator
combustion air damper operator
mixed air stat
drum type humidifier with Humidistat

RIELLO burner assembly
heat exchanger
fan limit control
duct stat
potentiometer
mixing box assembly
filter section and filters
Other control devices (see chapter on Controls)

2 3-1 5 FU – 2

I DESCRIPTION

This unit, an Arco warm air furnace located in Mechanical Room 146 on the main floor provides heated air to the kitchen and cafeteria on the main floor through a dedicated duct distribution system with both S/A and R/A ducting.

The S/A ducting consists of 12.5m of 600x300 duct, 20.5m of 400x200 duct, 2m of 450x250 duct, 3.5m of 300x100 duct, 8.5m of 250x100 duct, 5m of 150x100 duct, five S/A registers, balancing dampers, fire damper, duct reducers and elbows.

The R/A ducting consists of 10m of 600x300 duct, a 400 x 400 ceiling R/A grille, fire damper, and miscellaneous elbows, reducers, duct hangers and hardware.

I SEQUENCE OF OPERATION – MANUAL

- START-UP

- STOP / SHUTDOWN

The emergency shutdown switch HS-2B, located outside of room 146, activates the emergency shut down of the burner motor and fuel supply valve closure

- Systems interface
 - normal
 - emergency

III SEQUENCE OF OPERATION – AUTOMATIC

- START-UP

Operation of the FU burner is initiated by a thermostat (THERM-2) located in the cafeteria. Upon activation of the burner motor (RF2-1) the blower motor (RF2-2) will cycle via the fan limit control. The combustion air damper (DMC-2) will also open upon start up of the burner and burner motor. Following a two minute time delay (RTD-2) the minimum outside air damper (DM2-1) will open (POT-2A). If either fan EF-1, or the Kitchen Ecology unit are operating the blower motor will run continuously, the return air damper will close to (POT-2B) setting and the outside air damper will open.

- STOP / SHUTDOWN

The unit is also equipped with an adjustable duct stat (SAR-2) and Freezestat (FRZ-2) both located in the supply air duct.

The duct stat (SAR-2) will override the space thermostat (THERM-2) if the S/A temperature falls below 10° c.

The Freeze stat (FRZ-2) will lockout operation of FU-2 and sound an alarm if the S/A temperature falls below 5° c.

- SYSTEMS INTERFACE

- normal
- emergency

IV COMPONENT LIST

One - Arco oil fired furnace complete with flue pipe and damper
blower assembly with fractional H P motor thermostat
outside air damper operator
combustion air damper operator
mixed air stat
drum type humidifier with Humidistat

RIELLO burner assembly
heat exchanger
fan limit control
duct stat
potentiometer
mixing box assembly
filter section and filters
Other control devices (see chapter on Controls)

2 3-1 6 EF-1**I DESCRIPTION**

This fan, a Cook SQI, is located in the Mechanical room 146 and serves the cafeteria. Rated at 289 cfm, it draws air from the cafeteria and expels it to the outside through a single duct system. This fan is interlocked with FU-2.

II SEQUENCE OF OPERATION – MANUAL• **START-UP**

Fan EF-1 is operated from a disconnect in the cafeteria and it also switches the relay (REX-1) in CAB-2. On energization of EF-1 the relay RE1-1 operates which in turn results in the continuous operation of the blower FU-2.

• **STOP / SHUTDOWN**• **SYSTEMS INTERFACE**

- normal
- emergency

III SEQUENCE OF OPERATION – AUTOMATIC• **START-UP**• **STOP / SHUTDOWN**• **SYSTEMS INTERFACE**

- normal
- emergency

IV COMPONENT LIST

- 1 COOK 90SQI - B

2 3-1 7 EF-2**I DESCRIPTION**

This fan, a Cook SQI, serves the Men's washroom on the main floor. Rated at 362 cfm it removes a fixed volume of air from the space and expels it to the outside through a single duct.

II SEQUENCE OF OPERATION – MANUAL• **START-UP**

EF-2 is activated from a switch in the men's washroom and its operation switches relay (REX-2) in CAB-

2

• **STOP / SHUTDOWN**• **SYSTEMS INTERFACE**

- normal
- emergency

III SEQUENCE OF OPERATION – AUTOMATIC• **START-UP**

On energization of EF-2 the relay RF4-2 is activated resulting in the continuous operation of the blower fans on AHU-2 and AHU-3

• **STOP / SHUTDOWN**• **SYSTEMS INTERFACE**

– normal

This fan is interlocked with AHU-2, AHU-3

– emergency

IV Component List

1 Cook SQI90-B

2 3-1 8 EF-3**I DESCRIPTION**

This fan, a Cook SQI, serves the women's washroom on the main floor. Rated at 289 cfm it removes a fixed volume of air from the space and expels it to the outside through a single duct. Makeup air for the space enters through a grille in the entry door.

This fan is also interlocked with AHU-2, AHU-3

II SEQUENCE OF OPERATION – MANUAL• **START UP**

EF-3 is activated from a switch in the women's washroom and it's operation switches relay (REX-3) in CAB-3

On energization of EF-3 the relay RF5-2 is activated resulting in the continuous operation of the blower fans on AHU-2 and AHU-3

• **STOP / SHUTDOWN**• **SYSTEMS INTERFACE**

– normal

– emergency

III SEQUENCE OF OPERATION – AUTOMATIC• **START-UP**• **STOP / SHUTDOWN**• **SYSTEMS INTERFACE**

– normal

– emergency

IV COMPONENT LIST

2 3-1 9 EF-4**J DESCRIPTION**

EF-4, a Broan Lo-Sone 362, is located in the Mechanical room 146 and serves the janitor's closet room 152 in the kitchen on the main floor. Rated at 200 cfm it removes a fixed volume of air from the space and expels it to the outside through the duct for EF-1. Makeup air for the space enters through the spaces around and under the entry door.

I SEQUENCE OF OPERATION – MANUAL

- **START-UP**
EF-4 is turned on from a switch located in the janitor closet
- **Stop / shutdown**
EF-4 is turned off from a switch located in the janitor closet

- **SYSTEMS INTERFACE**
 - normal
 - emergency

II SEQUENCE OF OPERATION – AUTOMATIC

- **START-UP**

- **STOP / SHUTDOWN**

- **SYSTEMS INTERFACE**
 - normal
 - emergency

IV COMPONENT LIST

- 1 Broan 360 Lo -Sone ventilator

2 3-1 10 KITCHEN ECOLOGY UNIT**J DESCRIPTION**

This unit, a Garland Ecology Energy Reclaim System removes cooking fumes, odours, and fouled air from the kitchen cooking facilities. Fans EF-5 and EF 6 are part of this unit.

I SEQUENCE OF OPERATION – MANUAL

- **START-UP**

- **STOP / SHUTDOWN**

- **SYSTEMS INTERFACE**
 - normal
 - emergency

II SEQUENCE OF OPERATION – AUTOMATIC

- **START-UP**

- STOP / SHUTDOWN
- SYSTEMS INTERFACE
 - normal
This unit is interlocked with FU-2, AHU-2, and AHU-3
 - emergency

IV COMPONENT LIST

- 1 Garland Ecology Energy Reclaim Unit complete with
 - Control Panel
 - Filter Module
 - Odour reducing module
 - Exhaust fan module
 - Ecology control panel
 - Energy reclaim module (optional)

2 3-1 12 EF-7 through EF-13

I DESCRIPTION

Broan 675 bathroom fans are mounted in the ceiling space above the second floor bathrooms. Rated at 72 cfm these units remove a fixed volume of air from the occupied accommodations thus providing ventilation for the bathrooms.

II SEQUENCE OF OPERATION – MANUAL

- START-UP
Fans are operated from wall switches mounted in the bathroom on the wall
- STOP / SHUTDOWN
- SYSTEMS INTERFACE
 - normal
 - emergency

III SEQUENCE OF OPERATION – AUTOMATIC

- STOP / SHUTDOWN
- SYSTEMS INTERFACE
 - normal
 - emergency

IV COMPONENT LIST

Broan 675 bathroom fans

2 3-1 13 EF-14**I DESCRIPTION**

EF-14, a Broan Lo-Sone 362, serves the second floor laundry and janitorial room 222. Rated at 107 cfm it removes a fixed volume of air from the space and expels it to the outside through the duct for EF-14. Makeup air for the space enters through the spaces around and under the entry door.

II SEQUENCE OF OPERATION – MANUAL

- START-UP

- STOP / SHUTDOWN

- SYSTEMS INTERFACE
 - normal
 - emergency

III SEQUENCE OF OPERATION – AUTOMATIC

- START-UP

- STOP / SHUTDOWN

- SYSTEMS INTERFACE
 - normal
 - emergency

IV COMPONENT LIST

- 1 Broan 360 Lo -Sone ventilator

2 3-2 FUEL STORAGE AND DISTRIBUTION**I GENERAL DESCRIPTION**

The fuel oil supply for the oil fired equipment in the building is supplied from a 25,000 L storage tank located outside the facility on the south west corner. This oil is piped to day storage tanks located inside the building where it is stored for immediate use. From the day tanks the oil is distributed to the various oil fired units through a system of pipes, valves, and transfer pumps.

Propane is also provided to the facility from a propane tank adjacent to the loading dock ramp on the north side of the building. This propane is distributed exclusively to the food preparation equipment in the kitchen.

2 3-2 1 DAY TANK TK -2**I DESCRIPTION**

Tank TK -2 located in Mechanical Room 146 supplies fuel to hotwater heaters DWH -1 and DWH -2, furnaces Fu -1 and Fu -2, and Air Heating Units AHU-1 and AHU-2. Fuel oil transfer pumps P-5 and P-6 pump fuel oil from the main storage tank to the day tank TK -2. From TK -2 fuel oil flows to the burner units on the equipment identified through a system of pipes, valves and filters.

II SEQUENCE OF OPERATION – MANUAL• **START-UP**

Set the selector switch in panel CP-1 to the "HAND" position. This permits the manual operation of either P-5 or P-6.

• **STOP / SHUTDOWN**

Set the selector switch in panel CP-1 to the "OFF" position. This permits the manual stopping of either P-5 or P-6. This action by-passes Alternator Alt -1.

• **SYSTEMS INTERFACE**

– normal

– emergency

Through emergency shutdown button HS-2B and Fv -2B

III SEQUENCE OF OPERATION – AUTOMATIC• **START-UP**

With the selector switch in panel CP-1 set in the "AUTO" mode the fuel oil transfer pumps P-5 and P-6 will operate alternately through the alternator ALT -1.

Two level switches LS-4A-2 and LS-4A-3 control the fuel oil level in the tank. When the fuel level drops level switch LS-4A-3 will start either P-5 or P-6 which then starts pumping fuel into the tank. Level switch LS-4A-2 stops the pumping when the level reaches its level.

The tank is also fitted with two level alarms LS-4A-1 and LS-4A-4.

LS-4A-1 mounted 100mm from the top of the tank is a high level alarm and LS-4A-4 is a low level alarm. An audible alarm sounds when either is activated and an indicator light comes on in panel CP-1.

A pneumatic level gauge is mounted adjacent to the control panel and indicates the fuel level in litres.

Auxiliary fuel valves are piped in series with the burner fuel valve which opens upon an ignition signal from the temperature control. From the tank, fuel oil flows to the Riello burners by gravity feed via single fuel lines. A N O gate valve (#115) and a N O solenoid valve are installed in the fuel line adjacent to the tank. The solenoid valve (no number) is kept open via the heat detectors mounted over the burner units.

- STOP / SHUTDOWN
 - Pumps P-5 and P-6 are cycled "OFF" through the Alternator Alt -1
 - The solenoid valve closes off the fuel supply when any fire caused by burner malfunction is detected

- SYSTEMS INTERFACE
 - normal
 - Tank TK -2 located in Mechanical Room 146 supplies fuel to hot water heaters DWH -1, DWH -2, furnaces Fu -1 and Fu -2, and Air Heating Units AHU-1 and AHU-2
 - Relief air dampers interlocked to burners and alarms
 - emergency
 - Shutdown button HS-2B
 - Heat detectors at the burners

IV COMPONENT LIST

One Main Storage Tank TK -1, capacity unknown complete with
 80mm vent pipe level indicator,
 drain pipe and valve, overflow return pipes from day tanks,
 fuel indicator flexible connection, and gate valve
 Supply lines to TK-2, TK-7 and TK-12

Fuel tank TK -2 230 litre capacity complete with
 supply fuel lines and gate valves, line strainers
 flexible connections transfer pumps P-5 and P-6
 flexible connections swing check valves
 bypass gate valve drain pipe and gate valve
 level indicator high level alarm LS-4A -1
 LS-4A -2 high level switch LS-4A -3 low level switch
 LS-4A -4 low level alarm 1 - NO gate valve
 gate valve fuel line
 gate valve solenoid valve
 fuel delivery line to burners on equipment fuel meter

VALVE TAG SCHEDULE

<u>DESCRIPTION</u>	<u>ITEM NO.</u>	<u>LOCATION</u>	<u>VALVE</u>	<u>NUMBER</u>	<u>POSITION</u>
TK-2					
Fuel Pumps	P-5	Room 146	Inlet	#108	NO
			Outlet	#109	NO
Fuel Meter	P-6	Room 146	Inlet	#110	NO
			Outlet	#111	NO
			By-pass	#112	NO
			Inlet	#113	NO
Fuel Line		Room 146	Outlet	#114	NO
		Room 146	Supply	#115	NO
Level Switches		Room 146	Isolation	#116	NO
			Drain	#117	NC

<u>DESCRIPTION</u>	<u>ITEM NO.</u>	<u>LOCATION</u>	<u>VALVE</u>	<u>NUMBER</u>	<u>POSITION</u>
Fu-1					
Fuel Line		Room 146	Supply	#123	N O
Fusible Valve			Supply	#123	N O
			Solenoid	Fv2A-5	N C
Fu-2					
Fuel Line		Room 146	Supply	#121	N O
Fusible Valve			Supply	#122	N O
			Solenoid	Fv2A-4	N C
AHU-2					
Fuel Line		Room 146	Supply	#125	N O
Fusible Valve			Supply	#126	N O
Fuel Line		Room 146	Return	#127	N O
Fusible Valve			Return	#128	N O
			Solenoid	Fv2A 6	N C
AHU-1					
Fuel Line		Room 146	Supply	#129	N O
Fusible Valve			Supply	#130	N O
Fuel Line		Room 146	Return	#131	N O
Fusible Valve			Return	#132	N O
			Solenoid	Fv2A-3	N C
DWH-1					
Fuel Line		Room 146	Supply	#133	N O
Fusible Valve			Supply	#134	N O
Fuel Line		Room 146	Return	#135	N O
Fusible Valve			Return	#136	N O
DWH-2					
Fuel Line		Room 146	Supply	#137	N O
Fusible Valve			Supply	#138	N O
Fuel Line		Room 146	Return	#139	N O
Fusible Valve			Return	#140	N O
Legend	Position	Normally Open - N/O Normally Closed - N/C			

2 3-2 2 DAY TANK TK -7

I DESCRIPTION

Tank TK -7 located in Mechanical Room 117 supplies fuel to hot water heaters DWH -3 and Air Heating Units AHU-3 Fuel oil transfer pumps P-11 and P-12 pump the fuel oil from the main storage tank to the day tank TK -7 From TK -7 fuel oil flows to the burner units on the equipment identified through a system of pipes valves and filters

I SEQUENCE OF OPERATION – MANUAL

• START-UP

Set the selector switch HS-3A in panel CP-2 to the "HAND" position This permits the manual operation of either P-11 or P-12

- STOP / SHUTDOWN
 - Set the selector switch HS-3A in panel CP-2 to the "OFF" position This permits the manual stopping of either P-11 or P-12 This action by-passes Alternator Alt -2
- SYSTEMS INTERFACE
 - normal
 - emergency
 Through emergency shutdown button HS-1B and Fv -1B

II SEQUENCE OF OPERATION – AUTOMATIC

• START-UP

With the selector switch in panel CP-2 set in the "AUTO" mode the fuel oil transfer pumps P-11 and P-12 will operate alternately through the alternator ALT -2

Two level switches LS-3A-2 and LS-3A-3 control the level of the fuel oil in the tank When the fuel level drops level switch LS-3A-3 will start either P-11 or P-12 which then starts pumping fuel into the tank Level switch LS-3A-2 stops the pumping when the level reaches it's level

The tank is also fitted with two level alarms LS-3A-1 and LS-3A-4

LS-3A-1 mounted 100mm from the top of the tank is a high level alarm and LS-3A-4 is a low level alarm An audible alarm sounds when either is activated and an indicator light comes on in panel CP-2

A pneumatic level gauge is mounted adjacent to the control panel and indicates the fuel level in litres

Auxiliary fuel valves are piped in series with the burner fuel valve which opens upon an ignition signal from the temperature control From the tank, fuel oil flows to the Riello burners by gravity feed via single fuel lines A N O gate valve (#115) and a N O solenoid valve are installed in the fuel line adjacent to the tank The solenoid valve (no number) is kept open via the heat detectors mounted over the burner units

• STOP / SHUTDOWN

Pumps P-11 and P-12 are cycled "OFF" through the Alternator Alt -2

The solenoid valve Fv-1B closes, shutting off the fuel supply when any fire caused by burner malfunction is detected

• SYSTEMS INTERFACE

- normal

Tank TK -7 located in Mechanical Room 114 supplies fuel to hot water heaters DWH -3 and Air Heating Units AHU-3

Relief air dampers interlocked to burners and alarms

- emergency

Shutdown button HS-1B

Heat detectors at the burners

IV COMPONENT LIST

Fuel tank TK -7, 230 litre capacity complete with
 Fuel delivery lines from Main Storage Tank TK -1
 flexible connections
 bypass gate valve
 level indicator
 LS-3A -2 high level switch

transfer pumps P-11 and P-12
 swing check valves
 drain pipe and gate valve
 high level alarm LS-3A -1
 LS-3A -3 low level switch

- SYSTEMS INTERFACE
 - normal
 - emergency

II SEQUENCE OF OPERATION – AUTOMATIC

• START-UP

With the selector switch in panel CP-1 set in the "AUTO" mode the fuel oil transfer pumps P-13 and P-14 will operate alternately through the alternator ALT -3

Two level switches LS-12A-2 and LS-12A-3 control the level of the fuel oil in the tank. When the fuel level drops level switch LS-12A-3 will start either P-13 or P-14 which then starts pumping fuel into the tank. Level switch LS-12A-2 stops the pumping when the level reaches its level.

The tank is also fitted with two level alarms LS-12A-1 and LS-12A-4.

LS-12A-1 mounted 100mm from the top of the tank is a high level alarm and LS-12A-4 is a low level alarm. An audible alarm sounds when either is activated and an indicator light comes on in panel CP-1.

A pneumatic level gauge is mounted adjacent to the control panel and indicates the fuel level in litres.

Auxiliary fuel valves are piped in series with the burner fuel valve which opens upon an ignition signal from the temperature control. From the tank, fuel oil flows to the Riello burners by gravity feed via single fuel lines. A N/O gate valve and a N/O solenoid valve are installed in the fuel line adjacent to the tank. The solenoid valve (no number) is kept open via the heat detectors mounted over the burner units.

• STOP / SHUTDOWN

Pumps P-13 and P-14 are cycled "OFF" through the Alternator Alt -3

• SYSTEMS INTERFACE

- normal
- emergency
- Heat detectors at the burners

IV COMPONENT LIST

Fuel tank TK -7, 230 litre capacity complete with fuel delivery lines from Main Storage Tank TK -1	
Transfer pumps P-13 and P-14	flexible connections
swing check valves	bypass gate valve
Fuel tank TK -12 complete with	drain pipe and gate valve
level indicator	high level alarm LS-12A -1
LS-12A -2 high level switch	LS-12A -3 low level switch
LS12A -4 low level alarm	1 - NO gate valve
gate valve	fuel line
gate valve	
fuel delivery line to burners on equipment	

VALVE TAG SCHEDULE

DESCRIPTION	ITEM NO.	LOCATION	VALVE	NUMBER	POSITION
TK-12					
Fuel Meter		Room 146	By-pass	#101	N/O
			Inlet	#102	N/O
		Room 145	Outlet	#103	N/O

Fuel Pumps	P-13	Room 145	Inlet	#104	N/O
			Outlet	#105	N/O
	P-14	Room 145	Inlet	#106	N/O
			Outlet	#107	N/O
Fuel Line		Room 145	Supply	#108	N/O
Level Switches		Room 145	Isolation	#109	N/O
			Drain	#110	N/C
Emergency Generator		Room 145	Supply	#210	N/O
Fusible Valve			Supply	#211	N/O
Legend	Position	Normally Open - N/O			
		Normally Closed - N/C			

2 3-3 PLUMBING

I DESCRIPTION

Pumbing for the facility consists of two systems, domestic water which includes domestic hot water circulation, and sanitary and waste water

The domestic water system is divided into two systems serving three separate areas of the facility. Each system is equipped with a water storage tank, two booster pumps, one hydropneumatic tank, hot water tanks, valves, controllers, pipes, fittings, fixtures, and equipment. Water is brought in by tanker truck and pumped into the two water storage tanks located in the crawl space of the facility.

The first of the two systems serving this facility supplies water to the staff accommodation area on the second floor, and the kitchen/cafeteria area from storage tank TK-3. The second of the two systems serves the transient accommodation and washroom area from storage TK-8. Distribution is accomplished by means of four booster pumps, P-1, P-2, P-7, and P-8 which pump the water into two hydropneumatic tanks TK-6 and TK-8. From these tanks the water is circulated to all domestic and sanitary fixtures, hot water tanks, humidifiers, etc through the installed system of pipes, valves, fittings, controllers, etc.

The sanitary and waste water system is made up of three separate systems serving four separate areas. Each system contains four sewage holding tanks, large and small diameter drain pipes, vent pipes, cleanouts, fixtures, and equipment. The sanitary holding tanks TK -4, TK -5, TK -9 and TK -10 and three piping systems drain waste water from the various locations in the building. Holding tanks TK -4 and 5 serve the kitchen, cafeteria, and second floor staff accommodations. Holding tank TK -9 serves the transient accommodations and women's washroom. Holding tank TK -10 serves the transient accommodations and men's washroom and laundry. Each tank is equipped with a pump out connection located on the exterior of the building and when the tanks are full the effluent is pumped into a tanker truck and taken away for disposal. Gases produced in the system are vented off through the ventilator pipes in each of the three systems.

2 3-3 1 DOMESTIC WATER TK-3

I DESCRIPTION

Water tank TK-3, with a capacity of 11,365 litres, is located in the crawl space directly under the kitchen. It provides water to the kitchen/ cafeteria area on the main floor, to the second floor staff accommodation and to the domestic hot water heaters DWH-1 and DWH-2 via a system of pipes, valves, and pumps. Pressure in the system is maintained by two pressure pumps P-1 and P-2 which pump water into hydropneumatic tank TK-6. From TK-6 cold water is distributed to the hot water tanks, all the domestic and sanitary fixtures, humidifiers, kitchen equipment etc through the installed system of pipes, valves, fittings, controllers, etc.

I SEQUENCE OF OPERATION – MANUAL**• START-UP**

Commence by filling the tank TK-3 with water. Open the gate valve at the tank and the gate valves at the booster pumps P-1 and P-2. Place the selector switch in the hand (manual) position. This results in the continuous operation of the booster pumps and the by-passing of the pressure switches PS-6A-1 and PS-6A-2. With the booster pumps operating water is pumped into hydropneumatic tank TK-6 from which pressurized water is circulated throughout the serviced area. If the booster pumps have been stopped by the Low Level override switch LS-6A-3 and the line pressure has dropped below 40 psi the pumps must be restarted by resetting the low level switch.

PLEASE NOTE If the pumps P-1 and P-2 are stopped by the low level switch LS-6a-3 and the water line pressure drops below 40 psi these pumps will have to be started manually by resetting the switch located adjacent to the pumps.

• STOP / SHUTDOWN

Turn the booster pumps P-1 and P-2 off by either moving the selector switch to the OFF position or pulling the disconnect switch. Close the gate valves for the booster pumps and close the gate valve at the storage tank TK-3.

• SYSTEMS INTERFACE

- normal
- emergency

II SEQUENCE OF OPERATION – AUTOMATIC**• START-UP**

Commence by filling storage tank Tk-3. With the storage tank TK-3 full a high level alarm LS-6A-2 activates an indicator light on the exterior of the building adjacent to the fill pipe. When the tank is full and the appropriate gate valves are open set the selector switch to AUTO. This will activate booster pumps P-1 and P-2. These pumps will now alternate their operation through alternator ALT -5 in accordance with the settings on the pressure switches PS-6A-1 and PS-6A-2. When the line water pressure drops below 60 psi the contacts close activating the booster pump selected by ALT -5. With the booster pump operating, water is pumped into the hydropneumatic tank TK -6. From here pressurized water is distributed to the various fixtures etc. in the area.

• STOP / SHUTDOWN

When filling the storage tank TK-3 full a high level switch LS-6A-2 activates an indicator light on the exterior of the building adjacent to the fill pipe. This indicates that the tank is full and filling should stop. A low water level in the tank is indicated by an audible alarm located at panel CP-1, an audible and visual alarm at Remote -1 in room 225, and a remote on the roof. These alarms are initiated by the low level switch LS-67A-1. A second low level alarm LS-6A-3 stops the booster pumps P-1 and P-2 when the water level falls below 60 psi.

• SYSTEMS INTERFACE

Operation of the booster pumps P-1 and P-2 is interlocked with the sewage holding tanks TK -4 and TK -5 via the high level sensor and alarm in the sewage holding tanks. If the high level alarm LS-8A-1 is activated operation of the two booster pumps is locked out. Operation can be restored after the level has dropped and the reset button at CP-1 in room 146 has been reset.

- normal
- emergency

IV COMPONENT LIST

2500 gal water tank TK-3 complete with	50 Ø water fill connection, Kamlock fitting and cap,
50 Ø vent pipe	high level alarm and indicator
80 Ø overflow	low level alarm
80 Ø drain	
1 gate valve	40 Ø pipe
2 gate valves	2 drain lines with ball valves
2 flexible connections	2 booster pumps P-1 and P-2 with pressure switches
2 flexible connections	2 check valves
2 gate valves	1 - 44gallon hydropneumatic tank TK -6
30 Ø lines to kitchen and staff areas	20 Ø to the hot water tanks DWH-1 and DWH-2

VALVE TAG SCHEDULE**DOMESTIC COLD WATER**

<u>DESCRIPTION</u>	<u>ITEM NO.</u>	<u>LOCATION</u>	<u>VALVE</u>	<u>NUMBER</u>	<u>POSITION</u>
Water main		Crawl Space	Supply		N O
			Drain		N C
Domestic water	P-1	Crawl Space	Inlet	#225	N O
			Outlet	#226	N O
	P-2	Crawl Space	Inlet	#227	N O
Hydropneumatic	TK -6	Room 146	Isolation	#141	N O
			Drain	#142	N C
Kitchen		Room 146	Supply	#158	N/O
Juice Dispenser		Crawl space	Supply	#229	N/O
Rooms 209, 210, & 211		Room 146	Supply	#159	N/O
Rooms 212, 213, & 214		Room 142	Supply	#162	N/O
Rooms 216, 217, & 217		Room 143	Supply	#165	N/O
Rooms 219, 220, & 221		Room 150	Supply	#168	N/O
Rooms 206, 207, & 208		Room 150	Supply	#171	N/O
Rooms 222, & 223		Room 150	Supply	#174	N/O
Rooms 225		Room 150	Supply	#176	N/O
Rooms 202, 203, 204, & 205		Room 150	Supply	#178	N/O
Legend	Position	Normally Open - N/O			
		Normally Closed - N/C			

2 3-3 2 DOMESTIC WATER TK-8**I DESCRIPTION**

Water tank TK-8, with a capacity of 3,900 litres, is located in the crawl space directly under mechanical room 117 on the main floor and provides water to the Transient Area and Washrooms on the main floor and to the domestic hot water heater DWH-3 located in room 117 via a system of pipes, valves, and pumps. Pressure in the system is maintained by two pressure pumps P-7 and P-8 which pump water into hydropneumatic tank TK-11 located in room 117. From TK-11 cold water is distributed to the hot water tanks, all the domestic and sanitary fixtures, humidifiers, kitchen equipment etc through the installed system of pipes, valves, fittings, controllers, etc.

I SEQUENCE OF OPERATION – MANUAL• **START-UP**

Commence by filling the tank TK-8 with water. Open the gate valve at the tank and the gate valves at the booster pumps P-7 and P-8. Place the selector switch in the hand (manual) position. This results in the continuous operation of the booster pumps and by passing of the pressure switches PS-7A-1 and PS-7A-2. With the booster pumps operating water is pumped into the hydropneumatic tank TK-6 from which pressurized water is circulated throughout the serviced area.

When filling storage tank TK-8 a high level alarm LS-7A-2 activates an indicator light on the exterior of the building adjacent to the fill pipe when the tank is full. The tank is also equipped with a low level alarm LS-7A-1 which is activated when the water level falls below a certain point. When an alarm is initiated an audible alarm located on CP-1 and Remote-1 will sound and a light will flash at CP-1, Remote-1 and on the roof.

• **STOP / SHUTDOWN**

Turn the booster pumps P-7 and P-8 off by either moving the selector switch to the OFF position or pulling the disconnect switch. Close the gate valves for the booster pumps and close the gate valve at the storage tank TK-8.

• **SYSTEMS INTERFACE**

- normal
- emergency

II SEQUENCE OF OPERATION – AUTOMATIC• **START-UP**

With the storage tank TK-8 full and the appropriate gate valves open set the selector switch to AUTO. This will activate booster pumps P-7 and P-8. These pumps will now alternate their operation through alternator ALT-4 in accordance with the settings on the pressure switches PS-7A-1 and PS-7A-2. When the line water pressure drops below a set point, the contacts close and activate the booster pump selected by ALT-4. With the booster pump operating, water is pumped into the hydropneumatic tank TK-11. From here pressurized water is distributed to the various fixtures etc. in the area.

• **STOP / SHUTDOWN**

As previously described the booster pumps P-7 and P-8 cycle ON and OFF during their normal operation.

To turn the booster pumps P-7 and P-8 off either move the selector switch to the OFF position or pull the disconnect switch. Close the gate valves for the booster pumps and close the gate valve at the storage tank TK-8.

• **SYSTEMS INTERFACE**

- normal

Operation of the booster pumps P-7 and P-8 is interlocked with the sewage holding tanks TK-9 and TK-10 via the high level sensor and alarms in the sewage holding tanks. If both high level alarms LS-9A-1 and LS-10A-1 are activated, operation of the two booster pumps is locked out. Operation can be restored after the level has dropped and the reset button at CP-1 in room 146 has been reset.

A high level alarm in (LS-9A-1) in sewage holding tank TK-9 will lockout water supply S1-3 to the women's washroom until the level has dropped and the alarm is cleared by resetting the button CP-1 in room 146.

A high level alarm in (LS-10A-1) in sewage holding tank TK -10 will lockout water supply S4-6 to the men's washroom until the level has dropped and the alarm is cleared by resetting the button CP-1 in room 146

- emergency

IV COMPONENT LIST

- | | |
|---|--|
| 850 gal water tank TK-8 complete with | 50 Ø water fill connection, Kamlock fitting and cap, |
| 50 Ø vent pipe | high level alarm and indicator |
| 80 Ø overflow | low level alarm |
| 80 Ø drain | 40 Ø pipe |
| 1 gate valve | 2 drain lines with ball valves |
| 2 gate valves | 2 booster pumps P-7 and P-8 with pressure switches |
| 2 flexible connections | 2 check valves |
| 2 flexible connections | 1 - 44gallon hydropneumatic tank TK -11 |
| 2 gate valves | 30 Ø line |
| 20 Ø to the hot water tanks DWH-3 | lines to Women's and men's washrooms and laundry |
| 2 solenoid controlled gate valvesgate valve | |

VALVE TAG SCHEDULE

DOMESTIC COLD WATER

DESCRIPTION	ITEM NO.	LOCATION	VALVE	NUMBER	POSITION
TK -8		Crawl space	Drain	#212	N/O
Water main		Crawl space	Supply		N/O
Domestic water	P-7	Crawl space	Inlet	#213	N/O
			Outlet	#214	N/O
	P-8	Crawl space	Inlet	#215	N/O
			Outlet	#216	N/O
Hydropneumatic	TK-11	Room 117	Isolation	#201	N/O
			Drain	#	N/C
Room 107 & 108		Crawl space	Supply	#218	N/O
Utility Room 106		Crawl space	Supply	#221	N/O
Room 122		Crawl space	Supply	#222	N/O

Legend

- Position Normally Open - N/O
Normally Closed - N/C

2 3-3 3 DOMESTIC HOT WATER DWH-1 & DWH-2

I DESCRIPTION

Domestic hot water for the kitchen /cafetena area and the second floor staff accommodations is produced in two oil fired tank heaters DWH-1 and DWH- 2 located in mechanical room 146 Heated water from these tanks is then distributed through a piping system equipped with circulating pumps P-3 and P-4, pipes, fittings, valves, controllers, etc The system is designed to permit either hot water tank to supply hot water to the system with the other tank off

I SEQUENCE OF OPERATION – MANUAL

• **START-UP**

- Open valves on the main water supply and activate the main water supply system
- Open valves on the hot water circulating system
- Turn on the burner unit

Activate the recirculating pumps P-3 and P-4 via the manual wall switches. Circulating pump P-3 recirculates the hot water while P-4 recirculates the tempered water.

The temperature control on each tank DWH-1 and DWH-2 is a pre set limit control.
Set mixing valve to 35°

- STOP / SHUTDOWN

Close valves on the main water supply and deactivate the main water supply system.

Close valves on the hot water circulating system.

Turn off the burner unit.

Deactivate the recirculating pumps P-3 and P-4 via the manual wall switches. Circulating pump P-3 recirculates the hot water while P-4 recirculates the tempered water.

Emergency burner motor shutdown is provided through HS-2B in room 146.

- SYSTEMS INTERFACE

See Automatic operation.

III SEQUENCE OF OPERATION – AUTOMATIC

- START-UP

After the hot water system supplied from hot water tanks DWH-1 and DWH-2 is activated the hot water tanks will operate as controlled by their respective preset temperature limit controls.

- STOP / SHUTDOWN

Tank operation cycles via temperature limit controls which are preset.

Auto shutdown will occur via interlocks identified following.

- SYSTEMS INTERFACE

- normal

Provisions for interlocking of auxiliary fuel oil shut off valves FV-2A-1 and FV-2A-2.

Combustion air dampers DMC -6 and DMC -7 through burner fan interlock relays RW-1 and RW-2.

- emergency

Emergency burner motor shutdown and fuel lockout is provided through HS-2B in room 146.

Emergency shutdown relay R2B-5 and R2B-6.

IV COMPONENT LIST

2-butter fly valves

2-gate valves

2-temperature sensors high limit

hot water line to system

mixing valve

gate valve

cold water line to gate valve, to mixing valve

temperature indicator

butterfly valve

gate valve

Hot water return

Hot water recirculating pump P-3

Hot water return line to tank DWH-2

2-hot water heaters, DWH-1 and DWH-2

20 Ø lines to 2-temperature indicators

25 Ø line to T coupling

line to gate valve and mixing valve

temperature indicator

30 Ø line to showers

tempered water recirculation line

tempered water recirculating pump P-4

15 Ø tempered water return line to DWH-1

T connection

gate valve

butterfly valve

gate valve T connection

VALVE TAG SCHEDULE		DOMESTIC HOT WATER				
DESCRIPTION	ITEM NO.	LOCATION	VALVE	NUMBER	POSITION	
DWH-1						
Cold water main		Room 146	Inlet	#143	N/O	
Hot water			Outlet	#144	N/O	
Return			Isolation	#145	N/O	
Tank			Drain	#146	N/C	
DWH-2						
Cold water main		Room 146	Inlet	#147	N/O	
Hot water			Outlet	#148	N/O	
Return			Isolation	#149	N/O	
Tank			Drain	#150	N/C	
Circulation Pumps						
Hot Water	P-3	Room 146	Inlet	#151	N/O	
			Outlet	#152	N/O	
Tempered water	P-4	Room 146	Inlet	#153	N/O	
			Outlet	#154	N/O	
Mixing Valve						
Tempered water		Room 146	Isolation	#155	N/O	
Cold water			Bypass	#156	N/C	
Hot Water						
Coffee maker		Crawl space	Supply	#230	N/O	
Rooms 209, 210, & 211		Room 146	Supply	#160	N/O	
Rooms 212, 213, & 214		Room 142	Supply	#163	N/O	
Rooms 216, 217, & 217		Room 143	Supply	#166	N/O	
Rooms 219, 220, & 221		Room 150	Supply	#169	N/O	
Rooms 206, 207, & 208		Room 150	Supply	#172	N/O	
Rooms 222, & 223		Room 150	Supply	#175	N/O	
Rooms 225		Room 150	Supply	#177	N/O	
Rooms 202, 203, 204, & 205		Room 150	Supply	#179	N/O	
Tempered Water						
Room 210		Room 146	Supply	#161	N/O	
Room 213		Room 142	Supply	#164	N/O	
Room 217		Room 143	Supply	#167	N/O	
Room 219, 220, 221		Room 150	Supply	#170	N/O	
Room 207		Room 150	Supply	#173	N/O	
Room 203, & 20		Room 150	Supply	#180	N/O	

Legend

Position Normally Open - N/O
Normally Closed - N/C

2 3-3 4 DOMESTIC HOT WATER DWH-3**I DESCRIPTION**

Domestic hot water for the transient accommodations, men's and women's washrooms, and laundry, is produced in one oil fired tank heater DWH-3 located in mechanical room 117. Heated water from this tanks is distributed through a piping system equipped with two circulating pumps P-9 and P-10, pipes, fittings, valves, controllers, etc. P-9 is a hot water recirculating pump and p-10 is a tempered water recirculating pump.

II SEQUENCE OF OPERATION – MANUAL**• START-UP**

Open valves on the main water supply and activate the main water supply system

Open valves on the hot water circulating system

Turn on the burner unit

Activate the recirculating pumps P-9 and P-10 via the manual wall switches. Circulating pump P-9 recirculates the higher temperature water while P-10 recirculates the cooler tempered water.

Set the temperature control on each tank DWH-3

Set mixing valves

• STOP / SHUTDOWN

Close valves on the main water supply and deactivate the main water supply system

Close valves on the hot water circulating system

Turn off the burner unit

Deactivate the recirculating pumps P-9 and P-10 via the manual wall switches. Circulating pump P-9 recirculates the higher temperature water while P-10 recirculates the cooler tempered water.

Emergency burner motor shutdown is provided through HS-1B in room 117

• SYSTEMS INTERFACE

See Automatic operation

II SEQUENCE OF OPERATION – AUTOMATIC**• START-UP**

After the hot water system supplied from hot water tank DWH-3 is activated the hot water tank will operate as controlled by it's internal controls

• STOP / SHUTDOWN

Tank operation cycles via internal controls

Auto shutdown will occur via interlocks identified following

• SYSTEMS INTERFACE

– normal

Transient Area and Washrooms

Provisions for interlocking of auxiliary fuel oil shut off valves FV-1A-1

Combustion air dampers DMC -8 through burner fan interlock relays RW-3

– emergency

Emergency burner motor shutdown and fuel lockout is provided through HS-1B in room 117

Emergency shutdown relay R1B- 2

IV COMPONENT LIST

1-hot water heater, DWH-3	cold water supply to tank DWH-3
1-butter fly valve	1-gate valve
20 Ø lines to temperature indicator	temperature sensor – high limit
25 Ø line to T coupling	hot water line to system
2 solenoid valves	line to men's washroom
line to women's washroom	20 Ø line to gate valve and mixing valve
mixing valve	temperature indicator
gate valve	30 Ø line to T connection
2-solenoid valves	line to men's washroom
line to women's washroom	cold watersupply line to gate valve, to mixing valve
tempered water recirculation line	temperature indicator
recirculating pump P-10	butterfly valve
15 Ø tempered water return line to DWH-1	gate valve
T connection	hot water return
gate valve	recirculating pump P-9
butterfly valve	return line to tank DWH-3
gate valve	T connection

VALVE TAG SCHEDULE	DOMESTIC HOT WATER				
DESCRIPTION	ITEM NO.	LOCATION	VALVE	NUMBER	POSITION
DWH-3					
Cold water main		Room 117	Inlet	#201	N/O
Hot water			Outlet	# ?	
Return			Isolation	# ?	
Tank			Drain	#202	N/C
Circulation Pumps					
Hot Water	P-9	Room 117	Discharge	#203	N/O
Tempered water	P-4	Room 117	Discharge	#204	N/O
Mixing Valve					
Hot water		Room 117	Supply	#205	N/O
Cold water			Supply	#206	N/C
Cold water			Return	#207	N/C
Cold water			Bypass	#209	N/C
Tempered water		Room 117	Isolation	#208	N/O
Hot Water					
Men's washroom etc		Crawl space	Supply	#217	N/O
Utility and laundry			Supply	#220	N/O
Women s washroom			Supply	#223	N/O
Tempered Water					
Men's washroom etc		Crawl space	Supply	#219	N/O
Women's washroom			Supply	#224	N/O

Legend

Position Normally Open - N/O
Normally Closed - N/C

2 3-3 5 SANITARY HOLDING TANK TK-4 & TK-5**I DESCRIPTION**

The sanitary drainage requirements are met through the use of four holding tanks TK -4, TK -5, TK -9 and TK -10 and three piping systems which drain waste water from the various locations in the building. Holding tanks TK -4 and 5 serve the kitchen, cafeteria, and second floor staff accommodations. Holding tank TK -9 serves the transient accommodations and women's washroom. Holding tank TK -10 serves the transient accommodations and men's washroom and laundry. Each tank is equipped with a pump out connection located on the exterior of the building. Gases produced in the system are vented off through the ventilator pipes in each of the three systems.

II SEQUENCE OF OPERATION – MANUAL

Systems operations are passive with no operating devices involved except for the alarm interlocks (See Sequence of Operation – Auto)

III SEQUENCE OF OPERATION – AUTOMATIC• **START-UP**• **STOP / SHUTDOWN**• **SYSTEMS INTERFACE**– **normal**

A high level sensor and alarm (LS-8A-1) in tanks TK-4 and 5 when activated will lock out the operation of domestic water pumps P-1 and P-2 until the alarm is cleared and the reset button on CP-1 in room 146 is reset.

– **emergency****IV COMPONENT LIST**

Holding tanks TK-4 and TK-5

80 Ø pump out from TK-4 with crossover from TK-4

150 Ø crossover header with gate valve

level indicator on each tank

drain pipe system from sinks, toilets, etc

cross over TK-4 to TK-5

2 –150 Ø capped drains with crossover pipe and valve

1 – 80 Ø vent pipe from each tank

500 Ø manhole in each tank

high level alarm LS-8A-1 on TK -5

grease trap on kitchen wash sink

drain pipe system from sinks, toilets, etc

2 3-3 6 SANITARY HOLDING TANK TK-9**I DESCRIPTION**

Holding tank TK -9 serves the transient accommodations and women's washroom. Each tank is equipped with a pump out connection located on the exterior of the building. Gases produced in the system are vented off through the ventilator pipes in each of the three systems.

II SEQUENCE OF OPERATION – MANUAL

Systems operations are passive with no operating devices involved except for the alarm interlocks (See Sequence of Operation – Auto)

I SEQUENCE OF OPERATION – AUTOMATIC

- START-UP
- STOP / SHUTDOWN
- SYSTEMS INTERFACE
 - normal

A high level sensor and alarm (LS-9A-1) in tanks TK-9 when activated will lock out the water supply to the transient accommodations, men's washroom and laundry until the alarm is cleared and the reset button on CP-1 in room 146 is reset

- emergency

IV COMPONENT LIST

Holding tank TK-9	2 – 150 Ø capped drains with gate valve
80 Ø pump out from TK-9	1 – 80 Ø vent pipe
500 Ø manhole in tank	level indicator
high level alarm LS-9A-1 on TK -9	drain pipe system from sinks, toilets, etc

2 3-3 7 SANITARY HOLDING TANK TK-10**I DESCRIPTION**

Holding tank TK -10 serves the transient accommodations and men's washroom and laundry. Each tank is equipped with a pump out connection located on the exterior of the building. Gases produced in the system are vented off through the ventilator pipes in each of the three systems.

I SEQUENCE OF OPERATION – MANUAL

Systems operations are passive with no operating devices involved except for the alarm interlocks. (See Sequence of Operation – Auto)

I SEQUENCE OF OPERATION – AUTOMATIC

- START-UP
- STOP / SHUTDOWN
- SYSTEMS INTERFACE
 - normal

A high level sensor and alarm (LS-10A-1) in tanks TK-10 when activated will lock out the the water supply to the transient accommodation and women's washroom until the alarm is cleared and the reset button on CP-1 in room 146 is reset

- emergency

IV COMPONENT LIST

Holding tank TK-10	2 – 150 Ø capped drains with crossover pipe and valve
80 Ø pump out from TK-10	1 – 80 Ø vent pipe from each tank
500 Ø manhole in each tank	level indicator on each tank
high level alarm LS-10A-1 on TK -10	drain pipe system from sinks, toilets, etc

2.3 MECHANICAL

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2.3 MECHANICAL

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2.3 MECHANICAL

I GENERAL DESCRIPTION

The general operation of the Working Accommodation Unit utilizes several systems to provide heating and ventilating, water and sanitary service, and fuel delivery. Specifically these systems are; heating and ventilating; domestic water storage and distribution; sanitary and waste water storage and disposal, fuel oil storage and distribution.

These systems provide the building with heat, ventilation, hot and cold water, sanitary facilities, and fuel delivery to the furnaces, hot water heaters and unit heaters.

The heating and ventilating system is made up of four Olsen LoweBoy furnaces, one Temprite suspended air handling unit, one Temprite floor mounted air handling unit, one Powermatic unit heater, five Penn Airette exhaust fans, and two return fans.

Domestic water is trucked in by tanker truck and pumped into one main storage tank. From this tank water is distributed throughout the facility by one pump and distribution piping, fitted with valves and controls. Hot water is provided from one hot water tank via distribution piping and a recirculating pump.

Sanitary requirements are served by a system of pipes from the various washrooms and sinks which drain waste water and sewage into three holding tanks and one sump.

The fuel delivery system consists of the main bulk oil tank situated outside at the Southwest corner of the building, one steel day tank in the mechanical room, four service pumps, and a distribution system consisting of steep piping, valves, meters and level controls.

2.3-1 HEATING AND VENTILATING

I GENERAL DESCRIPTION

Heating for the building is provided by four furnaces, two air handling units, and one unit heater. Heated air from the furnaces and air handling units is distributed throughout the building via low velocity duct distribution through feed registers and hot air grilles. While these units collectively provide heat for the building individually each one services a specific area of the building. FU-1 and FU-2 together provide heat to the main floor offices 104 through 109. FU-3 supplies heat to the second floor offices and lab areas rooms 202 through 211. FU-4 supplies heat to the mechanical room 110. AHU-1, suspended from the ceiling in the marshalling area, supplies heat to this area. Make up heat is also supplied to the marshalling / packing area by a single unit heater UH-1. AHU-2 supplies heat to the garage room 101 and the parts room 113. Humidification is supplied by drum type humidifiers mounted in the supply air ducts of FU-1 and FU-3.

Ventilation and air circulation for the building in general along with a number of specific areas, is provided by four exhaust fans, two recirculating fans and six propeller fans. Several of the furnace blower units also operate in conjunction with the exhaust fans thus providing additional ventilation.

EF-1 provides ventilation for mechanical room 214 on the mezzanine.

EF-2 also located in mechanical room 214 provides ventilation for the parts area on the main floor. Both of these fans are interlocked with AHU-2.

EF-3 ventilates the second floor washrooms and works in conjunction with furnace FU-3. EF-3 is located in the ceiling over the washrooms.

EF-4 located in the ceiling space provides ventilation for the janitor closet and darkroom located on the second floor. This fan is interlocked with furnace FU-2.

EF-5 operating in conjunction with furnace FU-1 ventilates room 105.

Recirculating fan RF-1 moves air under the office while RF-2 moves air through the parts area.

Propeller fans PF-1, PF-2, PF-3, PF-4, PF-5 and PF-6 circulate warm air downward which collects at or near the roof level.

A fume hood in room 203 also provides specific use ventilation. This unit is interlocked with recirculating fan RF-1. Which provides make up air to the room when the fume hood is on.

2.3-1:1 FU-1

I DESCRIPTION

This unit, located in mechanical room 110 provides heat to part of the main floor office area consisting of room 104, 105 and 106 through a single main supply duct feeding seven branch supply air ducts with seven floor registers. The main supply duct runs exposed along the underside of the ceiling while the branch ducts are dropped to floor level and run under the floor of the building extension. Return air ducting runs exposed on the underside of the ceiling back to the furnace.

The main supply air duct is made up of 26 m of 450 x 250 ducting complete with elbows and take offs. The branch supply air ducts consist of 16 m of 200 x 100 duct, 13.5 m of 250 x 100 duct, 14.0 m of 300 x 100 duct and 6 m of 150 x 100 duct, reducers, balancing dampers, and floor registers.

Humidification is supplied by a drum type humidifier which is mounted in the supply air duct.

I SEQUENCE OF OPERATION – MANUAL

- Start-up

Set the wall thermostat to a higher temperature.

- Stop / shutdown

Set the wall thermostat to a lower temperature. Disable furnace operation via emergency stop on front of furnace.

- Systems interface

- ventilation
- fuel delivery - manual gate valve #23 (N.O.)

II SEQUENCE OF OPERATION – AUTOMATIC

- Start-up

Operation of the furnace burner is initiated by a wall mounted thermostat 3TC 10 mounted on the west wall of room 106. Upon activation of the burner motor the combustion air damper 3DM-13 and fuel line solenoid valve 3SV-17 both open. The supply air fan will cycle via the fan limit control.

When the supply air fan is activated the time delay 3TD-6 will open the outside air damper ADM-2 to minimum position after a two minute delay via control relay 3CR-23.

The supply fan is also activated upon start up of the exhaust fan EF-5 (see Ventilation). A manual switch can also be used to activate the supply air fan only.

- Stop / shutdown

When the temperature in the space reaches the set point of the wall thermostat 3TC 10 the burner unit is stopped. When the burner stops the combustion air damper 3DM-13, and solenoid valve 3SV-17 close. The supply fan stops when the furnace temp falls to the set point of the fan limit control and when the supply air fan stops the outside air damper 3DM-2 close.

A duct stat 3TC-11 mounted in the supply air duct will over ride the wall thermostat and shut down the burner unit if the temperature falls below 15°C.

if the supply air temperature falls below 5°C of the manual set freeze stat (3FZ-20) the outside air damper 3DM-2 will close and an audible and visual alarm will occur at the mechanical annunciator panel in room 110. If exhaust fan EF-5 is operating it will also be stopped.

Shut down of the furnace will also occur via either of the smoke detectors located in the supply and return air ducts. When this occurs an audible and visual alarm are activated on the mechanical annunciator panel.

A heat detector (3HD-330) with a set point of 200°C mounted over the burner unit on FU-1. In the event of fire the N.C. solenoid valve 125V 336 and the fuel transfer pumps P5 and P6 will be disabled via control relay 12CR-332.

- Systems interface
- Ventilation exhaust fan EF-5.
- Fuel delivery system

IV COMPONENT LIST

COMPONENT	KEY	QTY	O.S. NUMBER	DESCRIPTION
1-Furnace	FU-1		BCL 115H 0.2	Olsen Duo Matic
1-Outside air damper	3DM-2		M436A1116	120v Operator
	c/w	1	PBS 4H6	Low Leakage Damper
	c/w	1	A27520K	Pushrod
1-Combustion air damper	3DM-13		ACAPAC-150	Combustion Air Damper
1-Duct stat		3TC-11	T675A1458	Duct Stat
	c/w	1	311266D	Duct Bulb Holder
1-Freeze stat	3FZ-20		L480G1044	Man. Reset Freezestat
	c/w	5	314439	Mounting Clips
1-Solenoid Valve	3SV-17(N.C.)		2LB2LBG5102/120	3/4" Dia. N.C. Solenoid
1-Heat detector	3HD-330		284A	Heat Detector
1-Time delay	3TD-6		H3BA/120	Time Delay Relay
	c/w	1	P2CF-11	Socket
1-Control Relay	3CR-10		LY3F-AC24	24v 3PDT Relay
	c/w	1	129384A	Case & Cover
1-Control Relay	3CR-23		R4222D1013	120v DPDT Relay
	c/w	1	129384A	Case & Cover
1-Control Transformer	3TX-10		AT72D1048	120/24 vac X'FMR
1-Drum type humidifier				
2-Duct smoke detectors				
1-Wall Thermostat	3TC-10			

2.3-1:2 FU-2

I DESCRIPTION

This unit, located in mechanical room 110 provides heat to part of the main floor area consisting of room 107, 108 and 109 through two main ducts equipped with eight hot air registers. One duct runs exposed along one wall and contains three s/a registers. The second duct 400 x 250 runs along the opposite wall and contains five s/a registers. The ducting from this furnace contains 15 m of 200 x 150 and 13 m of 400 x 250 duct complete with elbows, s/a outlets, and fire dampers.

II SEQUENCE OF OPERATION – MANUAL

• Start-up

The supply air blower can be started independent of the furnace burner via the manual switch. Set wall thermostat to a higher set point.

• Stop / shutdown

The supply air blower can be stopped independent of the furnace burner via the manual over ride switch. Set the wall thermostat to a lower set point. Disable furnace via emergency stop on front of furnace.

• Systems interface

- Ventilation - exhaust fan EF-4
- Fuel delivery system
- control

III SEQUENCE OF OPERATION – AUTOMATIC

• Start-up

Operation of the furnace burner is initiated by a wall mounted thermostat 4TC-50 mounted on the west wall of room 107. When the space temperature falls below the set point of this thermostat the furnace burner is activated.

Upon activation of the burner motor the solenoid fuel valve 4SV-48 opens and the combustion air damper 4DM-53 opens via control relay 4CR-50. When the bonnet temperature of the furnace reaches the set point on the fan high limit control the blower fan starts. Upon activation of the blower fan the outside air damper 4DM-34 opens to its minimum position after a two minute delay via time delay 4TD-42 and control relay 4CR-60.

The furnace fan also operates independently of the burner controls. Upon activation of EF-4 (darkroom exhaust) the furnace fan starts via control relay 4CR-60. Simultaneously the outside air damper 4DM-34 opens to 100% and the return air damper 4DM-63 partially closes to balance the air flow.

• Stop / shutdown

When the space temperature reaches the set point of the wall thermostat 4TC50 the furnace burner is deactivated. After the burner stops the combustion air damper 4DM-53 and the fuel line solenoid valve 4SV-48 close. The furnace fan stops when the bonnet temperature falls below the set point of the fan limit control. When the furnace fan (supply air) stops the outside air damper 4DM-34 closes.

A duct stat 4TC-S1 will over ride the space thermostat and shut down the burner if the temperature falls below 15°C.

If the supply air temperature falls below the 5°C set point of the manual set freeze stat 4FZ-57 the furnace operation is disabled and the outside air damper 4DM-34 closes activating an audible and visual alarm at the mechanical annunciator panel in room 110. If the exhaust fan EF-4 is operating it will also be stopped via control relay 4CR-60.

A heat detector 4HD331 with a set point of 200°C mounted over the burner unit on FU-2 will, in the event of fire, close the fuel line solenoid valve 4SV-48, and disable the fuel transfer pumps P5 and P6 via control relays 12CR-334 and 12CR-332. This activates an audible and visual alarm.

Shut down of the furnace will also occur via either of the smoke detectors located in the supply and return air ducts. when this occurs an audible and visual alarm are activated on the mechanical annunciator panel.

- Systems interface
- Ventilation and exhaust fan EF-4.
- Fuel delivery
- Controls

IV COMPONENT LIST

COMPONENT	KEY	QTY	O.S. NUMBER	DESCRIPTION
1-Furnace	FU-2		BCL 115H 0.2	Olsen Duo Matic
1-Outside air damper	4DM-34		M945A4003	Operator
	c/w	1	PBS 4H6	Low Leakage Damper
	c/w	1	272600A	Cover Transformer
	c/w	1	Q209A1022	Min. Position Pot.
	c/w	1	Q605A1062	Linkage
	c/w	1	A27520K	Pushrod
1-Return air damper	4DM-63		M445A4004	120v Operator
	c/w	1	PBS 4H6	Low Leakage Damper
	c/w	1	Q605A1062	Linkage
	c/w	1	A27520K	Pushrod
1-Combustion air damper	4DM-53		ACAPAC-150	Combustion Air Damper
1-Duct stat-S.P.15°C	4TC-51		T675A1425	Duct Stat
	c/w	1	311266D	Duct Bulb Holder
1-Freeze stat-S.P.5°C	4FZ-57		L480G1044	Man. Reset Freezestat
	c/w	5	314439	Mounting Clips
1-Solenoid Valve	4SV-48		2LB2LBG5102/120	3/4" Dia. N.C. Solenoid
1-Heat detector	4HD-331		284A	Heat Detector
1-Time delay	4TD-42		H3BA/120	Time Delay Relay
	c/w	1	P2CF-11	Socket
1-Control Relay	4CR-60		LY3F-AC24	24v 3PDT Relay
	c/w	1	129384A	Case & Cover
1-Control Relay	4CR-60		R4222D1013	120v DPDT Relay
	c/w	1	129384A	Case & Cover
1-Control Transformer	3TX-50		AT72D1048	120/24 vac X'FMR
2-Duct smoke detectors				
1-Wall Thermostat	4TC-50			

2.3-1:3 FU-3**I DESCRIPTION**

This unit located in mechanical room 110 provides heating and ventilating to the second floor lab area and offices consisting of rooms 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 215, 216 and 217 through two main ducts. One duct runs exposed along the underside of the main floor ceiling and feeds floor registers next to the west wall while the second duct runs exposed along the underside of the main floor ceiling and feeds floor registers next to the east wall. These two ducts consist of 3.5 m of 500 x 300 duct, 10 m of 450 x 250 duct, 12 m of 350 x 200 duct, 8 m of 300 x 200 duct, 6 m of 250 x 150 duct, 3 m of 300 x 100 duct, 9 supply air floor registers, elbows, splitter sections, splitter dampers, and fire dampers. A single return duct system collects air through seven return air grilles complete with fire dampers.

Ventilation is provided by this furnace also, working in conjunction with exhaust fan EF-3.

Humidification is provided by humidifier mounted in the return air duct and controlled by duct mounted humidistat.

II SEQUENCE OF OPERATION – MANUAL**• Start-up**

The furnace supply air fan can be started independent of the burner via a manual fan switch or by turning on exhaust fan EF-3. Set the wall thermostat to a higher set point.

• Stop / shutdown

The supply air fan can be stopped independent of the burner via the manual fan switch or by turning off exhaust fan EF-3. Set the wall thermostat to a lower set point. Emergency stop switch on front of furnace.

• Systems interface

- Ventilation exhaust fan EF-3.
- Fuel delivery system
- Controls

III SEQUENCE OF OPERATION – AUTOMATIC**• Start-up**

Operation of the furnace burner is initiated by a wall mounted thermostat 5TC-83 mounted on the west wall of room 203. Upon activation of the burner motor the solenoid fuel valve 5SV-90 opens and the combustion air damper 5DM-86 opens via control relay 5DM-83. When the bonnet temperature of the furnace reaches the set point of the fan high limit control the supply air fan starts. After the blower fan starts the outside air damper 5DM-70 opens to its minimum position after a two minute delay via time delay 5TD-78 and control relay 5CR-96. The blower fan also operates independently of the burner controls. Upon start up of the exhaust fan EF-3 the blower fan starts via control relay 5CR-96. Simultaneously the outside air damper 5DM-70 opens to 100% and the return air damper 5DM-99 partially closes to balance the air flow.

• Stop / shutdown

Burner shut down occurs when the temperature in the space reaches the set point of the thermostat 5TC-83. After the burner stops the combustion air damper 5DM-86 and the fuel line solenoid valve 5SV-90 close. The blower fan will stop when the bonnet temperature falls to the set point of the fan limit control. At the same time the outside air damper 5DM-70 closes.

A duct stat 5TC-84 mounted in the supply air duct will override the space thermostat 5TC-83 and shut down the furnace if the temperature falls below 15°C.

If the supply air temperature falls below 5°C the manual set freeze stat 5FZ-93 mounted in the supply air duct disables the furnace operation and closes the outside air damper 5DM-70 via control relay 5CR-96. This activates an audible and visual alarm at the annunciator panel in the mechanical room 110. If the exhaust fan EF-3 is running at the time, it too will be shut down via control relay 5CR-96.

A heat detector 5HD-332 with a set point of 200°C, mounted over the burner unit on FU-3 will, in the event of fire disable the burner motor via control relay 5CR-83 which closes the fuel line solenoid valve 5SV-90 and disables the fuel transfer pumps P5 and P6 along with control relays 12CR-334 and 12CR-332. This activates an audible and visual alarm at the annunciator panel in mechanical room 110 via control relay 5CR-92.

Furnace shutdown will also occur via either of the smoke detectors located in either of the supply and return air ducts. When this occurs an audible and visual alarm are activated on the mechanical annunciator panel.

- Systems interface
- Ventilation and exhaust fan EF-3.
- Fuel delivery
- Control

IV COMPONENT LIST

COMPONENT	KEY	QTY	O.S. NUMBER	DESCRIPTION
1-Furnace	FU-3		BCL 115H 0.2	Olsen Duo Matic
1-Outside air damper	5DM-70		M945A4003	Operator
	c/w	1	PBS 4H6	Low Leakage Damper
	c/w		1272600A	Cover Transformer
	c/w	1	Q209A1022	Min. Position Pot.
	c/w	1	Q605A1062	Linkage
	c/w	1	A27520K	Pushrod
1-Return air damper	5DM-99		M445A4004	120v Operator
	c/w	1	PBS 4H6	Low Leakage Damper
	c/w	1	Q605A1062	Linkage
	c/w	1	A27520K	Pushrod
1-Combustion air damper	5DM-86		ACAPAC-150	Combustion Air Damper
1-Duct stat-low limit	5TC-84		T675A1425	Duct Stat
	c/w		1311266D	Duct Bulb Holder
1-Freeze stat	5FZ-93		L480G1044	Man. Reset Freezestat
	c/w	5	314439	Mounting Clips
1-Solenoid Valve	5SV-90		2LB2LBG5102/120	3/4" Dia. N.C. Solenoid
1-Heat detector	5HD-332		284A	Heat Detector
1-Time delay	5TD-78		H3BA/120	Time Delay Relay
	c/w	1	P2CF-11	Socket
1-Control Relay	5CR-83		LY3F-AC24	24v 3PDT Relay
	c/w	1	129384A	Case & Cover
1-Control Relay	5CR-96		R4222D1013	120v DPDT Relay
	c/w	1	129384A	Case & Cover
1-Control Transformer	5TX-83		AT72D1048	120/24 vac X'FMR
2-Duct smoke detectors				
1-Space Thermostat	5TC-83			

2.3-1:4 FU-4

I DESCRIPTION

This unit located in mechanical room 110 provides heat to the main mechanical room only via two supply air ducts and one return air ducts. These ducts run exposed below the ceiling in the mechanical room. The two supply air ducts consist of 7.0 m of 300 x 200 duct, and 5.0 m of 250 x 160. The return air duct consists of 5.0 m of 400 x 250 duct.

II SEQUENCE OF OPERATION – MANUAL

• Start-up

Manual setting of the thermostat located on the west wall of room 110 to a higher temperature set point. The supply air fan can be started independent of the burner via a manual fan switch on the furnace.

• Stop / shutdown

Manual setting of the wall thermostat to a lower temperature set point will stop the burner and fan operation.

Manually setting the duct stat 6TC-111 to a set point lower than 15°C will shut down the furnace.

The supply fan can be shut down via manual operation of the fan switch on the furnace.

Emergency stop switch on front of furnace.

• Systems interface

- Fuel system
- Control
- Electrical

III SEQUENCE OF OPERATION – AUTOMATIC

• Start-up

Operation of the furnace is initiated by the wall thermostat 6TC-16 on the west wall of mechanical room 110. When the space temperature falls below the set point of this wall stat the furnace burner is activated.

Upon activation of the burner motor the solenoid fuel valve 6SV-117 and the combustion air damper 6DM-113 open simultaneously via control relay 6CR-110. When the bonnet temperature of the furnace reaches the set point of the fan/high limit control, the supply air fan starts. After the supply air fan starts the outside air damper 6DM-104 opens to its minimum position after a two minute delay via time delay 6TD-108 and control relay 6CR-109. The supply air fan also operates independently of the fan limit control via the manual switch mounted on the furnace to permit continuous fan operation.

• Stop / shutdown

Furnace shut down occurs when the temperature in the space reaches the set point of the wall thermostat 6TC-110. After the burner stops the combustion air damper 6DM-113 and the fuel line solenoid valve 6SV-117 close. The supply air fan stops when the bonnet temperature falls to the set point of the fan limit control. At the same time the outside air damper 6DM 104 closes.

Stop/shutdown is also precipitated by the duct stat 6TC-111 and or freeze stat 6FZ-109 both located in the supply air duct. If the supply air temperature falls below 15°C the duct stat will override the space thermostat 6TC-110 via control relay 6CR-110. If the supply air temperature falls below 5°C the manual set freeze stat 5FZ-109 disables the furnace operation and closes the outside air damper 6DM-104 via control relay 6CR-109. This activates an audible and visual alarm via control relay 6CR-109 at the annunciator in Mechanical Room 110.

A high temperature heat detector 6HD-333 with a set point of 200°C and mounted over the burner unit will in the event of a fire disable the burner motor via control relay 6CR-110 which closes the fuel line solenoid valve 6SV-117, disables the fuel transfer pumps P5 and P6 and de-activates control relays 12CR-332 and 12CR-334. This activates an audible and visual alarm in the annunciator panel in Mechanical Room 110 via control relay 6CR-110.

Furnace will also be disabled by either smoke detectors mounted in the supply and return air ducts. When this occurs an audible and a visual alarm are activated in the mechanical annunciator panel.

- Systems interface
- Fuel system
- Electrical
- Controls

IV COMPONENT LIST

<u>COMPONENT</u>	<u>KEY</u>	<u>QTY</u>	<u>O.S. NUMBER</u>	<u>DESCRIPTION</u>
1-Furnace	FU-4		BCL 115H 0.2	Olsen Duo Matic
1-Outside air damper	6DM-104		M436A1116	120v Operator
	c/w	1	PBS 4H6	Low Leakage Damper
	c/w	1	A27520K	Pushrod
1-Combustion air damper	6DM-113		ACAPAC-150	Combustion Air Damper
1-Freeze stat	6FZ-109		L480G1044	Man. Reset Freezestat
	c/w	5	314439	Mounting Clips
1-Duct stat-low limit	6TC-111		T675A1425	Duct Stat
	c/w	1	311266D	Duct Bulb Holder
1-Solenoid Valve	6SV-117		2LB2LBG5102/120	3/4" Dia. N.C. Solenoid
1-Heat detector	6HD-333		284A	Heat Detector
1-Time delay	6TD-108		H3BA/120	Time Delay Relay
	c/w	1	P2CF-11	Socket
1-Control Relay	6CR-110		LY3F-AC24	24v 3PDT Relay
	c/w	1	129384A	Case & Cover
1-Control Relay	6CR-109		R4222D1013	120v DPDT Relay
	c/w	1	129384A	Case & Cover
1-Control Transformer	6TX-110		AT72D1048	120/24 vac X'FMR
1-Space Thermostat	6TC-110			

2.3-1:6 AHU-1**I DESCRIPTION**

Suspended from the roof beams in the central marshalling area AHU-1 provides heat to the general and vehicle storage area and central marshalling area via a single main supply air duct with two branch s/a. ducts. Return air flows back through a single R/A inlet mounted on the underside of the unit. Fresh air supply is ducted to the unit from outside via a single duct.

The supply air duct system consists of 4.0 m of 575 dia, 1.7 m of 3.75 dia and 8.2 m of 350 dia main supply air duct with four 450 x 150 s/a outlets equipped with balancing dampers. The branch supply air ducts consist of 32.2 m of 400 dia duct, 12 m of 300 dia duct, 7 m of 200 dia duct. The branch s/a ducting is fitting with 22-250 x 100 s/a outlets equipped with balancing dampers. Ducting also contains elbows, reducing sections and ten floor registers on the mezzanine.

This unit also provides ventilation and cooling air.

II SEQUENCE OF OPERATION – MANUAL**• Start-up**

Manual setting of either the day thermostat 7TC-124 or the night thermostat 7TC-128 to a higher temperature will activate the furnace.

The supply air fan can be activated by the continuous run switch which overrides other fan controls.

• Stop / shutdown

Manually resetting the space thermostats 7TC-124 and 7TC-128 to a lower temperature will deactivate the furnace.

The supply air fan can be deactivated when in the continuous run mode by switching "OFF" the continuous run switch.

• Systems interface

- Fuel system
- Controls
- Electrical

III SEQUENCE OF OPERATION – AUTOMATIC**• Start-up**

Operation of AHU-1 is cycled by a two stage day thermostat 7TC-124 and a night thermostat 7TC-128 mounted on the east wall of the marshalling packing area. Upon activation of the burner motor the fuel line solenoid valve 7SV-154, and the combustion air damper 7DM-152 open simultaneously via control relay 7CR-150. When the bonnet temperature reaches the set point of the fan high limit control the supply fan starts. Once the supply fan starts the outside air/return air damper 7DM-132 starts to modulate after two minutes via time delay 7TD-145. This maintains the mixed air temperature at set point.

With the space stat 7TC-124 set to the cooling mode the furnace burner is disabled and the furnace fan runs. At the same time, the outside air/return air damper 7DM-132 modulate with the gravity relief damper. 7DM-139 to maintain.

• Stop / shutdown

Shut down occurs when the space temperature rises above the set point for heating on the two stage wall thermostat. Upon burner shut down the fuel solenoid valve 7SV-154, and combustion air damper 7DM-152 close. Via control relay 7CR-150 the supply air fan stops when the temperature of the bonnet falls below the

fan/high limit set point. When the fan stops the outside air damper 7DM-132 and gravity relief damper 7DM-139 close to minimum position.

Stop/shutdown is also initiated by: a manual set freeze stat 7FZ-156 mounted in the supply air duct, smoke detectors mounted in the return air and supply air ducts, temperature sensors 11TC-292/11TC-288 in the marshalling area pit, sensors 11TC-283/11TC287 in the garage pit, sensor 11TC-281 mounted on the exterior of the building and a heat detector 7HD-339.

The freeze stat 7FZ-156 will close the outside air damper and activate both a visual and audible alarm at annunciator panel AP-1 if the supply air temperature falls below 5°C.

The smoke detectors will disable the AHU and activate a visual and audible alarm at annunciator panel AP-1.

The temperature sensors located in the sensor pits in the garage floor and marshalling area floor will disable the AHU and activate audible and visual alarms at the annunciator panel AP-1 if the temperature rises above the set point of the sensors (0°C). (See control section for details)

The heat detector 7HD-339 will in the event of fire or a temperature rise to 200°C stop the fuel flow by closing solenoid valve 12SV-345 via control relays 12CR-343 and 12CR-341.

- Systems interface
- Fuel system
- Electrical system
- Controls
- Fuel delivery
- Pan alarm system

IV COMPONENT LIST

COMPONENT	KEY	QTY	O.S. NUMBER	DESCRIPTION
1-Air handling unit	AHU-1			
1-Outside/Return air damper	7DM-132		M945A4003	Operator
	c/w	1	PBS 4H6	Low Leakage Damper
	c/w	1	272600A	Cover Transformer
	c/w	1	Q605A1062	Linkage
	c/w	1	A27520K	Pushrod
1-Combustion air damper	7DM-152	1	ACAPAC-200	Combustion Air Damper
1-Freeze stat	7FZ-156	1	L480G1044	Man. Reset Freezestat
	c/w	5	314439	Mounting Clips
1-Solenoid Valve	7SV-145	1	2B2LBG5102/120	3/4" Dia. N.C. Solenoid
1-Heat detector	7HD-339	1	284A	Heat Detector
1-Time delay	7TD-147	1	A208120/600	Time Delay Relay
	c/w	1	SR2P-06U	Socket
1-Control Relay	7CR-150	1	RH2BU/24VAC	24v 3PDT Relay
	c/w	1	PTF-08A	Socket
	c/w	1	129384A	Case & Cover
1-Space Thermostat	7TC-124 / DAY			
	7TC-128 / NIGHT			
2-Smoke Detectors				

2.3-1:6 AHU-1

DESCRIPTION

Located in the second floor mechanical room 214, this unit provides heat to the garage area, room 101, the workshop room 113 and the parts room 114 via two supply air ducts and a single return air duct. Fresh outside air is mixed with the return air via a duct from the he outside while a single duct from outside supplies combustion air for the burner.

Supply air ducting is made up of 6.0 m of 550 dia duct complete with fire damper, 2.5 m of 450 dia duct, and 2.8 m of 350 dia duct, with. This duct is equipped with three 450 x 150 take offs each equipped with balancing dampers. A branch supply air duct is made up of 2.0 m of 250 x 200 duct down to 1.5 m of 150 x 100 duct with balancing damper and 3.0 m of 250 x 200 duct with baiancing damper.

The single return air duct consists of 3.5 m of 600 x 400 duct, fire damper, and one 600 x 700 R/A grille.

The outside air duct fresh air supply consists of 1.5 m of 500 x 300 duct fitted with bird screen, motorized damper and fire damper.

The combustion air duct consists of 5.2 m of 200 x 200 duct fitted with elbow and birdscreen. Ducting also contains elbows, reducing sections and other hardware.

I SEQUENCE OF OPERATION – MANUAL

• Start-up

Manual setting of either the day thermostat 8TC-186 or night thermostat 8TC-188 to a higher set point will activate the furnace.

The supply air fan can be activated independent of the burner by the continuous run switch which overrides other fan controls.

Manual operation of exhaust fans EF-1 or EF-2 will start fan unit also, independent of burner.

• Stop / shutdown

Switch "off" the manual fan switch. Manually adjust the space thermostat. Switch exhaust fans "off."

• Systems interface

- Fuel system
- Electrical
- Controls
- Pan alarm

II SEQUENCE OF OPERATION – AUTOMATIC

• Start-up

Operation of AHU-2 is cycled by a day thermostat 8TC-186 and night thermostat 8TC-188 mounted on the south wall of the garage adjacent to the entry door to the shop. When the space temperature falls below the thermostat set point the burner is energized. Upon activation of the burner motor the fuel line solenoid valve 8SV-192 and the combustion air damper 8DM-194 open simultaneously via control relay 8CR-183. When the bonnet temperature reaches the set point of the fan high limit control the supply fan starts. When the supply fan starts the outside air damper 8DM-164 opens to a minimum position after a two minute via time delay 8TD-182.

The supply fan will also run independent of the burner controls when either of exhaust fans EF-1 or EF-2 are activated. When air flow is established in either exhaust fan the supply air fan in AHU-2 will run, the outside air damper 8DM-168 will partially close to balance the air flow.

- Stop / shutdown

When the space temperature rises above the thermostat set point the burner is de-energized, the fuel , solenoid valve 8SV-192, and combustion air damper 8DM-194 close. When the bonnet temperature falls below the fan/high limit low temp set point the supply air fan stops, and the outside air damper closes to minimum position.

Stop/shutdown is also controlled by: a manual set freeze stat 8FZ-195 mounted in the supply air duct, two temperature sensors 11TC-283 and 11TC-287 set at 0°C, mounted in the garage area sensor pit, sensor 11TC-281 mounted on the exterior of the building, smoke detectors mounted in the return and supply air ducts and a heat detector 8HD-340 mounted over the burner unit.

The freeze stat 8FZ-195 closes the outside air damper 8DM-184 and activates an audible and visual alarm at annunciator panel AP-1 if the supply air temp fails below 5°C. Exhaust fans EF-1 and EF-2 are also disabled.

The temperature sensors 11TC-283 and 11TC-287 will disable AH2-2 and activate audible and visual alarms at the annunciator panel AP-1 if the pit temperature rises above the 0°C set point or the sensors.

The smoke detectors will disable the AHU and activate an audible and visual alarm at annunciator panel AP-1.

The heat detector 8HD-340 will in the event of fire or a temperature rise to 200°C stop the fuel flow by closing solenoid valve 12SV-345 via control relays 12CR-343 and 12CR-341.

- Systems interface

- normal: Exhaust fans - EF-1 and EF-2
Fuel delivery system
Electrical system
Control system
- emergency:

IV COMPONENT LIST

COMPONENT	KEY	QTY	O.S. NUMBER	DESCRIPTION
1-Air handling unit	AHU-2	1	LOTDM25-D	Temprite
1-Outside/Return air damper	8DM-164	1	M945A4003	Operator
	c/w	1	PBS 4H6	Low Leakage Damper
	c/w	1	272600A	Cover Transformer
	c/w	1	Q209A1022	Min. Position Pot.
	c/w	1	Q605A1062	Linkage
	c/w	1	A27520K	Pushrod
1-Return air damper	8DM-168,202	2	M445A4004	120v Operator
1-Exhaust air damper (EF-1)	c/w	2	PBS 4H6	Low Leakage Damper
	c/w	2	Q605A1062	Linkage
	c/w	2	A27520K	Pushrod
1-Exhaust air damper(EF-2)	8DM-207	1	M436A1116	120v Operator
	c/w	1	PBS 4H6	Low Leakage Damper
1-Combustion air damper	8DM-194	1	ACAPAC-200	Combustion Air Damper
1-Freeze stat	8FZ-195	1	L480G1044	Man. Reset Freezestat
	c/w	5	314439	Mounting Clips
1-Flow Sensor	8FS-174,175	2	AFS222	Air Flow Switch
1-Solenoid Valve	8SV-192	1	2LB27BB7127120	1.25" Dia. N.C. Solenoid
1-Heat detector	8HD-340	1	284A	Heat Detector

COMPONENT	KEY	QTY	O.S. NUMBER	DESCRIPTION
1-Time delay	8TD-182	1	A208120/600	Time Delay Relay
	c/w	1	SR2P-06U	Socket
1-Control Relay	8CR-183	1	RH2BU/24VAC	24v DPDT Relay
	c/w	1	PTF-08A	Socket
	c/w	1	129384A	Case & Cover
1-Space Thermostat	8TC-186 / DAY 8TC-188 / NIGHT			
2-Smoke Detectors				

2.3-1:8 EF-1

DESCRIPTION

Located in mechanical room 214 this unit serves the garage area room 101. It removes a fixed volume of air from the space via a single main duct and expels it outside through a roof mounted exhaust ventilator. Make up air is supplied by AHU-2, and through open doors, etc. The single return duct consists of 0.7 m of 250 x 250 duct, 6.0 m of 300 x 300 duct, 2.5 m of 350 x 350 duct, two 200 x 200 R/A grilles complete with manual dampers, fire damper, reducing sections and elbows. The exhaust ventilator consist of 1.5 m of 350 x 450 duct and roof cap.

I SEQUENCE OF OPERATION – MANUAL

• Start-up

Turn on the disconnect switch located adjacent to the unit in mechanical room 214 or the one on the south wall of the garage next to the plain door.

With the switch turned on the exhaust air damper 8DM-202 opens. When damper is open an end switch in the damper motor activates the exhaust fan. After a short delay AHU-2 supply fan only starts.

• Stop / shutdown

Turn off the disconnect switch adjacent to the unit or the one in the Garage area. Shutdown of EF-2 closes the exhaust air damper 8DM-202 stopping EF-2, the supply air fan on AHU-2 is stopped closing the outside air damper 8DM-164 and opening return air damper 8DM-168.

• Systems interface

- normal: AHU-2
Electrical

II SEQUENCE OF OPERATION – AUTOMATIC

• Start-up• Stop / shutdown• Systems interface

- normal: AHU-2
Electrical

IV COMPONENT LIST

<u>COMPONENT</u>	<u>KEY</u>	<u>QTY</u>	<u>O.S. NUMBER</u>	<u>DESCRIPTION</u>
1-Exhaust Fan	EF-1	1	SX125B	Penn Centrex
1-Exhaust Air Damper	8DM-202	2	M445A4004	120v Operator
	c/w	2	PBS 4H6	Low Leakage Damper
	c/w	2	Q605A1062	Linkage
	c/w	2	A27520K	Pushrod
1-Air Flow Switch	8FS-174,175	2	AFS222	Air Flow Switch
2-Wall Switches				

2.3-1:9 EF-2

DESCRIPTION

Located in mechanical room 214 this unit serves the parts room and workshop area room 113. It removes a fixed volume of air from the space via a single duct and expels it outside through a single duct. Make up air is supplied by AHU-2. The single R/A duct consists of 6.2 m of 250 x 150 duct, 3.0 m of 250 x 200 duct, two R/A grilles, duct elbows, and transition sections. The discharge duct consists of 3.5 m of 250 x 200 duct, fire damper, elbow, and bird screen.

I SEQUENCE OF OPERATION – MANUAL

• Start-up

Turn "on" the manual switch located adjacent to the mechanical room 214 or the one on the south wall of the garage area room 101.

Upon activation of fan EF-2, damper 8DM-207 located within the unit will open. An end switch inside the damper motor will activate the exhaust fan. Once an airflow is established in EF-2 the supply fan in AHU-2 will start, the outside air damper 8DM-164 will open to 100% and the return air damper 8DM-168 will close part way to balance the air flow.

• Stop / shutdown

Move the manual switch to the "off" position.

Shutdown of EF-2 closes the exhaust air damper 8DM-207 closing stopping EF-2, the supply air fan on AHU-2 stops closing the outside air damper 8DM-164 and opening the return air damper 8DM-168.

• Systems interface

- normal: AHU-2
Electrical

II SEQUENCE OF OPERATION – AUTOMATIC

• Start-up• Stop / shutdown

Manual start is required after which automatic sequence occurs.

• Systems interface

- normal: AHU-2
Electrical

IV COMPONENT LIST

<u>COMPONENT</u>	<u>KEY</u>	<u>QTY</u>	<u>O.S. NUMBER</u>	<u>DESCRIPTION</u>
1-Exhaust Fan	EF-2	1	SX105B	Penn Centrex
1-Exhaust Air Damper	8DM-207	1	M436A1116	120v Operator
	c/w	1	PBS 4H6	Low Leakage Damper
1-Air Flow Switch	8FS-175	1	AFS222	Air Flow Switch
2-Wall Switches				

2.3-1:10 EF-3

DESCRIPTION

Located in the attic space above room 208 this unit serves the men's and women's washrooms, and the janitors closet. Activated by manual switches in either of the three rooms this fan removes a fixed volume of air from these rooms and discharges it outside. When this fan is running furnace FU-3 operates also, providing make up air to these rooms. The ducting consists of 2 m of 200 x 200 duct complete with roof vent and cap, 1.8 m of 200 x 175 duct, 3.2 m of 200 x 100 duct all complete with balancing dampers, fire dampers, reducing section, elbows and R/A grilles.

I SEQUENCE OF OPERATION – MANUAL

• Start-up

Turn "on" any one of the manual switches located in the janitor's closet - room 209, washroom 208 and washroom 215. Once the manual switch is turned "on" the operating sequence is automatic.

• Stop / shutdown

Turn "off" any one of the manual switches. Once the switch is turned "off" the shutdown sequence is automatic.

• Systems interface

- normal: Furnace FU-3
Electrical

II SEQUENCE OF OPERATION – AUTOMATIC

• Start-up

Upon activation of the fan, damper 5DM-97 located within the fan opens. An end switch inside the damper motor will activate the exhaust fan EF-3. Once an air flow is established in EF-3 the furnace fan in FU-2 will start, the outside air damper 5DM-70 will open to 100% and the return air damper 5DM-99 will close partially to balance the air flow.

• Stop / shutdown

Shut down of EF-3 will open the return air damper 5DM-99, close the outside air damper 5DM-70 to the set point, de-activate the fan unit in FU-3 and close damper 5DM-97.

• Systems interface

- normal: FU-3
Electrical
- emergency

IV COMPONENT LIST

<u>COMPONENT</u>	<u>KEY</u>	<u>QTY</u>	<u>O.S. NUMBER</u>	<u>DESCRIPTION</u>
1-Exhaust Fan	EF-3	1	77-TDA	Penn Zephyr Lo Sone
1-Exhaust Air Damper	5DM-97	1	M436A1116	120v Operato
	c/w	1	PBS 4H6	Low Leakage Damper
	c/w	1	A27520K	Pushrod
1-Air Flow Switch	5FS-80	1	AFS222	Air Flow Switch
3-Wall Switches				

2.3-1:11 EF-4

DESCRIPTION

Located in the attic space above room 209, this unit serves the darkroom, room 210. Activated by a manual switch inside the darkroom this fan removes a fixed volume of air from the darkroom and discharges it outside via a single duct. When EF-4 is running the fan unit in furnace unit FU-2 will also run. This provides make up air for the darkroom. Ducting consists of 1.2 m of 200 x 150 duct and 2 m of discharge duct and roof vent.

I SEQUENCE OF OPERATION – MANUAL

• Start-up

Turn "on" the manual switch inside the darkroom, room 210. Once the switch is turned "on" the operating sequence is automatic.

• Stop / shutdown

Turn "off" the manual switch inside the darkroom. Once the switch is turned "off" the shutdown sequence is automatic.

• Systems interface

- normal: Furnace FU-2
Electrical

II SEQUENCE OF OPERATION – AUTOMATIC

• Start-up

Upon activation of the fan EF-4, damper 4DM-61 located within the fan unit opens. An end switch inside the damper 4DM-61 motor activates the fan EF-4. When air flow is established the blower fan in FU-2 starts, the outside air damper 4DM-34 opens to 100%, and the return air damper 4DM-63 partially closes to balance the air flow.

• Stop / shutdown

Shut down of EF-4 will open the return air damper 4DM-63, close the outside air damper 4DM-34 to the set point, de-activate the blower fan in FU-2, and close damper 4DM-61.

• Systems interface

- normal: Furnace FU-2
Electrical

IV COMPONENT LIST

<u>COMPONENT</u>	<u>KEY</u>	<u>QTY</u>	<u>O.S. NUMBER</u>	<u>DESCRIPTION</u>
1-Exhaust Fan	EF-1	1		Penn Zephyr Lo Sone
1-Exhaust Air Damper	4DM-61	1	M436A1116	120v Operator
	c/w	1	PBS 4H6	Low Leakage Damper
	c/w	1	A27520K	Pushrod
1-Air Flow Switch	4FS-44	1	AFS222	Air Flow Switch
1-Wall Switch				

2.3-1:12 EF-5

DESCRIPTION

Located inside the main floor darkroom, room 105, this unit ventilates this same area. Activated by a manual switch within the darkroom it removes a fixed volume of air and discharges it outside via a single duct system. When this fan is operating the blower fan in furnace FU-1 is also running providing make up air for the dark room. Ducting consists of 0.7 m of 200 x 150 intake duct with R/A grille and 1.2 m of discharge duct with elbow down with bird screen on outside of building.

I SEQUENCE OF OPERATION – MANUAL

• Start-up

Turn "on" the manual switch inside the dark room, room 105. Once the switch is turned "on" the start-up sequence is automatic.

• Stop / shutdown

Turn "off" the manual switch inside the darkroom. Once the switch is turned "off" the shutdown sequence proceeds automatically.

• Systems interface

- normal: Furnace FU-1
 Electrical

II SEQUENCE OF OPERATION – AUTOMATIC

• Start-up

Upon activation of fan EF-5, damper 3DM-24 located within the fan unit opens. An end switch inside the damper motor activates the exhaust fan EF-5. When air flow is established the blower fan in FU-1 starts, the outside air damper 3DM-2 opens to 100%.

• Stop / shutdown

Shut down of EF-5 close the outside air damper 3DM-2 to the set point, de-activate the blower fan in FU-1 and close damper 3DM-24.

• Systems interface

- normal: Furnace FU-1
 Electrical
 Controls

IV COMPONENT LIST

<u>COMPONENT</u>	<u>KEY</u>	<u>QTY</u>	<u>O.S. NUMBER</u>	<u>DESCRIPTION</u>
1-Exhaust Fan	EF-5	1		Penn Zephyr Lo Sone
1-Exhaust Air Damper	5DM-97	1	M436A1116	120v Operator
	c/w	1	PBS 4H6	Low Leakage Damper
	c/w	1	A27520K	Pushrod
1-Air Flow Switch	5FS-80	1	AFS222	Air Flow Switch
1-Wall Switch				

2.3-1:13 RF-1

DESCRIPTION

Located in the attic space above the second floor room 209 this unit recirculates air from the building perimeter east to the central interior via a metal duct system. This ducting consists of seven 1 m - 200 x 150, and four 0.5 m - 200 x 150 intakes complete with balancing dampers, 6.5 m of 250 x 250 duct, 3.5 m of 250 x 200 duct, 5.5 m of 350 x 250 duct, 4.5 m of 350 x 300, 11 m of 450 x 350 duct, 3 m of 500 x 300 duct, transition sections, manual dampers, elbows, fire dampers, and return air grilles.

I SEQUENCE OF OPERATION – MANUAL

• Start-up

Unit is controlled through a selector switch 10SW-269 located in Panel CP-1. With this switch in the "hand" position RF-1 runs continuously. A switch adjacent to the unit also turns the unit once the selector switch is set.

• Stop / shutdown

With the selector switch in the "off" position neither unit will run. The local switch adjacent to the unit also turns the unit "off".

• Systems interface

– normal: RF-2

II SEQUENCE OF OPERATION – AUTOMATIC

• Start-up

With the selector switch in the "auto" position the thermostat/temperature control 10TC-277 located on the building exterior will activate both return fans when the temperature falls below 10°C.

• Stop / shutdown

When the outside air temperature rises above 10°C the thermostat 10TC-277 will de-energize the fans.

• Systems interface

– normal: RF-2
Electrical
Controls

– emergency

IV COMPONENT LIST

Refer to RF-2

2.3-1:14 RF-2

DESCRIPTION

Located adjacent to room 214, the second floor mechanical room. This unit recirculates air from the west building perimeter wall to the central interior via a metal duct system. The duct consists of three 0.5 m - 200 x 150 intakes complete with manual control dampers, transition sections, 5.5 m of 250 x 200 main intake duct, fire damper, fan unit, fire damper, 1.5 m of 300 x 200 discharge duct, elbow, open end.

I SEQUENCE OF OPERATION – MANUAL

• Start-up

Unit is controlled through selector switch 10SW-274 located in panel CP-1. When the switch is in the "hand" position unit runs continuously. A local switch located adjacent to the unit is also used to turn unit on when selector switch is set in "hand".

• Stop / shutdown

With the selector switch in the "off" position neither unit will run. The local switch adjacent to the unit also turns RF-2 "off".

• Systems interface

– normal: RF-1

II SEQUENCE OF OPERATION – AUTOMATIC

• Start-up

With the selector switch in the "auto" position the thermostat/temperature control 10TC-277 located on the building exterior activates both return fans when the temperature falls below 10°C via control relay 10CR-279.

• Stop / shutdown

When the outside temperature rises above 10°C the temperature sensor 10TC-277 de energizes both return fans via control relay 10CR-279.

• Systems interface

– normal: RF-1
Electrical
Controls

IV COMPONENT LIST

<u>COMPONENT</u>	<u>KEY</u>	<u>QTY</u>	<u>O.S. NUMBER</u>	<u>DESCRIPTION</u>
2-Return Fans	RF-1&2	1		Penn Zephyr Lo Sone
1-Temperature Sensor	10TC-277	1	T675A1169	Thermostat
	c/w	1	34886A	Sunshield
1-Control Relay	10CR-279			

2.3-1:15 PROPELLER FANS - PF-1 and PF-2**I DESCRIPTION**

These fans are located in the north end of the central marshalling area on the underside of the roof structure. They recirculate rising hot air downward.

The fans are controlled by a variable speed controller and a two position selector switch, "hand" and "auto" located in the mechanical control panel CP-1.

II SEQUENCE OF OPERATION – MANUAL• **Start-up**

Move the selector switch to "hand." This over rides the thermostat control and turns the fans "on."

• **Stop / shutdown**

Move the selector switch to "auto". Fan will stop if temperature is below stat set point.

• **Systems interface**

– normal Electrical

III SEQUENCE OF OPERATION – AUTOMATIC• **Start-up**

Move the selector switch to the "auto" position. When the temperature rises above the set point of the thermostat 9TC-226 the fan is activated. If the temperature continues to rise the fans will run faster via the variable speed control.

• **Stop / shutdown**

With the selector switch in the "auto" position the fans will stop when the temperature falls below the set point of the thermostat.

• **Systems interface**

– normal Electrical

IV COMPONENT LIST

<u>COMPONENT</u>	<u>KEY</u>	<u>QTY</u>	<u>O.S. NUMBER</u>	<u>DESCRIPTION</u>
2-Ceiling Fans	PF-1&2	1	CP-56	Pleasantaire
	c/w	1	MC3	Speed Contro
1-Thermostat	9TC-226	1	T6051A1057	120v Thermostat
	c/w	1	23394B	Metal Locking Guard

2.3-1:16 PROPELLER FANS - PF-3 and PF-4**I DESCRIPTION**

These fans are located in the south end of the central marshalling area on the underside of the roof structure. They recirculate rising hot air downward.

The fans are controlled by a variable speed controller and a two position selector switch, "hand" and "auto" located in the mechanical control panel CP-1.

I SEQUENCE OF OPERATION – MANUAL• Start-up

Move the selector switch to "hand." This over rides the thermostat control and turns the fans "on."

• Stop / shutdown

Move selector switch to "auto". Fan will stop if temperature is below stat set point.

• Systems interface

– normal Electrical

II SEQUENCE OF OPERATION – AUTOMATIC• Start-up

Move the selector switch to the "auto" position. When the temperature rises above the set point of the thermostat 9TC- 241 the fan is activated. If the temperature continues to rise the fans will run faster via the variable speed control.

• Stop / shutdown

With the selector switch in the "auto" position the fans will stop when the temperature falls below the set point of the thermostat.

• Systems interface

– normal Electrical

IV COMPONENT LIST

COMPONENT	KEY	QTY	O.S. NUMBER	DESCRIPTION
2-Ceiling Fans	PF-3&4	1	CP-56	Pleasantaire
	c/w	1	MC3	Speed Control
1-Thermostat	9TC-241	1	T6051A1057	120v Thermostat
	c/w	1	23394B	Metal Locking Guard

2.3-1:17 PROPELLER FANS - PF-5 and PF-6**I DESCRIPTION**

These fans are located in the garage area on the underside of the roof structure. They recirculate rising hot air downward.

All the fans are controlled by variable speed controllers and two position selector switches, "hand" and "auto" located in the mechanical control panel.

I SEQUENCE OF OPERATION – MANUAL• Start-up

Move the selector switch to "hand." This over rides the thermostat control and turns the fans "on."

• Stop / shutdown

Move selector switch to "auto". Fan will stop if temperature is below stat set point.

- Systems interface
- normal Electrical

II SEQUENCE OF OPERATION – AUTOMATIC

• Start-up

Move the selector switch to the "auto" position. When the temperature rises above the set point of the thermostat 9TC-261 the fan is activated. If the temperature continues to rise the fans will run faster via the variable speed control.

• Stop / shutdown

With the selector switch in the "auto" position the fans will stop when the temperature falls below the set point of the thermostat.

- Systems interface
- normal Electrical

IV COMPONENT LIST

<u>COMPONENT</u>	<u>KEY</u>	<u>QTY</u>	<u>O.S. NUMBER</u>	<u>DESCRIPTION</u>
2-Ceiling Fans	PF-5&6	1	CP-56	Pleasantaire
		c/w	1	MC3
Speed Control				

2.3-2 PLUMBING

I GENERAL DESCRIPTION

Plumbing for the facility consists of two systems, domestic water including hot water circulation and sanitary and waste water.

The domestic water is a single system serving the entire building. This system is equipped with a 3,700 L water storage tank, booster pump, hydropneumatic tank, hot water heaters, circulating pump and piping distribution which includes pipes, fittings, valves, controllers, fixtures and equipment.

The sanitary and waste water system is a single system containing a main 7,450 L holding tank, two secondary holding tanks of 1,112 L and 105 litres capacity, large and small diameter drainpipes, vent pipes, cleanouts, fixtures and equipment.

Domestic water is brought in by tank truck and pumped into the main water storage tank while sewage is pumped from the main holding tank into a tank truck and taken away. Except for these two operations the plumbing system is fully automatic.

2.3-2:1 DOMESTIC WATER

I DESCRIPTION

Domestic water is stored in tank TK-2 located in the main mechanical room 110. This tank is fitted with two level switches. One level 13LS-390 activates a light 131L-390 on the outside wall above the fill pipe when the tank is full while the other 13LS-430 indicates a low water situation which activates a visual alarm on the mechanical annunciator panel. The tank is also fitted with a visual indicator, overflow pipe, drain pipe and manhole.

Pump P-1 pressurizes the domestic water and distributes cold water to each fixture and domestic hot water heater DWH-1 and DWH-2. Pressurization of the system is controlled by a pressure switches which

I SEQUENCE OF OPERATION – MANUAL• Start-up

Fill tank TK-2 until high level switch 13LS-390 activates light 13IL-390 mounted above fill pipe indicating the tank is full.

Open all valves necessary to allow water distribution and circulation.

Energize electrical and oil fired equipment.

See also annual start-up/shutdown procedures - section 5.0.

• Stop / shutdown

De-energize electrical and oil fired equipment.

Close valves necessary to stop water distribution and circulation. (Repair situations)

Drain main storage tank only as required to effect repairs.

See also annual start-up/shutdown procedures - Section 5.

• Systems interface

- normal

II SEQUENCE OF OPERATION – AUTOMATIC• Start-up

Once the main storage tank TK-2 is filled water is supplied automatically on demand. As demand increases the line pressure drops tripping pressure switch 7PS-361 in pump P-1. This activates P-1 which continues pumping until the set line pressure is restored.

• Stop / shutdown

Once the line pressure is restored the pressure switch 7PS-362 de-activates pressure pump P-1.

Water service is also stopped by high sewage level in tank TK-5 via level switch 13LS-363. Pressure pump P-1 is disabled and an audible and visual alarm is activated at annunciator panel AP-1.

• Systems interface

- normal: Sanitary system
Electrical
Controls
- emergency: Panel CP-1 alarm
High level sewage alarm

IV COMPONENT LIST

<u>COMPONENT</u>	<u>KEY</u>	<u>QTY</u>	<u>O.S. NUMBER</u>	<u>DESCRIPTION</u>
1-Storage Tank	TK-2	1		
2-Level Switches	13LS-390,430	2	ENH-10	Level Switch
1-Indicator Light	13IL-390	1	RWP-100A	120v Amber Light
1-Pressure Pump	P-1	1	JKC-S4	Monarch Jet Pump
Pressure Switch	7PS-361	1		Lo Limit
	7PS-362	1		Hi Limit

<u>COMPONENT</u>	<u>KEY</u>	<u>QTY</u>	<u>O.S. NUMBER</u>	<u>DESCRIPTION</u>
1-Pressure Tank	TK-3	1		Amtrol/Well-x-trol
Water Closet	WC-1		3180-0001	IFO Cascade
	WC-2		3-154	Neu-Hymont
Lavatories	LAV-1			Norwich
	LAV-2			Marquis
Stainless Steel Sink	SK-1,3		QL202	Steel Queen
Laundry Tubs	LS-1			Serv-A-Sink
Mop Service Sink	MS-1		MS2424	Swan

2.3-2:2 DOMESTIC HOT WATER

I DESCRIPTION

Hot water is produced in two water heaters. DWH-1 A189L (41gal) oil fired hot water heater located in mechanical room 110 supplies the offices and labs on the east side of the building. Distribution is via a system which includes one circulating pump P-2, piping, fittings and valves. DWH-2 is a small electric water heater located in workshop room 113, supplies hot water to a sink in this room only.

II SEQUENCE OF OPERATION – MANUAL

- Start-up

DWH-1:

Open supply valves to tank and activate main distribution system.

Open valves on hot water recirculating system and energize electrical and oil fired equipment.

Turn recirculation pump on with manual switch.

DWH-2:

Turn on water and electrical

SEE also annual start-up/shutdown procedures in Section 5.

- Stop / shutdown

DWH-1:

De-activate the main water supply system and close appropriate valves.

De-energize electrical and oil fired equipment.

Turn off recirculating pump.

DWH-2:

Turn off water and electrical

SEE also annual start-up/shutdown procedures in Section 5.

- Systems interface

– normal Domestic Water
Fuel Delivery
Electrical

III SEQUENCE OF OPERATION – AUTOMATIC

- Start-up

Once the domestic cold water system and distribution system is activated and the hot water heaters are operational hot water is supplied on demand.

Water temperature in both tanks is controlled by preset aquastats mounted on the tank.

When the water temperature in DWH-1 falls below the set point of the aquastat the burner unit is activated which simultaneously opens the combustion air damper 13DM-396 and the fuel line solenoid valve 13SV-398 via control relay 13CR-393. The hot water recirculation pump P-2 runs continuously.

When the water temperature in DWH-2 falls below the set point of the aquastat the electric heating elements are cycled on. This tank does not utilize a circulating pump.

See also annual start-up/shutdown procedures in Section 5.

- Stop / shutdown

DWH-1

When the water temperature in the tank rises to the set point of the aquastat the burner unit shuts down simultaneously closing the combustion air damper 13DM-396 and the fuel line solenoid valve 13SV-398 via control relay 13CR-393. If the aquastat malfunctions and the tank water temperature rises to 72°C the burner unit is disabled and an audible and visual alarm is activated at the annunciator panel AP-1.

If the burner malfunctions causing a fire, a heat detector 12HD-334 mounted over the burner will trip and shut down the fuel delivery system by closing fuel line solenoid valve 12SV-336 via control relays 12CR-332 and 12CR-334..

SEE also annual start-up/shutdown procedures in Section 5.

- Systems interface

- normal: Domestic cold water
Sanitary system
Electrical
Fuel delivery system
Controls
- emergency: Alarm panel
Fuel delivery

IV COMPONENT LIST

<u>COMPONENT</u>	<u>KEY</u>	<u>QTY</u>	<u>O.S. NUMBER</u>	<u>DESCRIPTION</u>
1-Hot Water Heater	DWH-1	1	1000-50	Aero-gas fired
1-Hot Water Heater	DWH-2		JW-145-481	John Wood
1-Heat Detector	13HD-334	1	284A	Heat Detector
1-Damper	13DM-306	1	ACAPAC-150	Combustion Air Damper
1-Solenoid Valve	13SV-398	1	2LB2LBG5102120	3/4" Dia. N.C. Solenoid
1-Control Relay	13CR-393	1	RH2BU/24VAC	24v DPDT Relay
	c/w	1	PTF-08A	Socket
	c/w	1	129384A	Case & Cover
1-Circulating Pump	P-2		S.25AB	Armstrong

VALVE TAG SCHEDULE

<u>DESCRIPTION</u>	<u>ITEM NO.</u>	<u>LOCATION</u>	<u>VALVE</u>	<u>NUMBER</u>	<u>POSITION</u>
<u>Cold Water</u>					
Shut-off from Tank TK-2	TK-2	Tank	Outlet	#36	N.O.
Shut-off to Pump P-1	P-1	Pump P-1	Inlet	#37	N.O.
Shut-off to Pressure Tank	TK-3	TK-3	Shut-off	#38	N.O.
Domestic Water Syst. Drain	P-1	Pump P-1	Drain	#39	N.C.

<u>DESCRIPTION</u>	<u>ITEM NO.</u>	<u>LOCATION</u>	<u>VALVE</u>	<u>NUMBER</u>	<u>POSITION</u>
Tank TK-3 Drain	TK-3	Tank TK-3	Drain	#40	N.C.
Pump P-1 Drain	P-1	Pump P-1	Drain	#41	N.C.
2nd Fl. Shut-off	Rm 110	Shut-off		#42	N.O.
Shut-off to Parts Rm.	Rm 110	Shut-off		#43	N.O.
Return from Parts Rm.		Above Tank TK-3		#44	N.O.
<u>Hot Water</u>					
Hot Water Tank Supply		DHW -1		#45	N.O.
D.H.W. from Hot Water Tank		DHW -1		#46	N.O.
Pump P-2 Isolation	P-2	Beside DHW -1	Isolation	#47	N.O.
Pump P-2 Isolation	P-2	Beside DHW -1	Isolation	#48	N.O.
Hot Water Tank Drain		DHW -1	Drain	#49	N.C.

2.3-2:3 SANITARY SYSTEM

I DESCRIPTION

The sanitary and waste water system consists of one 7,450 L primary holding tank and two secondary holding tanks of 1,122 L and 106 L capacity, drain pipes, pumps and fixtures. When either of tanks TK-5 and TK-7 are full the effluent is pumped into a tank truck and taken away for disposal. Gases produced in the system escape through a system of vent pipes.

Primary holding tank TK-5 serves the labs and washrooms on the east side of the building and secondary tank TK-6. Secondary tank TK-6 services the darkroom 105 while TK-7 services the garage sump and the sink in room 113. The sump in the garage serves as a holding pit for drainage from the garage floor area and the sink in room 113.

II SEQUENCE OF OPERATION – MANUAL

The systems operations are passive with no operating equipment except for pumps P-7 and P-8 and the alarm interlocks. (See Sequence of Operation - Automatic.)

- Start-up

SEE also annual start-up/shutdown procedures in Section 5.

- Stop / shutdown

SEE also annual start-up/shutdown procedures in Section 5.

- Systems interface

- normal Domestic Water
 Electrical
 Controls

III SEQUENCE OF OPERATION – AUTOMATIC

- Start-up

The system is passive except for pumps P-7 and P-9 and the level switches and Interlocks.

When the effluent level in TK-6 rises above the set point of the level switch the pump P-7 is activated. Effluent is then pumped from TK-6 into the main holding tank TK-5 located in the main mechanical room 110.

TK-5 - Effluent from the washrooms, labs, janitor sink and second floor darkroom flows by gravity into the main molding tank TK-5. Waste water from the main floor darkroom 105 flows into storage tank TK-6 located in room 107.

Tank TK-7 services the sump located in the garage. Waste water from the laundry sink and from the garage area drains into this sump. When the level of the effluent in the sump rises to the set point of the level switch mounted in the sump, pump P-8 mounted in the sump is activated. The effluent in the sump is then pumped into holding tank TK-7.

When either tank TK-5 or TK-7 are in a high level alarm condition the effluent must be pumped out and the alarms reset before pumps P-1 and P-8 will operate.

- Stop / shutdown

TK-5 - When the effluent level in TK-5 rises to the set point of the high level switch 13LS-363, set at four inches from the top of the tank, domestic water booster pump P-1 and pump P-7 in sump tank TK-6 are disabled and an audible and visual alarm activated at annunciator panel AP-1.

TK-7 - When the waste water level in TK-7 rises to the set point of the high level float switch 13LS-370, pump P-8 in the drainage pit is disabled and an audible and visual alarm activated at the annunciator panel AP-1.

These pumps will remain disabled until the high level condition is rectified and the alarms reset. SEE also annual start-up/shutdown procedures in Section 5.

- Systems interface

- normal: Domestic water system
Electrical
Controls

IV COMPONENT LIST

<u>COMPONENT</u>	<u>KEY</u>	<u>QTY</u>	<u>O.S. NUMBER</u>	<u>DESCRIPTION</u>
1-Sewage Holding Tank	TK-5			
1-Sewage Holding Tank	TK-6			
1-Sewage Holding Tank	TK-7			
2-Waste Water Pumps	P-7 & P-8			Duroflo Submersible
2-Level Switches	13LS-363 13LS-370	2	ENH-10	Level Switch

2.3-3 FUEL STORAGE AND DISTRIBUTION

I GENERAL DESCRIPTION

The fuel oil supply for the oil fired equipment in the building is supplied by the local utility company from the main bulk storage tank TK-1 located outside of the building. From here the oil is pumped to day storage tank TK-4 located in the main mechanical room 110. From this day tank oil is distributed to the various oil fired units through a system of pipes, valves, and circulating pumps.

2.3-3:1 TK-1 MAIN STORAGE TANK

I DESCRIPTION

Tank TK-1 is a 13,500 L tank located outside the building at the southwest corner. Transfer pumps P-3 and P-4 pump oil from TK-1 to the day tank TK-4 through an oil meter and piping system.

I SEQUENCE OF OPERATION – MANUAL• Start-up

Open main supply valve online through meter.

Open valves to transfer pumps P-3 and P-4.

Energize transfer pumps.

SEE also annual start-up/shutdown procedures in Section 5.

• Stop / shutdown

Close main supply valve and meter bypass valve.

Close valves to transfer pumps P-3 and P-4.

De energize transfer pumps.

SEE also annual start-up/shutdown procedures in Section 5.

• Systems interface

– normal Electrical

– emergency

II SEQUENCE OF OPERATION – AUTOMATIC• Start-up

Fuel flow is precipitated by demand once system is energized.

• Stop / shutdown

Once system is energized fuel demand will govern stop sequence.

• Systems interface

– normal Electrical

IV COMPONENT LIST

<u>COMPONENT</u>	<u>KEY</u>	<u>QTY</u>	<u>O.S. NUMBER</u>	<u>DESCRIPTION</u>
1-Main Fuel Tank	TK-5			
1-Level Indicator	12LI-A			
1-Fuel Meter				
Piping and valves in tank supply header				

2.3-3:2 TANK TK-4 FUEL OIL DAY TANK**I DESCRIPTION**

TK-4 located in the main mechanical room No. 110 supplies fuel oil to all the oil fired equipment throughout the building. This includes hot water heater DWH-1, furnaces FU-1, FU-2, FU-3, and FU-4, air handling units AHU-1 and AHU-2 and unit heater UH-1. Fuel oil is distributed to the burner units on this equipment by pumps P-5 and P-6 through a system of distribution piping, valves, and filters. This distribution system consists of two loops. Pressure in the system is regulated by two pressure reducing valves, one located on the supply end of the mechanical room loop and the other on the return end of the main building loop. One loop carries fuel to the oil fired equipment in the mechanical room which consists of FU-1, FU-2, FU-3, FU-4 and DWH-1. The second loop carries fuel to AHU-1, AHU-2 and UH-1 which are located outside the mechanical room. The fuel level in TK-4 is monitored and controlled by level indicator 12LI-B mounted on the wall adjacent to the tank and the tank mounted level switches 12LS-426 (low limit), 12LS-424 (high limit), and 12LS-351 and 12LS-352 which cycle the fuel transfer pumps. P-3 and P-4.

I SEQUENCE OF OPERATION – MANUAL• Start-up

Set all valves to their normal operating position and energize pumps.

Ensure main tank TK-5 and TK-4 are full.

SEE also annual start-up/shutdown procedures in Section 5.

• Stop / shutdown

De energize pumps P-3 and P-4 and set all valves to their normal shutdown position.

SEE also annual start-up/shutdown procedures in Section 5.

• Systems interface

– normal Electrical

II SEQUENCE OF OPERATION – AUTOMATIC• Start-up

If the fuel level in TK-4 falls below the set point of level switch 12LS-352 (LS3A-3) the transfer pumps P-3 and P-4 are energized. The setting of the manual selector switch in panel CP-1 determines which pump will operate.

• Stop / shutdown

When the fuel level in TK-4 rises to the set point of level switch 12LS-351 (LS3A-2) the transfer pumps P-3 and P-4 are de energized. If level switch 12LS-351 (LS3A-2) fails to de energize the transfer pumps another tank continues to fill and the high limit switch 12LS-424 (LS3A-1) will stop the pumps and activate an audible and visual alarm at the annunciator panel AP-1. If the fuel level falls below the set point of level switch 12LS-352 (LS3A-3) and continues to fall the low limit switch 12LS-424 (LS3A-4) will stop the transfer pumps and activate an audible and visual alarm at the annunciator panel in mechanical room 110.

Any burner malfunction resulting in fire will trip heat detectors mounted over the burner units de energizing the normally closed solenoid valves 12SV-336 (FV1B) and 12SV-345 (FV-2B). Heat detectors 3HD-330, 4HD-331, 5HD-332, 6HD-333 and 13HD-334 de energizes the solenoid valve 12SV-336 via control relays 12CR-334 and 12CR-332. The quick release button 12SW-336 mounted beside the mechanical room door will close solenoid valve 12SV-336. Heat detectors 7HD-339, 8HD-340 and 10HD-341 de-energize solenoid valve 12SV-345 via control relays 12CR-343 and 12CR-341. The quick release button 12SW-345 mounted adjacent to the mechanical room door, outside, will close solenoid valve 12SV-345.

Tripping of any heat detector will also disable fuel transfer pumps via the respective control relays listed previously along with control relays 12CR-322 or 12CR-323.

Each burner fuel supply also has a fused link valve. In the case of fire the fusible link melts allowing the valve to close which stops the fuel flow.

• Systems interface

– normal Heating & Ventilating
 Domestic Hot Water
 Electrical
 Controls

IV COMPONENT LIST

COMPONENT	KEY	QTY	O.S. NUMBER	DESCRIPTION
1-Fuel Tank	TK-1			

1-Day Tank	TK-4			
1-Fuel Pumps	P-3, P-4			
	P-5, P-6			
	12LS-351,	4	McDonnell #80	Fuel Level Switch
	352,424,426			
	12SV-336, 345	2	2LB27BB8127120	1.5" Dia. N.C. Solenoid
	12SW-336, 345	2	RPV-K01	Panic Button
	12LI-A, B	2	ES11027	Simons Levelometer

Fused Link Valves

VALVE TAG SCHEDULE

<u>DESCRIPTION</u>	<u>ITEM NO.</u>	<u>LOCATION</u>	<u>VALVE</u>	<u>NUMBER</u>	<u>POSITION</u>
Meter bypass shut-off		TK-2 fr P/3-4	Inlet	#1	N.C.
Pump P-3 Isolation	P-3	Pump P-3 Outlet	Isolation	#2	N.O.
Pump P-3 Isolation	P-3	Pump P-3 Inlet	Isolation	#3	N.O.
Pump P-4 Isolation	P-4	Pump P-4 Outlet	Isolation	#4	N.O.
Pump P-4 Isolation	P-4	Pump P-4 Inlet	Isolation	#5	N.O.
Isolates inner sys from bulk tk	TK-1	Inlet Header P-3&P-4	Isolation	#6	N.O.
Pressure relief	P-3&P-4	Outlet of PRV P-3&P-4	Isolation	#7	N.O.
Oil meter isolation		Oil Meter Outlet	Isolation	#8	N.O.
Oil meter isolation		Oil Meter Inlet	Isolation	#9	N.O.
Pres. Red. Valve from marsh.area		Above Day Tank TK-2	Bypass	#10	N.C.
Main shut-off to system		Above Pump P-5	Shut-off	#11	N.O.
Mech Rm Supply Shut-off	P-2	Above Pump P-5	Shut-off	#12	N.O.
Mech Rm Return Shut-off	TK-2	Above Day Tank TK-2	Shut-off	#13	N.O.
Day tank TK-2 Shut-off	TK-2	Outlet of Day Tk TK-2	Shut-off	#14	N.O.
Day tank drain	TK-2	Outlet of Day Tk TK-2	Drain	#15	N.C.
Control Column Shut-off	TK-2	Outlet of Day Tk TK-2	Shut-off	#16	N.O.
Inlet Shut-off	P-6	Pump P-6	Shut-off	#17	N.O.
Outlet Shut-off	P-6	Pump P-6	Shut-off	#18	N.O.
Inlet Shut-off	P-5	Pump P-5	Shut-off	#19	N.O.
Outlet Shut-off	P-5	Pump P-5	Shut-off	#20	N.O.
Pressure Relief Isolation	P-5&P-6	Outlet of PRV P-5&P-6	Isolation	#21	N.O.
Mech Rm Return Shut-off		Between FU-3 & FU-4	Shut-off	#22	N.O.
Fuel Oil Supply Shut-off	FU-1	Furnace FU-1	Shut-off	#23	N.O.
Fuel Oil Supply Shut-off	FU-2	Furnace FU-2	Shut-off	#24	N.O.
Fuel Oil Supply Shut-off	FU-3	Furnace FU-3	Shut-off	#25	N.O.
Fuel Oil Supply Shut-off	FU-4	Furnace FU-4	Shut-off	#26	N.O.
Fuel Oil Supply Shut-off		Hot Water Tank	Shut-off	#27	N.O.
Fuel Oil Supply Shut-off		AHU-1	Shut-off	#28	N.O.
Fuel Oil Return Shut-off		AHU-1	Shut-off	#29	N.O.
Fuel Oil Supply Shut-off		AHU-2	Shut-off	#30	N.O.
Fuel Oil Return Shut-off		AHU-2	Shut-off	#31	N.O.

2.3**OPERATING PROCEDURES****MECHANICAL**

<u>DESCRIPTION</u>	<u>ITEM NO.</u>	<u>LOCATION</u>	<u>VALVE</u>	<u>NUMBER</u>	<u>POSITION</u>
Fuel Oil Supply Shut-off		UH-1	Shut-off	#32	N.O.
SPARE		Inside Control Panel	SPARE	#33-35	SPARE
Low Level Alarm		Tank TK-2 Control Col.	Switch	#50	Control
Pump P-3 or P-4 On		Tank TK-2 Control Col.	Switch	#51	Control
Pump P-3 or P-4 Off		Tank TK-2 Control Col.	Switch	#52	Control
High Level Alarm		Tank TK-2 Control Col.	Switch	#53	Control
Pump P-3 Electric Disconnect		Behind Pump P-5	Elec. Disconnect	#54	Control
Pump P-4 Electric Disconnect		Behind Pump P-5	Elec. Disconnect	#55	Control
Pump P-5 Electric Disconnect		Beside Pump P-4	Elec. Disconnect	#56	Control
Pump P-6 Electric Disconnect		Beside Pump P-4	Elec. Disconnect	#57	Control

<p>Photo of technology¹:</p> 	<p>Type/Name of Technology: ECO-Mobile – ECO M2TN</p> <p>Manufacturer: ECO Waste Solutions (EWS)</p> <p>Specifications:</p> <ul style="list-style-type: none"> - Combines EWS patented process with the transportability of a skid-mounted incinerator package. - Permanently housed in a 20'-40' shipping container. - "Plug-and-play" set-up allows operations with minimal assembly and disassembly.
<p>Website/Contact: www.ecosolutions.com +1-905-634-7022 Tracey Goldberg (ext. 31) tgoldberg@ecosolutions.com</p>	<p>Capacity:</p> <ul style="list-style-type: none"> - Batch: up to 2,000 kg/day - Continuous: 250-1000 kg/hour <p>* See Batch and Continuous feed process below.</p>
<p>Power requirements:</p> <ul style="list-style-type: none"> - 3-phase, 110/220 V, 60 hZ - Electrical consumption is estimated at 32 kWh/batch (per day) 	<p>Price Estimate:</p> <ul style="list-style-type: none"> - Starting at CDN\$ 550,000 - Fuel (diesel) consumption is estimated at 85 US Gallons/batch (per day) - Maintenance Cost on the equipment is estimated at 5% of capital cost per year - One year equipment warranty period
<p>Temperature at Incinerator Inlet:</p> <ul style="list-style-type: none"> - Primary Chamber: 650°C - 850°C - Secondary Chamber: 1000°C 	<p>Vicinity Requirements</p> <p>It is a containerized system, so it does not need a building enclosure.</p>
<p>Limitations:</p> <ul style="list-style-type: none"> - Household hazardous waste must be diverted for appropriate treatment. - Continuous feed process requires an Operator to load the chamber every 20 minutes during the burn cycle - Loading is done at the top of the main primary chamber using a waste bin/forklift (added cost) - Concrete is deemed an unacceptable waste stream for the incinerator. 	
<p>Green Considerations and Options:</p> <ul style="list-style-type: none"> - Optional Containerized Scrubber or Air Pollution Control (APC) module to meet global air emission standard: neutralise acid gases, remove particulate matter and capture heavy metals and other toxic compounds; - Hot water heat exchanger for heat recovery (see "energy from waste" section below) available with Continuous Feed Process mainly; - Performance Claim Verified by the ETV Program; - In Wemindji, Quebec (Cree Nation of Wemindji) it is used to balance a need to protect the environment and the need to manage the community's waste. Fact sheet is available from: http://www.ecosolutions.com/documents/Cree%20REV%20A.pdf 	

¹ Containerised Incinerator and Scrubber Package picture from http://www.ecosolutions.com/index.php/screen/eco_mobile

General Description of Technology:

- Formats:
 - Batch feed operation or;
 - Continuous feed operation
- Batch Feed Process:
 - Gasification of waste materials as a single batch load without adding more waste until the completion of the cycle;
 - Fully automated after loading and starting the machine; no need for constant attendance;
 - Starved-air, pyrolytic combustion process where oxygen levels are kept at minimum;
 - Minimum disturbance of the waste results in a very thorough thermal conversion and very low carbon emissions.
 - Primary Chamber: waste burning
 - Secondary Chamber: cleansing of generated gases through high temperature, rich oxygen and turbulent conditions
 - After cooling, residual materials are removed by manual or automated means
- Continuous Feed Process:
 - Same design principles as batch feed operation – pyrolytic gasification in the first stage and thermal oxidation in the second;
 - Waste is charged on a continuous basis;
 - Ash conveyed out of the system automatically;
 - Can economically be scaled up to meet larger needs;
 - 24 hours operation is more conducive to energy recovery.

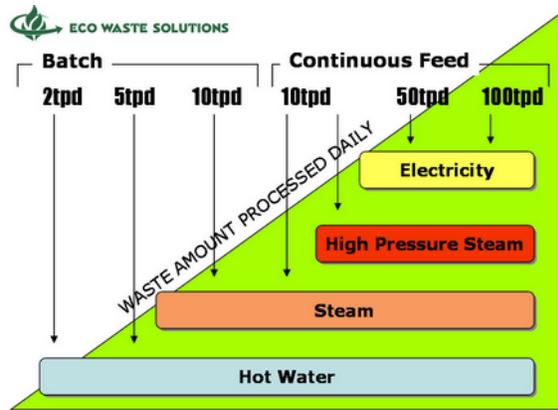


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² Eco Model Process Illustration from: http://www.ecosolutions.com/index.php/screen/technology_eco_process

- Incinerator components:
 - Primary Waste Chamber
 - Secondary Combustion Chamber
 - Stacks
 - Central Control Panel: by ECO Waste Solutions' proprietary *4G System Controls*.
 - It is housed in three 20 ISO containers. One for the primary chamber, one for the secondary chamber and one for Main Control Panel, which acts as a control room for the entire system. Additional space in the third container is used for transporting required accessories such as stack sections, spare parts packages.
- Optional Features available as fully containerized modules:
 - Air Pollution Control (Wet Scrubber): additional cleansing of the gases if required
 - Loading devices
 - Continuous emission monitoring systems (CEMS)
 - Waste storage
- Advantages:
 - Ease of Transport
 - Minimal Assembly
 - Immediate Activation
 - Single point connection for utilities
 - Automated – Easy to operate
 - Adaptable to a wide range of waste materials.
 - Compliance with strict environmental standards.
- Technical Specifications:
 - Fuel Supply option: diesel, fuel, oil, JP8, natural gas, arctic diesel, propane and waste oil.
 - Power Supply: 3-phase, 110/220 V, 60 Hz, other power supply options available.
 - Burners: Electronic auto-spark mechanical packaged burners with flow modulation.
 - Blowers: Forced air heavy-duty blowers for cooling and combustion air with automated modulating dampers and speed control on Secondary.

- Energy from Waste³:
 - Mainly available with continuous feed operation
 - Generates high quality steam, which can be used on-site for process input, used to drive turbines and generate electricity.



³ ECO Waste Solutions diagram from: http://www.ecosolutions.com/index.php/screen/energy_recovery



TECHNICAL SERVICE PACKAGES

Item	Package Description	Unit Price \$US
1	Start-up & Training Package (required) <ul style="list-style-type: none"> 1 Technician, 5 days on-site for system installation check, system start-up and operator training 	\$12,500
2	Installation and Assembly Supervision Service Package (recommended) <ul style="list-style-type: none"> 1 Technician, 10 days on-site for Installation and Assembly Supervision 	\$25,000

TECHNICAL ASSISTANCES RATES

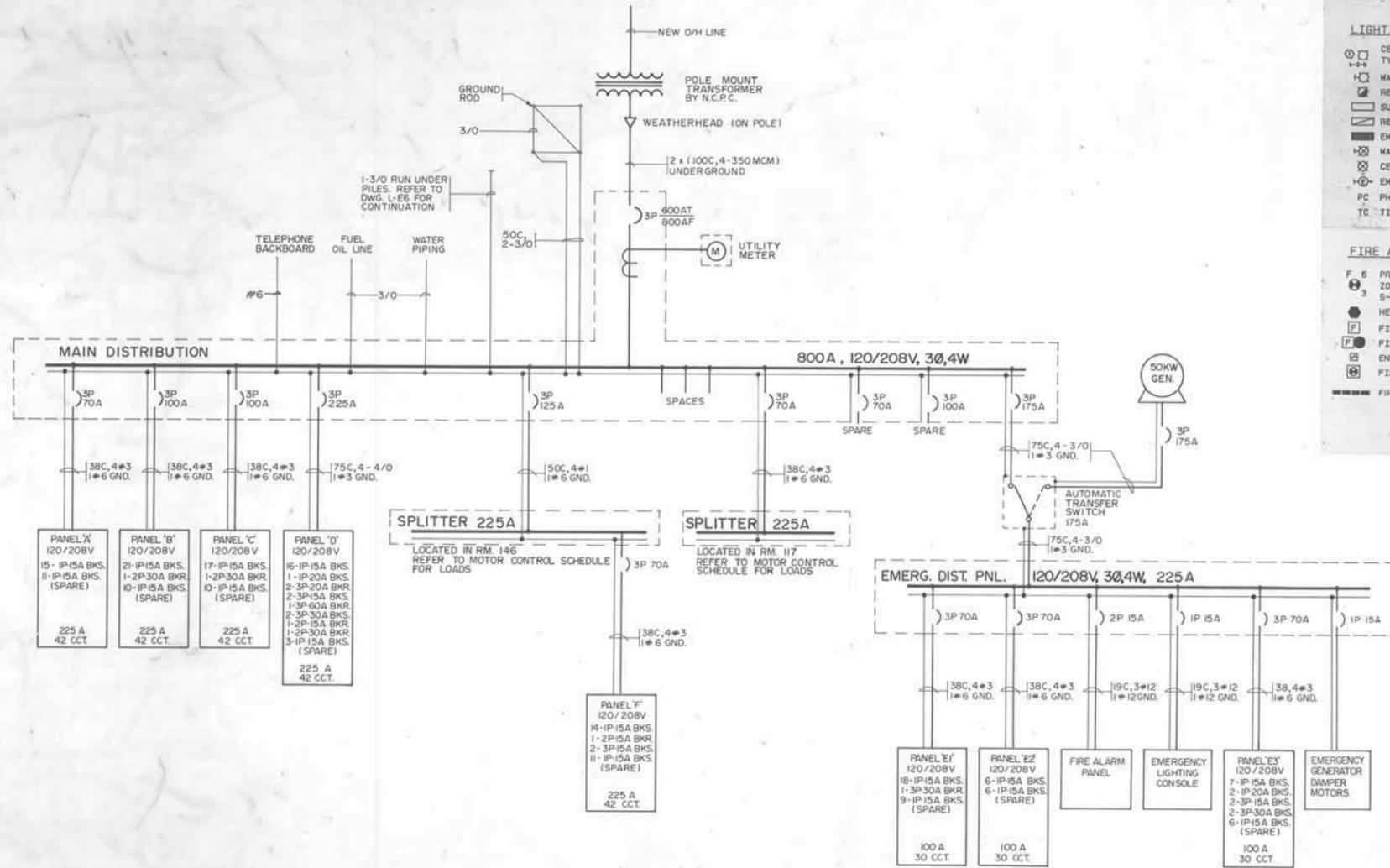
In-field Service & Training Rate	Price \$US	Description
Standard Rate	\$1,250.00	per day for standard eight (8) hour day (Monday to Friday)
Overtime Rate	\$200.00	per hour for weekdays (Monday to Friday) in excess of eight (8) hour per day
Non Working Days	\$200.00	per hour for Saturday eight (8) hour day
	\$275.00	per hour for Sunday or Holidays eight (8) hour day
Non Working Days Overtime Rate	\$350.00	per hour for Saturday, Sunday or Holidays in excess of eight (8) hours per day
Travel Time	\$650.00	per day Monday through Sunday
Travel Costs	TBD	Travel expenses charged out at cost + 10%
Factory Training & Assistance Rate	Price \$US	Description
Standard Rate	\$900.00	per day for standard eight (8) hour day (Monday to Friday)
Overtime Rate	\$150.00	per hour for weekdays (Monday to Friday) in excess of eight (8) hour per day
Non Working Days	\$150.00	per hour for Saturday eight (8) hour day
	\$200.00	per hour for Sunday or Holidays eight (8) hour day
Non Working Days Overtime Rate	\$250.00	per hour for Saturday, Sunday or Holidays in excess of eight (8) hours per day

EWS Technical Service Packages and Technical Assistance Rates

References:

1. ECO Waste Solutions. *4G System Controls*. From: http://www.ecosolutions.com/index.php/screen/4g_control_system
2. ECO Waste Solutions. *ECO Mobile Incineration Systems*. From: http://www.ecosolutions.com/index.php/screen/eco_mobile
3. ECO Waste Solutions. *ECO Mobile: Clean Burning Solutions, Product Spotlight*. From: <http://www.ecosolutions.com/documents/ECO%20Mobile.pdf>
4. ECO Waste Solutions. *Energy from Waste*. From: http://www.ecosolutions.com/index.php/screen/energy_recovery
5. ECO Waste Solutions. *Performance*. From: http://www.ecosolutions.com/index.php/screen/technology_performance
6. ECO Waste Solutions. *Process*. From: http://www.ecosolutions.com/index.php/screen/technology_process

Appendix 5 - Original Electrical Distribution



SINGLE LINE DIAGRAM

MOTOR CONTROL SCHEDULE												
MOTOR NUMBER	LOCATION	DESCRIPTION	MOTOR SIZE			CIRCUIT	BREAKER	FEEDER	CONDUIT	STARTER	SIZE	REMARKS
			HP	FLA	FLC							
MS-1	MECH. RM. 146	AIR LIFT - BUSSING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1, 2	
MS-2	MECH. RM. 146	AIR LIFT - BUSSING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1, 2	
MS-3	MECH. RM. 146	AIR LIFT - BUSSING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1, 2	
MS-4	MECH. RM. 146	AIR LIFT - BUSSING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1, 2	
MS-5	MECH. RM. 146	AIR LIFT - BUSSING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1, 2	
MS-6	MECH. RM. 146	AIR LIFT - BUSSING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1, 2	
MS-7	MECH. RM. 146	AIR LIFT - BUSSING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1, 2	
MS-8	MECH. RM. 146	AIR LIFT - BUSSING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1, 2	
MS-9	MECH. RM. 146	AIR LIFT - BUSSING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1, 2	
MS-10	MECH. RM. 146	AIR LIFT - BUSSING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1, 2	
MS-11	MECH. RM. 146	AIR LIFT - BUSSING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1, 2	
MS-12	MECH. RM. 146	AIR LIFT - BUSSING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1, 2	
MS-13	MECH. RM. 146	AIR LIFT - BUSSING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1, 2	
MS-14	MECH. RM. 146	AIR LIFT - BUSSING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1, 2	
MS-15	MECH. RM. 146	AIR LIFT - BUSSING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1, 2	
MS-16	MECH. RM. 146	AIR LIFT - BUSSING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1, 2	
MS-17	MECH. RM. 146	AIR LIFT - BUSSING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1, 2	
MS-18	MECH. RM. 146	AIR LIFT - BUSSING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1, 2	
MS-19	MECH. RM. 146	AIR LIFT - BUSSING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1, 2	
MS-20	MECH. RM. 146	AIR LIFT - BUSSING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1, 2	

MOTOR CONTROL SCHEDULE												
MOTOR NUMBER	LOCATION	DESCRIPTION	MOTOR SIZE			CIRCUIT	BREAKER	FEEDER	CONDUIT	STARTER	SIZE	REMARKS
			HP	FLA	FLC							
EP-1	MECH. RM. 146	EMERGENCY LIGHTING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1	
EP-2	MECH. RM. 146	EMERGENCY LIGHTING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1	
EP-3	MECH. RM. 146	EMERGENCY LIGHTING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1	
EP-4	MECH. RM. 146	EMERGENCY LIGHTING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1	
EP-5	MECH. RM. 146	EMERGENCY LIGHTING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1	
EP-6	MECH. RM. 146	EMERGENCY LIGHTING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1	
EP-7	MECH. RM. 146	EMERGENCY LIGHTING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1	
EP-8	MECH. RM. 146	EMERGENCY LIGHTING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1	
EP-9	MECH. RM. 146	EMERGENCY LIGHTING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1	
EP-10	MECH. RM. 146	EMERGENCY LIGHTING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1	
EP-11	MECH. RM. 146	EMERGENCY LIGHTING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1	
EP-12	MECH. RM. 146	EMERGENCY LIGHTING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1	
EP-13	MECH. RM. 146	EMERGENCY LIGHTING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1	
EP-14	MECH. RM. 146	EMERGENCY LIGHTING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1	
EP-15	MECH. RM. 146	EMERGENCY LIGHTING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1	
EP-16	MECH. RM. 146	EMERGENCY LIGHTING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1	
EP-17	MECH. RM. 146	EMERGENCY LIGHTING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1	
EP-18	MECH. RM. 146	EMERGENCY LIGHTING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1	
EP-19	MECH. RM. 146	EMERGENCY LIGHTING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1	
EP-20	MECH. RM. 146	EMERGENCY LIGHTING	1/2	1.0	0.8	3P 15A	15A	1/2"	15A	1/2"	NOTE 1	

LUMINAIRE SCHEDULE											
TYPE	VOLTAGE	WATTAGE	LUMENS	NOMINAL SIZE	DIFFUSER	COL OR FINISH	PARTS	MOUNTING	REMARKS	MANUFACTURER	CATALOGUE NUMBER
EP-1	120	30	300	4"	ACR	WHITE	RECESSED	RECESSED	RECESSED	EP-10	EP-10
EP-2	120	30	300	4"	ACR	WHITE	RECESSED	RECESSED	RECESSED	EP-10	EP-10
EP-3	120	30	300	4"	ACR	WHITE	RECESSED	RECESSED	RECESSED	EP-10	EP-10
EP-4	120	30	300	4"	ACR	WHITE	RECESSED	RECESSED	RECESSED	EP-10	EP-10
EP-5	120	30	300	4"	ACR	WHITE	RECESSED	RECESSED	RECESSED	EP-10	EP-10
EP-6	120	30	300	4"	ACR	WHITE	RECESSED	RECESSED	RECESSED	EP-10	EP-10
EP-7	120	30	300	4"	ACR	WHITE	RECESSED	RECESSED	RECESSED	EP-10	EP-10
EP-8	120	30	300	4"	ACR	WHITE	RECESSED	RECESSED	RECESSED	EP-10	EP-10
EP-9	120	30	300	4"	ACR	WHITE	RECESSED	RECESSED	RECESSED	EP-10	EP-10
EP-10	120	30	300	4"	ACR	WHITE	RECESSED	RECESSED	RECESSED	EP-10	EP-10
EP-11	120	30	300	4"	ACR	WHITE	RECESSED	RECESSED	RECESSED	EP-10	EP-10
EP-12	120	30	300	4"	ACR	WHITE	RECESSED	RECESSED	RECESSED	EP-10	EP-10
EP-13	120	30	300	4"	ACR	WHITE	RECESSED	RECESSED	RECESSED	EP-10	EP-10
EP-14	120	30	300	4"	ACR	WHITE	RECESSED	RECESSED	RECESSED	EP-10	EP-10
EP-15	120	30	300	4"	ACR	WHITE	RECESSED	RECESSED	RECESSED	EP-10	EP-10
EP-16	120	30	300	4"	ACR	WHITE	RECESSED	RECESSED	RECESSED	EP-10	EP-10
EP-17	120	30	300	4"	ACR	WHITE	RECESSED	RECESSED	RECESSED	EP-10	EP-10
EP-18	120	30	300	4"	ACR	WHITE	RECESSED	RECESSED	RECESSED	EP-10	EP-10
EP-19	120	30	300	4"	ACR	WHITE	RECESSED	RECESSED	RECESSED	EP-10	EP-10
EP-20	120	30	300	4"	ACR	WHITE	RECESSED	RECESSED	RECESSED	EP-10	EP-10

NOTES: 1. CONDUIT TO UNIT, 2. CONDUIT TO TRIP SWITCH (SUPPLIED BY DIV. 15), 3. CONDUIT TO RECEPTACLE (SUPPLIED BY DIV. 15), 4. REFER TO DRAWINGS FOR ALL LUMINAIRE SCHEDULES.

LEGEND

WIREWAYS

- SURFACE MOUNTED PANEL
- FLUSH MOUNTED PANEL
- CONDUIT RUN IN WALL OR CEILING

LIGHTING

- CEILING MOUNTED FIXTURE TYPE-1 PNL-A CCT-2 SWITCH-D
- WALL MOUNTED LUMINAIRE
- RECESSED LUMINAIRE
- SURFACE MTD. FLUORESCENT LUMINAIRE
- RECESSED FLUORESCENT LUMINAIRE
- EMERGENCY LUMINAIRE (SHADED)
- MALL MOUNTED EXIT LIGHT
- CEILING MOUNTED EXIT LIGHT
- EMERGENCY LIGHT REMOTE HEAD
- PC PHOTOCELL CONTROLLED
- TC TIMECLOCK CONTROLLED

OUTLETS AND DEVICES

- WALL MOUNTED DUPLEX RECEPTACLE (CIRCUIT A-1)
- SINGLE 30A RECEPTACLE
- QUADRUPLEX RECEPTACLE
- SPLIT FED RECEPTACLE
- SPECIAL RECEPTACLE: G - GROUND FAULT, I - ISOLATED GROUND, E - EMERGENCY
- MOUNTED AT 1060mm ABOVE FIN. FLOOR
- 20 AMP
- WEATHERPROOF
- SWITCH: 2 - 2 POLE, 3 - 3 WAY, P - PILOT LIGHT, K - KEY OPERATED
- SWITCH - SINGLE POLE
- DIMMER CONTROL SWITCH
- PHOTO ELECTRIC CELL
- CEILING MOUNTED JUNCTION BOX
- MALL MTD. SINGLE FACED CLOCK

FIRE ALARM DEVICES

- PRODUCTS OF COMBUSTION DETECTOR
- ZONE 3, DEVICE 6, P-FLUSH MTD, S-SURFACE MTD, OUTLET BOX
- HEAT DETECTOR (FIXED TEMP)
- FIRE ALARM PULL STATION
- FIRE ALARM BELL
- END OF LINE RESISTOR
- FIRE ALARM DUCT DETECTOR
- FIRE ZONE LIMITS

MOTORS AND CONTROL

- MOTOR EF-2, CIRCUIT D-2
- MAGNETIC STARTER
- COMBINATION MAGNETIC STARTER UNFUSED DISCONNECT SWITCH
- MANUAL MOTOR STARTER
- THERMOSTAT
- TIMED SWITCH (SUPPLIED BY DIV. 15)

LOW TENSION AND SIGNAL

- MALL MTD. TELEPHONE OUTLET
- MALL MTD. TELEVISION OUTLET

Public Works Travaux publics
Canada Canada

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CHERTON ENGINEERING INC.

THE ASSOCIATION OF PROFESSIONAL ENGINEERS OF THE PROVINCE OF ALBERTA
REG. NO. 1000
CHERTON ENGINEERING INC.
PERMIT NUMBER
1000
Dec 7, 1987

RECORD DRAWINGS 04/89

SCALE: 1" = 10'

A **A**
C **B** **C**

PROJECT: **LIVING ACCOMMODATION POLAR CONTINENTAL SHELF PROJECT RESOLUTE BAY, N.W.T.**

DRAWING: **SINGLE LINE, LEGEND AND DETAILS**

N.T.S.

DESIGNED: *N.A. FORTY*

DATE: 1987/12/07

REVISION: 1987/12/07

APPROVED: *[Signature]*

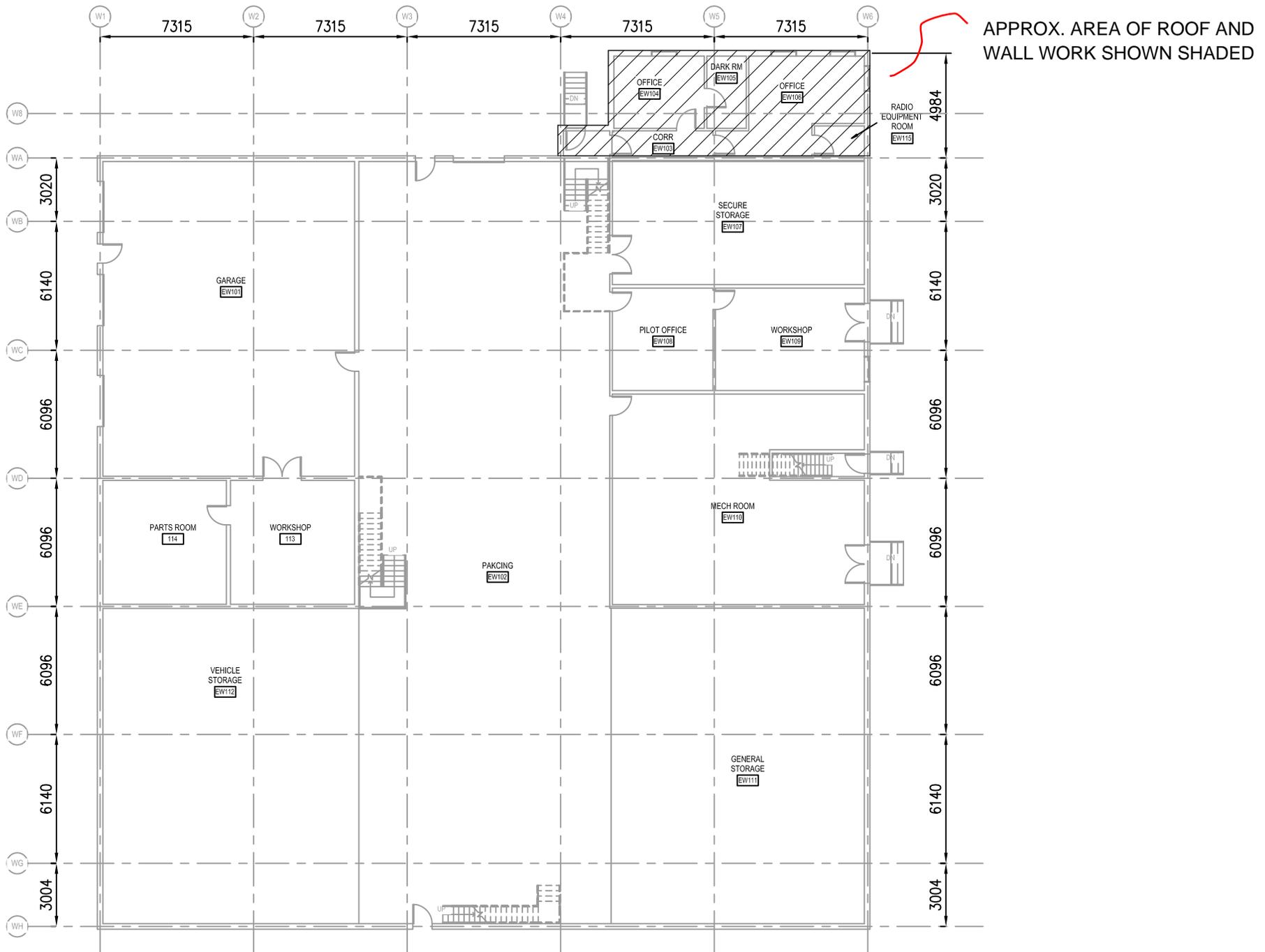
DATE: 1987/12/07

TITLE: *[Signature]*

PWC Project Manager: *[Signature]* Administrateur de projets: *[Signature]*

PROJECT NUMBER: 621059

DRAWING NO: L-E1

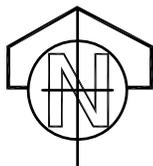
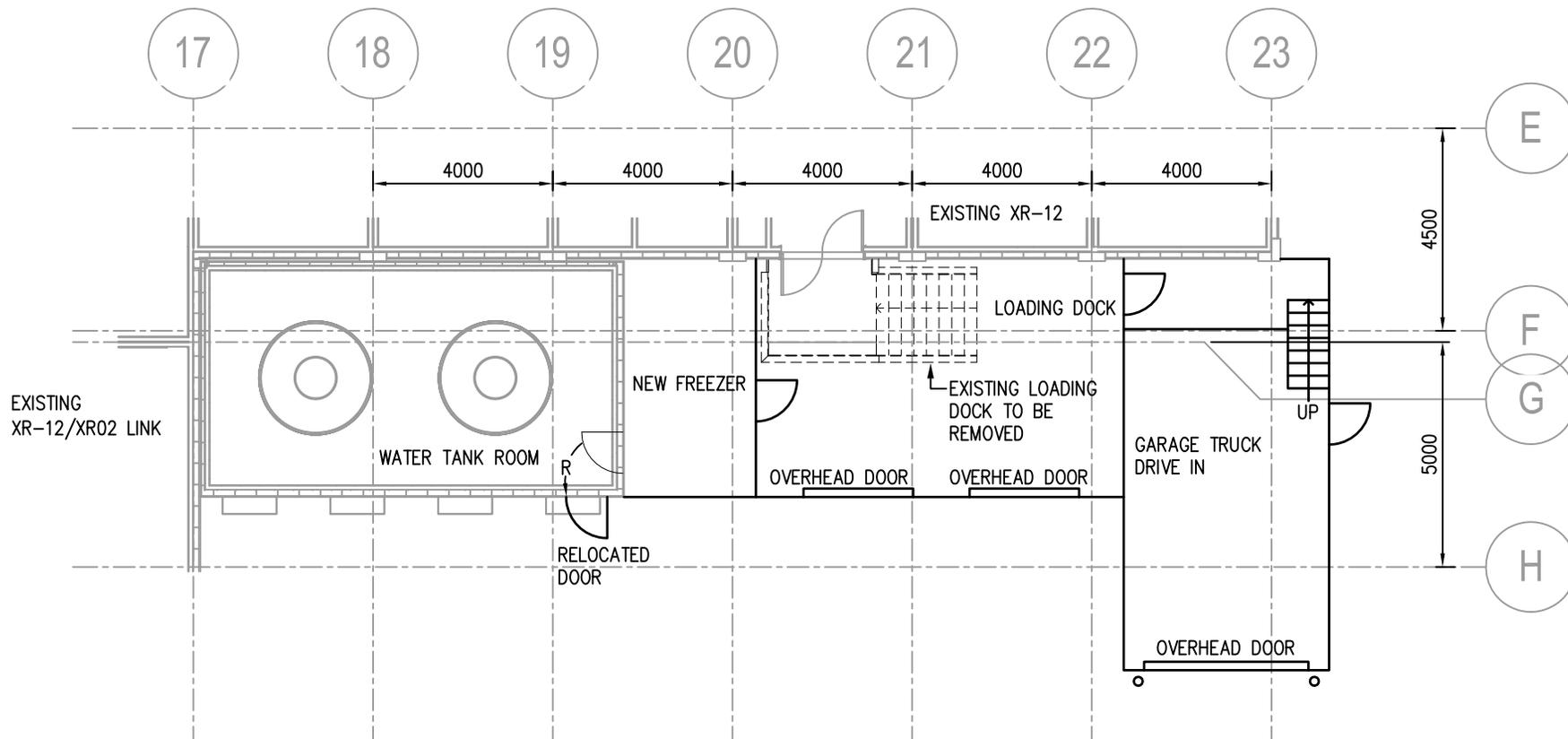


APPENDIX 6: XR-03 PCSP OPERATIONS CENTRE PARTIAL ROOF INFORMATION









**APPENDIX 7:XR-12 AIRF KITCHEN AND DINING COMPLEX -
ADDITION AT LOADING DOCK AND COLD STORAGE CONCEPT DIAGRAM**

