Correctional Service Canada | Service correctionnel Canada

SAFETY, RESPECT AND DIGNITY FOR ALL

LA SÉCURITÉ, LA DIGNITÉ ET LE RESPECT POUR TOUS

Technical Criteria for

Correctional Institutions

SECTION E – ELECTRICAL

Canada

E-1 ELECTRICAL – GENERAL ELECTRICAL ENGINEERING & DISTRIBUTION SYSTEM

1. SCOPE

- This section outlines the basic electrical engineering design criteria related to the special requirements of Correctional Service Canada (CSC) and the requirements for electrical distribution.
- It applies for CSC buildings that are inside and outside the fenced institutional perimeter.
- Approval from CSC must be obtained before any variations from this document are incorporated into any designs.

2. RELATED SECTIONS

E–2 to E–6 inclusive
SP–4 – Site Lighting
SU–4 – Power Supply & Electrical Power Distribution (Comply with all clauses in this section)

3. CODES AND STANDARDS

3.1 The design for the electrical work shall:

3.1.1 Be based on and conform with the updated requirements of the applicable National, Federal, Provincial and Local Municipal Codes, Standards, Rules, Regulations and all the appropriate authorities and agencies having jurisdiction.

3.1.2 Specify applicable standards for all equipment, i.e. EEMAC, CSA, NEMA, ULC, ASTM, NFPA, ANSI, IEEE, ULI.

3.1.3 Avoid specifying trade names, when it is required, provide not less than 3 trade names and/or equivalent equal.

3.2 The last edition of the "Canadian National Master Construction Specification" format shall be used when preparing specifications.

3.3 For wiring in hazardous locations follow CSA publication "A Guide for the Design, Construction and Installation of Electrical Equipment".

4. GENERAL REQUIREMENTS

4.1 The scope of technical work shall include, but not be limited to, engineering services required for sound planning and design of all electrical work necessary for the Project including:

4.1.1 Determination of existing and site conditions.
4.1.2 Economic and feasibility studies of alternatives.
4.1.3 Services and connection to utilities.
4.1.4 Integration of design with that of other disciplines.
4.1.5 Preparation of preliminary and detailed cost estimates.
4.1.6 Preparation of Drawings and Specifications as complete Contract Documents suitable for tendering.

5. SYSTEM CONSIDERATIONS AND PRIMARY DESIGN

5.1 The guiding principles for design of electrical systems are to ensure sustainable development, reliability and LEED program.

The electrical design shall be based on the following characteristics and features:

5.1.1 Safety to personnel during operation and maintenance.
5.1.2 Flexibility of electrical services.
5.1.3 Stringent security requirements up to the level of maximum security institutions.
5.1.4 High level of vandalism and deliberate tampering with systems and equipment.
5.1.5 Availability of electrical power to critical security and life safety support systems shall exceed 99.99%; that is, less than one hour down per year. Redundancy for UPS power and air conditioning for CER and MCCP Rooms and electronics located within this room.
5.1.6 Fail safe systems and equipment of a quality consistent with anticipated building life and/or required reliability of service.

5.2 Reliability/availability studies shall be carried out for power delivery to the main communications and control post, security control posts and other areas as designated by CSC. The study shall be carried out in accordance with *IEEE Standard 493-2007*[1].

5.3 Service

5.3.1 Carry out preliminary load study and establish approximate loads at each load centre/connection point.

5.4 Voltage

5.1.1 Preferred secondary voltages and systems for internal distribution are:

- 600/347 volt wye grounded 3 phase – 4 wire
- 208/l20 volt wye grounded 3 phase – 4 wire

There may be some limited requirement to serve special loads at 120/240 volt 3 wire on 240 volt, 2 wire single phase.

5.1.2 Review voltage considerations as presented in

- *IEEE Standard 241-1990*[2] – Section 3 and
- *IEEE Standard 141-1990*[3]
- Voltage profile limits to be as presented in Figure 6 of Reference *ANSI Standard C84.1-2006*[4] – Range "A".

5.5 Metering Requirements

5.5.1 Arrange and provide revenue metering to suit utility requirements in conjunction with configuration for service/distribution.
5.5.2 Distribution configuration to provide internal energy metering upon request of the institution. Metering equipment shall be similar to that provided by the utility and shall be in accordance with *CSA Standard C17-M84 (R2008)*[5].
5.5.3 Instrument transformers for metering to be in accordance with *CAN3-C13-M83 (R2004)*[6]. Specify instantaneous indicating voltmeters and ammeters at each distribution switchboard.

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1 493-2007 – IEEE Recommended Practice for the Design of Reliable Industrial & Commercial Power Systems
2 241-1990 – IEEE Recommended Practice for Electric Power Systems in Commercial Buildings
3 141-1993 – IEEE Recommended Practice for Electric Power Distribution for Industrial Plants
4 C84.1-2006 – American National Standard for Electric Power Systems & Equipment – Voltage Ratings (60 Hz)
5 CAN3-C17-M84 (R2008) – Alternating-Current Electricity Metering
6 CAN3-C13-M83 (R2004) – Instrument Transformers

5.6 Service/Distribution System (Transformer) Configuration

5.6.1 Reliability considerations dictate that some redundant transformation is provided for large customer owned 3 phase stations since a suitable temporary spare is usually unavailable.

For smaller stations single non redundant configurations should be considered. A source for replacement spare must be established. This could mean on a project with a number of single transformer stations that a suitable spare be provided and held on the premises.

The stations must be standardized at least to the extent that the single spare may be installed at each location. Consideration should be given to installing and connecting the spare at one station in a redundant or "double ended" configuration.

Design size and configuration of systems to recognize limitations of components:

- Full load rating, interrupting capacity and withstand capability of switching, protection and control equipment.
- Short circuit capability and thermal capacity of system conductors.

5.6.2 Generally the following guidelines should be considered.

- 600 volt systems - maximum transformer size - 2500 kVA with 6.5 to 7.0% impedance to limit maximum 3 phase bolted secondary through faults to 35,000 RMS (without considering internal system sources). (3300 kVA with single stage of fan cooling on a power transformer).
- 208/120V systems - maximum transformer size - 400 kVA with 5.0 to 5.5% impedance to limit maximum 3 phase bolted secondary through faults to 20,000A RMS.
- 4160 volt systems - maximum transformer size - 4000/5333 kVA with single stage of fan cooling.

5.7 Preliminary Design Study

5.7.1 Carry out an economic study to establish optimum system configuration, voltage levels and size. Establish at least 2 and preferably 3 alternative system configurations which reasonably represent the options to consider.

- Prepare capital cost estimates for each system.
- Evaluate complete owning and operating cost estimates including
  - utility energy charges
  - losses
  - depreciation
  - cost of money
- Also carry out a quantitative analysis of the reliability of each option. Methods for this study to be set out in *IEEE Standard 493-2007*[7].
- The study to be presented in report form and should include qualitative analysis and comparisons, recognizing factors which fall outside quantitative economic reliability analysis.

[7] 493-2007 – IEEE Recommended Practice for the Design of Reliable Industrial & Commercial Power Systems

The reliability analysis should consider the system through to typical points of utilization one of which must be the critical "Emergency" power connection to the "Control Centre".

5.7.2 Based on preliminary load calculations transformer sizes and main secondary system equipment must be sized to permit 50% future expansion.

5.8 Co-ordination Study

5.8.1 Carry out preliminary co ordination study during system development.

5.8.2 Use manufacturer's typical time overcurrent characteristics for relays, fuses and circuit breaker tripping elements.

5.8.3 Specify preparation of a complete co-ordination study as part of the contract. Contractor to employ recognized independent company. Co ordination study to be submitted over stamp of a Professional Engineer, licensed to practice in a Province of Canada.

5.8.4 Co-ordination study to be submitted for approval as shop drawings.

5.8.5 Final corrected copies to be included with maintenance manuals.

5.8.6 Co-ordination studies to be carried out and presented in accordance with *IEEE Standard 242-2001*[8].

5.9 Commissioning

5.9.1 Specify preparation of a load study as part of the contract. Load study is to be reviewed and commented on by the design engineer. Study is then to be submitted to CSC.

5.9.2 Load study is to contain full load current readings of all feeders connected to 50 A circuit interrupting devices and larger. Currents are to be read at the line side of the feeders if possible.

5.9.3 Load study is to contain voltage readings taken at the load side of the feeders. Adjust transformer taps to within 2% of rated voltage of equipment.

5.9.4 Load study is to identify loads i.e. are they motors, lighting or heating.

5.9.5 Specify equipment and wiring identification as covered in Canadian National Master Construction Specification Section 26 05 00.

5.9.6 Specify balancing of loads.

5.9.7 Specify for contractor to demonstrate that systems operate as design intended them to operate and that contractors must be prepared to operate each device, such as switches, relays etc, to the satisfaction of CSC and PWC personnel involved in the acceptance procedure.

6. DISTRIBUTION EQUIPMENT

6.1 General Requirements

6.7.6 Copper bus bars for all distribution equipment.

6.7.7 Main electrical and telecom rooms should be built above 200-year flood plains.

6.7.8 Apply ground fault protection as per Canadian Electrical Code.

[8] 242-2001 – IEEE Recommended Practice for Protection and Commercial Power Systems

6.2 Switchgear Assemblies

Refer to and specify in accordance with *CSA Standard C22.2 No. 31-04 (R2009)*[9]. Also refer to and specify as "*Metal Enclosed Low Voltage Power Circuit Breaker Switchgear*" in accordance with *EEMAC G8-2, 1972*[10] (section from page 48 to page 55).

6.3 Distribution Switchboards

Refer to and specify in accordance with *CSA Standard C22.2 No. 31-04 (R2009)*[11]. Also refer to *ANSI/IEEE Standard 241-1990* [12] under "*Metal Enclosed Distribution Switchboards*" and to *NEMA PB 2-2006* [13].

6.4 Unit Substations

Refer and specify in accordance with:

- *EEMAC G13.1, 1978*[14]
- *ANSI/IEEE C37.121-1989*[15]
- Refer to Section SU-5.

6.5 Feeder Switch Units (Fusible)

Refer to and specify heavy duty classified switch units in accordance with:

- *NEMA KS 1-2001 (R2006)*[16], and
- *CAN/CSA-C22.2 No. 4-04 (R2009)*[17]

Units shall be horsepower rated for overload current interrupting capability.

6.6 Fuses for Feeder Switch Units

Select and specify a suitable time delay J type fuse (not covered under referenced standard) and apply for transformer primary protection where required.

6.7 Moulded Case Circuit Breakers

6.7.1 *CSA Standard C22.2 No. 5-09*[18].

6.7.2 The use of solid state trip units for moulded case breakers at the distribution level is encouraged to allow for best protection coordination

6.8 Panel boards

6.8.1 Refer to and specify in accordance with *CSA C22.2 No. 29-M1989 (R2009)*[19].
A considerable number of spare breakers and spaces are required.

6.8.2 For panel boards supplying appliance loads to cells, specify contactor, electrically held in mains with 120V 600Hz coil for remote control (3 wire) from central control station.

6.8.3 Panels with GFP to be installed as close as practical to the outlets served.
NOTE: All appliance receptacle circuits to cells supplied from GFP breakers.

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[9] C22.2 No.31-04 (R2009) – Switchgear assemblies
[10] EEMAC G8-2, 1972 – EEMAC Standard for Switchgear Assemblies
[11] C22.2 No.31-04 (R2009) – Switchgear assemblies
[12] 241-1990 – IEEE Recommended Practice for Electric Power Systems in Commercial Buildings
[13] NEMA PB 2-2006 – Deadfront Distribution Switchboards
[14] EEMAC G13-1, 1978 – EEMAC Standard for Unit Substations
[15] ANSI/IEEE C37.121-1989 – American National Standard for Switchgear – Unit Substations – Requirements (NEMA 210.1970(R1976) – Secondary Unit Substations has been withdrawn no direct replacement.)
[16] NEMA KS 1-2001 (R2006) – Enclosed and Miscellaneous Distribution Equipment Switches (600 V max.)
[17] CAN/CSA-C22.2 No. 4-04 (R2009) – Enclosed and Dead-Front Switches
[18] C22.2 No. 5-09 – Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
[19] C22.2 No. 29-M1989 (R2009) – Panelboards and Enclosed Panelboards

6.9 Busways

6.9.1 Refer to and specify in accordance with *CSA C22.2 No. 27-09*[20].

6.9.2 Where practical specify for feeders 1000A and larger, and where run between switchboards within equipment rooms and in service corridors:

- for feeder specify low impedance type, open ventilated with insulated bus bars and joints.
- specify copper bus bars.
- specify bracing for available fault current.
- specify neutral if required.

6.9.3 Where feasible - in manufacturing areas, in accordance with accepted industrial practice, specify plug in bus duct, totally enclosed type.
Plug in units with circuit breaker for branch power circuit protection.
Size Ranges: 100A and 225A.

6.9.4 3 phase 4 wire bus duct to have full size neutral.

6.10 Step down Transformers

Refer to and specify dry type transformers in accordance with *CSA C9-02 (R2007)*[21].

6.11 Grounding Systems

6.11.1 When designing grounding systems for Electrical Distribution refer to and comply with the following standards:

- *CSA Standard C22.1-09*[22]
- *ANSI/IEEE Standard 142-2007*[23]

6.11.2 Design is to ensure that grounding system ground resistance suits the needs of the most sensitive equipment even if this exceeds by far the CSA Standard (50 ohms).

7. WIRING

7.1 Methods

7.1.1 For feeders, 1000A and larger which run in

- main electrical rooms
- main power plant

Specify - bus duct.

7.1.2 For feeders 1000A and less, emergency feeders, branch circuits, control circuits, alarm circuits and any other kind of feeders and/or circuits; Specify copper conductors and shall conform with the applicable Codes, Standards, Rules, Regulations and all the appropriate authorities having jurisdiction.

7.1.3 Specify flexible steel conduit for final connections to motors of all equipment subject to vibration.

7.1.4 Specify liquid tight flexible steel conduit where conditions of installation, operation or maintenance require flexibility and protection from liquids, vapours or solids.

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[20] CSA C22.2 No. 27-09 – Busways

[21] CSA C9-02 (R2007) – Dry-Type Transformers

[22] C22.1-09 – Canadian electrical code, part I (21st ed.), safety standard for electrical installations

[23] 142-2007 – IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems

7.1.5 Specify minimum conduit size for light and power branch circuits to be 20 mm.

7.1.6 In armouries and wherever solvents are used, specify explosion proof installations. (Refer to Section A-13 Armoury)

7.2 Conduit Raceway

7.2.1 Specify conduit raceway in accordance with applicable CSA Standard.

- *C22.2 No. 45.2-08*[24]
- *C22.2 No. 56-04 (R2009)*[25]
- *C22.2 No. 83.1-07*[26]
- *C22.2 No. 211.2-06*[27]

7.2.2 The electrical designer is to request in writing to the Project Manager that he, the designer, is given in time all the necessary information on all the empty conduit and raceway systems required for other systems such as alarms and telephones etc. so that these conduits can be included in the electrical design before the electrical tender call.

7.3 Conductors

7.3.1 Specify all conductors to be of copper.

7.3.2 Insulation is to be of the thermosetting type XLPE, Rated RW90.
Conductors are to be manufactured and tested in accordance with *CSA C22.2 No. 38-05*[28]. Specify RWU90 type if in conduit raceway in or below slab or in perimeter wall when in contact with earth or backfill materials.

7.3.3 Minimum conductor sizes for lighting and appliance circuits to be copper AWG #12.

7.3.4 For feeders specify compression lugs wherever possible.

7.3.5 For feeders and branch wiring specify colour coding of conductors for phases, neutral and ground.

7.4 Wiring Design

7.4.1 Design interior distribution system so that branch circuits are concentrated at the panelboards and the circuits so connected that the loads on each side of the system will balance within three percent with all the lamps burning.

7.4.2 Specify that Contractor, in providing this installation balances all loads as evenly as possible on all phases at each panel.

7.4.3 Special requirements - for cells:

- Separate lighting circuits for cells.
- Institutions for men; separate receptacle circuit (120V) for each cell. Receptacle circuits in cells supplied with 15 Amp breakers ground fault circuit interrupter type GFCI at panel, separate neutral required.

[24] C22.2 No. 45.2-08 – Electrical rigid metal conduit – Aluminium, red brass, and stainless steel
[25] C22.2 No. 56-04 (R2009) – Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit
[26] C22.2 No. 83.1-07 – Electrical Metallic Tubing – Steel
[27] C22.2 No. 211.2-06 – Rigid PVC (Unplasticized) Conduit
[28] CAN/CSA-C22.2 No. 38-05 – Thermoset-Insulated Wires and Cables

- Institutions for women; separate receptacle circuit (120V) for each cell. Receptacle circuits in cells supplied with 20 Amp breakers ground fault circuit interrupter type GFCI at panel, separate neutral required.
- Arc Fault Circuit Interrupter AFCI is considered a non code requirement for cells.

7.5 Underfloor Duct System

Base design of an underfloor distribution system, specify in accordance with *CSA C22.2 No.80-1978 (R2008)*[29] and *CEMA F 4-1, 1970*[30].

8. ELECTRIC HEATING

8.1 General

8.1.1 In areas where hot water heating is not feasible or such heating is unavailable, electric heaters should be considered.

8.1.2 Specify heaters to be controlled by either remote wall mounted room thermostats or built in thermostats. Thermostats should be used singly or in combination to control several heaters up to the permissible thermostat ampere rating. Where required, appropriate contactors should be specified.

8.1.3 All thermostats should be programmable line voltage with modulating output.

8.2 Electric Heaters for Pipe Tracing

Where electric heater cables are to be used for protecting piping from freezing, only heaters of the required length of cable and capacity should be specified.

8.3 Heater Units

Specify heater units consisting of a heating section of specified length, joined to a cold section of required length to connect to junction boxes located to suit the particular conditions.

8.4 Heating Sections

Specify heating sections to be of two or three conductor copper alloy resistance wire, insulated with compressed magnesium oxide, and covered by an annealed seamless copper sheath. Cold section should consist of two or three conductor mineral insulated copper sheathed power cable with a current carrying capacity in accordance with the Canadian Electrical Code.

8.5 Thermostats

Specify that heater circuits be controlled by thermostat(s) with temperature range of 0°C to 40°C housed in NEMA 4 cast aluminium enclosure.

[29] CSA C22.2 No.80-1978 (R2008) – Underfloor Raceways and Fittings

[30] F4-1, 1970 – CEMA Standard For Underfloor Distribution System

E-2 ELECTRICAL – WIRING DEVICE

1. SCOPE

This section outlines the requirements and characteristics of wiring devices.

2. RELATED SECTIONS

SP–4 – Site Lighting
E–1 and E-3 to E–6 inclusive

3. LOCAL SWITCHES

3.1 Local switches are to be rated 15 A at 125 V with fully enclosed composition cases, and rated 20 Amperes at 250 V for control of fluorescent lighting loads exceeding 500 W. Specify mounting 1370 mm centre from finished floor.

3.2 Specify three tamper resistant receptacles in living unit cells and administrative segregation cells.

3.3 Switching of Cell Lights and receptacles can be combined onto a single touch screen that is combined with door control, P/A, and Cell Call Systems.

3.4 Specify a master control to cut power to all cell receptacles in each living unit etc. This could be achieved by use of main breaker in cell receptacle panel.

4. CONVENIENCE RECEPTACLES

Duplex receptacles *NEMA Standard 5-20R*[1] U ground - rated 20 A at 125 V with double wiping contacts. Specification grade. Specify mounting at 300 mm centre from finished floor, unless otherwise directed by User. Cell and segregation receptacles to be tamper resistant.

5. POWER AND SPECIAL PURPOSE RECEPTACLES

5.1 Specify all receptacle in accordance with *CSA C22.2 No. 42-99 (R2009)*[2] and related NEMA *Standards WD 1-1999 (R2005)*[3], and *WD 6-2002 (R2008)*[4].

5.2 Power and special purpose receptacles of ratings and configurations compatible with usage in shops, laboratories, etc. Specify a minimum of one receptacle 30A, voltages that are available on site (208, 240 or 347V) per laboratory.

6. G.F.C.I.

Provide G.F.C.I. breaker on all circuits supplying receptacles in cells and any other locations required by code.

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1 Receptacles design: ANSI/NEMA WD 6-2002 (R2008) – Wiring Devices—Dimensional Specifications
2 C22.2 No. 42-99 (R2009) – General Use Receptacles, Attachment Plugs, and Similar Wiring Devices
3 NEMA WD 1-1999 (R2005) – General Color Requirements for Wiring Devices
4 ANSI/NEMA WD 6-2002 (R2008) – Wiring Devices-Dimensional Specifications, WD 5-1977 has been withdrawn with no clear replacement

7. COVER PLATES

7.1 Specify device plates for switches and receptacles for single and multigang application. Stainless steel, satin finish on flush mounted outlet boxes, and galvanized pressed steel surface covers on surface mounted outlet boxes. Plates for weatherproof receptacles gasketed with spring loaded lift covers. Corrosive resistant where corrosive materials may be used. Bushed openings where required in laboratories. Specify that finishes on electrical equipment, cover plates and surface mounted outlet boxes match the finishes on mechanical fittings. Specify all receptacle cover plates be identified to the panel and breaker for that circuit.

7.2 For devices in cells, specify cover plates with “Security Screws” or have special boxes and cover plates fabricated. Refer to detail included herewith.

8. OUTLET BOXES

Galvanized steel outlet boxes, 4 inch square minimum and oversized where number of conductors exceed standard size. Open back concrete type where cast in slab. Cast iron fittings where exposed and appropriate supports for secure fastening.

9. MULTIOUTLET SYSTEMS

In laboratories and certain shops consider the use of multi-outlet systems of the following types and characteristics:

9.1 Surface mounted all steel raceways for use with number and type of wiring devices required.

9.2 System of raceway with snap on cover containing brackets for mounting of grounding type wiring devices located and rated as required and having the capability of being installed wherever desired within the raceway.

9.3 Alternate system of raceway with snap on cover containing prewired coils with 15A, 125V grounding type receptacles spaced in groups of two(2), on 1500 mm centers, or as directed by User (providing a duplex receptacle at each location).

9.4 Device plates finished to match that of multi-outlet system raceway. Each receptacle cover indent stamped with the voltage and ampere rating of that receptacle. Receptacles fed from an emergency source should be of the illuminated face type with integral neon glow lamp.

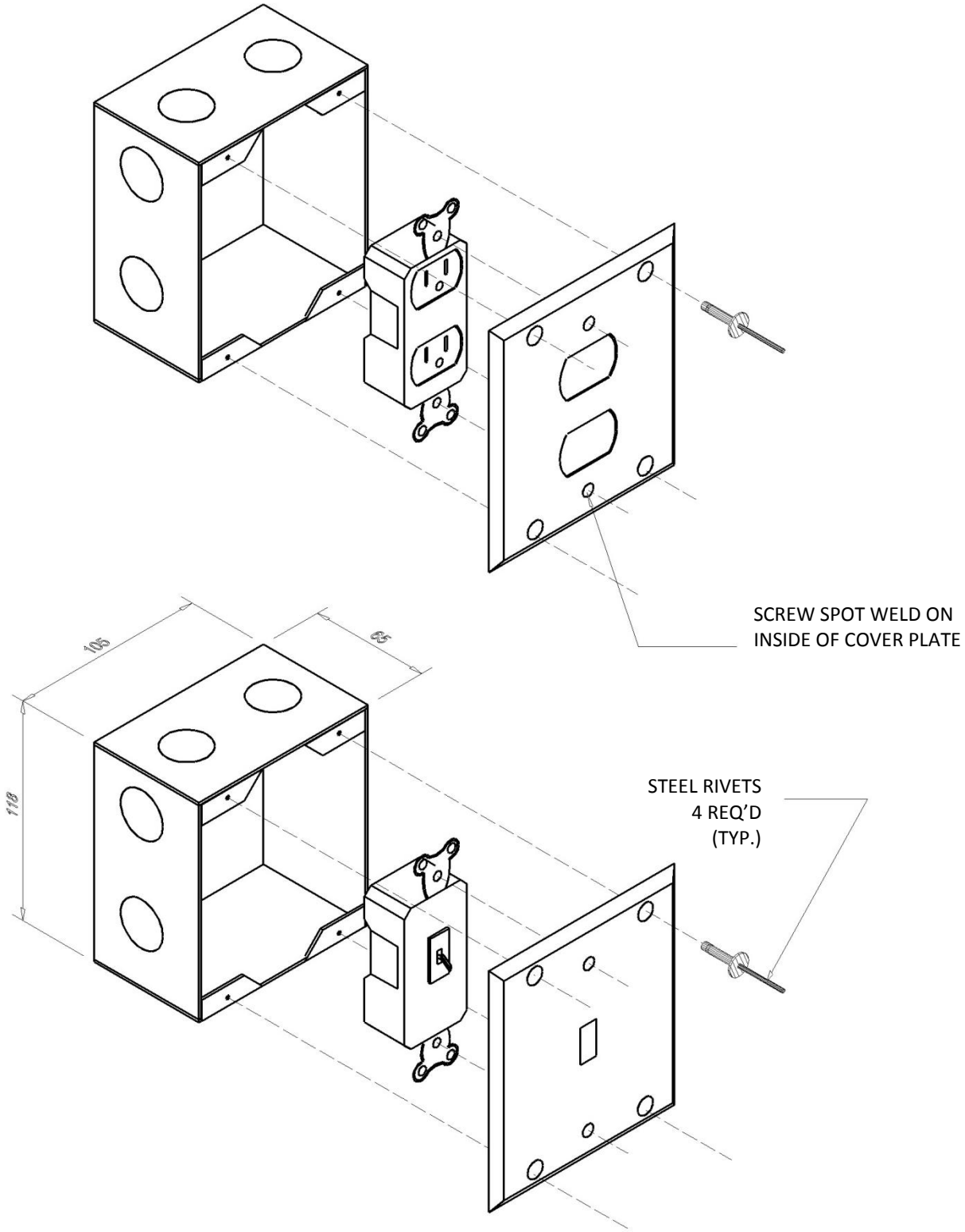

PLATE E–2–1 – FASTENING OF CELL WIRING DEVICES USING POP RIVETS

E-3 ELECTRICAL – MOTOR CONTROLS

1. SCOPE

This section outlines the characteristics and features of motor controls and auxiliary control components and provides design guidelines for these components.

2. RELATED SECTIONS

E–1 – General Electrical Engineering
E–2 – Wiring Devices

3. MOTOR CONTROLS

3.1 General

Consider and specify the following characteristics and features for motor controls and auxiliary control components to obtain the performance intended.

3.1.1 Motor controls to conform to UL Standard 508[1].

3.1.2 Sequential starting of large motors connected to emergency generator.

3.1.3 Provide for an overload heater in every phase.

3.1.4 Draw to the attention of the mechanical designer to call for factory installed thermistors, one in each phase, wired to identify terminals in the motor terminal box. This thermal protection shall be provided for all motors above 25 HP. The motor starters must also be specified to include the required controls.

3.2 Magnetic Starters

3.2.1 Combination magnetic motor starters shall be provided for all 3 phase motors.

3.2.2 Combination magnetic starters requiring motor circuit protection shall be equipped with circuit breaker type or "Motor Circuit Protector" with integral current limiting fuses where required for available short circuit: Multipole opening on blown fuses.

3.2.3 Combination magnetic starters not requiring motor circuit protection shall be equipped with horsepower rated unfused switch. Switch to comply with applicable sections of *CSA C22.2 No. 4-04 (R2009)*[2].

3.2.4 Combination magnetic starters shall have low voltage protection type control circuit, with momentary contact type manual control. Where auto restart is required provide timing relay adjustable pickup to ensure stable voltage on application (return) of power. Applicable for motor sizes 5 HP and larger.

3.2.5 Manual automatic control with HOA selector switch, LED pilot light and low voltage release shall be provided for motors below 5 HP. Positive indication using LED pilot lights shall be provided for motors with local disconnect switches.

3.2.6 Black sandwich type laminated plastic nameplates with white letters indicating function and association shall be provided for all magnetic starters.

3.3 Manual Type Motor Starters

For manual type motor starters specify toggle switches with thermal overload protection and LED pilot light.

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[1] UL 508 -- Industrial Control Equipment, Edition: 17th, Underwriters Laboratories / 28-Jan-1999 / 208 pages
[2] CAN/CSA-C22.2 No. 4-04 (R2009) -- Enclosed and Dead-Front Switches

3.4 Reduced Voltage Starters

3.4.1 Verify whether the voltage drop due to motor starting is within limits acceptable to the local Power Authority. Also consider motor starting transient voltage effect on other building systems, motor circuit, distribution system protection device and sensitive electronic equipment.

3.4.2 Determine, according to application, the most appropriate method of limiting the starting inrush current and specify the type of reduced voltage starter to satisfy the starting requirements of the load. Consider star delta, auto transformer, part winding and primary resistor starter types depending on the specific application requirements. All starting sequences shall be of the closed transition type.

3.4.3 Specify motor starter with soft start on motor > 5 HP or where reduced starting torque will reduce maintenance and energy requirement significantly.

4. MOTOR CONTROL CENTRES

Motor control centres shall include:

4.1 Multiple vertical sections with main horizontal and vertical copper buses.

4.2 Ground bus copper, minimum 25% of main bus.

4.3 Main disconnect device, heavy duty load break, or non auto air circuit breaker.

4.4 Individual combination (fuses, unfused or circuit breaker) controllers of required NEMA size, mechanically interlocked to prevent opening door when in ON position except through release mechanism, and suitable for padlocking. Equipped with appropriate push buttons, selector switches, pilot lights, reset buttons. Other applicable features as described for individually mounted motor starters, manual and magnetic types.

4.5 Auxiliary relays for automatic operation.

4.6 Wiring compartments for copper conductors, power and control wiring.

4.7 Black sandwich type laminated plastic nameplates with white letters identifying each circuit.

4.8 Use Class II C for motor control requiring interlocks or extensive automatic sequenced pilot control for industrial process or building systems.
Use Class 1B for stand alone or single automatic pilot control.

4.9 Specify primary and secondary fuses for all control transformers in motor control centres.

4.10 Bus supports: With high dielectric strength, low moisture absorption, high impact material and long creepage surface signed to discourage collection of dust.

4.11 Refer also to *EEMAC Standard E14-2, 1983*[3].

5. CONTROL SEQUENCES

Specify that Contractor co ordinate all work with respect to motors controlled by individual starters or/and from motor control centers and all control sequences.

[3] EEMAC E14-2, 1983 -- EEMAC Standard for Industrial Control and Systems

6. DISCONNECT SWITCHES

6.1 Specify horsepower rated disconnect switches, fused or unfused, mounted adjacent to all motors regardless of their location with respect to the motor circuit branch circuit breaker.

6.2 Disconnect switches shall comply with *CSA C22.2 No. 4-04 (R2009)*[4].

7. WIRING

7.1 Power wiring shall be in accordance with Section E-1 Electrical Distribution.

7.2 Specify stranded tinned copper for control wiring. All terminations shall be on terminals or terminal blocks. All control wiring shall be colour coded.
Wherever practical specify multi conductor cable assemblies; conductors with 600 V insulation; minimum size 2 mm^2 overall PVC jacket.

7.3 Control wiring shall be terminated with compression type terminals.

7.4 Control wiring method shall generally be conductors (cable assembly) in electric metallic tubing.

[4] CAN/CSA-C22.2 No. 4-04 (R2009) Enclosed and Dead-Front Switches

E-4 ELECTRICAL – INTERIOR LIGHTING & CELL LIGHTING FIXTURES

1. SCOPE

This section outlines the requirements for interior lighting and provides design criteria for the following:

1.1 Quality and quantity of illumination for specific visual tasks, movements and exits.

1.2 Interior lighting fixtures.

1.3 Cell lighting fixtures.

2. RELATED SECTIONS

E–1 – General Electrical Engineering
E–2 – Wiring Devices
E–6 – Emergency Electrical

3. CODES AND STANDARDS

Design the interior lighting in accordance with the following Codes and Standards and applicable local regulations:

4.1 ***National Building Code -- Latest Edition***

The requirements of the National Building Code have been included in this Document. Wherever local regulations differ from the Code and this Document, the most stringent conditions shall apply.

4.2 ***ANSI/IESNA RP-1-04[1].***

I.E.S. Handbook10th Edition

The latest edition of the Illuminating Engineering Society Handbook[2] contains detailed information on light sources and lighting for all types of applications.

4.3 ***CSA-C22.2 No. 250.13-12 – Light emitting diode (LED) equipment for lighting applications***

4. ELEMENTS OF ILLUMINATION

4.1 General requirement

Design the lighting system to provide the levels of illumination in accordance with Latest Edition of IESNA. Consideration should be given to environment, green initiative and rapid changes due to new technology. Select lighting fixtures of the quality and characteristics to achieve and maintain the following criteria.

4.2 Glare Control

Keep direct glare and reflected glare to a minimum.

4.3 Brightness Pattern of Environment

Design lighting system to conform to the following visual criteria:

4.3.1 Ensure that the task is visible by being brighter than its immediate background

[1] ANSI/IESNA RP-1-04 -- American National Standard Practice for Office Lighting (CSA C92.4-1977 has been withdrawn, CSA has adopted the ANSI equivalent)

[2] IESNA -- Lighting Handbook on CD-ROM, 9th edition, 10th edition → late 2010

4.3.2 Control other brightness within the office environment and reflectance of interior finish.

4.4 Colour

The colour of the illuminant (light) is an important facet of the lighting quality and has a direct effect on the people and furnishings within an office environment. Therefore, the following aspects shall be considered in selecting light sources (lamps):

4.4.1 In offices, administrative areas, maintenance and service areas specify 32W, rapid start (RS) fluorescent cool white lamps which offer a more efficient, moderately cool source of illumination. For LED lighting, specify a colour temperature of 4000k.

4.4.2 In areas where people congregate for discussion, e.g., conference rooms, cafeterias, etc. specify good colour rendering 32W rapid start, deluxe cool white fluorescent lamps which offer a warmer atmosphere.

4.4.3 LED and induction lamps and luminaires with high colour rendering may also be specified as necessary to achieve the desired illumination levels and effects. A 3500K color temperature shall be specified to achieve a warmer ambiance.

4.4.4 Confer with Architect and draw to his attention the following considerations affecting general visual comfort:

4.4.4.1 Light colours are preferred for interior furnishings and dark colours should only be used in small areas as contrasts to the colours of the major areas.

4.4.4.2 Selection of colours of walls, floors, furniture and furnishings should be made in accordance with the Technical Criteria Section A-7 “Finishes”.

4.5 Office Lighting Layout

In laying out the office lighting systems, consider the fact that most office spaces undergo rearrangement. This need for rearrangement requires that the lighting system be flexible and suitable for partitions to be erected between rows of luminaires and individual units. Modular co-ordinated systems are suited to the solution of this problem and should be studied for possible incorporation into the design.

4.6 Supplementary Lighting

4.6.1 Design supplementary or local (task) lighting in the form of units attached to the ceiling or building structure for limited areas that require higher levels of illumination.

4.6.2 Design lighting so as to avoid and discourage the use of portable desk lights, table lamps, swag lamps, etc.

4.7 Video Display Units

4.7.1 Consider indirect lighting systems.

4.7.2 Arrange lighting fixtures to eliminate source brightness contrast on video screens. Employ low brightness louvers with minimum 45° shielding angle.

4.7.3 Consider reduced task lighting levels in order to eliminate brightness contrast.

4.7.4 Provide 500 lx on task surface where source documents must be read.

4.8 Control Posts and Ranges

In ranges and related control post areas, design corridor lighting to eliminate glare and source brightness in field of view from control post. Take note of glass/plastic and other highly reflective surfaces and ensure against mirrored light source images within control post field of view. Refer to Technical Criteria Section A-13 regarding glare control in control posts. Include dimmer controls for general lighting in control posts. Make provision for Task Lighting.

5. LIGHTING FOR MOVEMENTS AND EXITS

In designing lighting systems for areas of circulation, means of egress and means of vertical transportation, consider the following factors:

5.1 Public Entrance Lobbies

5.1.1 Design lighting to facilitate movement throughout the area without being garish or creating glare and discomfort.

5.1.2 Where canopies extend outside the entrances, specify lighting which is not subject to fluctuation on light output due to high winds or low temperatures.

5.1.3 Specify low temperature ballasts (-40°C) in all fixtures located outdoors.

5.1.4 Totally enclosed and gasketed fixtures should be specified for outdoor applications only.

5.1 Corridors and Hallways

5.1.1 The spacing of lighting equipment from centre to centre should not exceed 1½ times the mounting height.

5.1.2 The level of illumination shall be between 20% and 30% of adjacent areas but not less than 215 lx minimum. Where security viewing is involved the minimum shall be 325 lx.

5.1.3 Reflectance for ceilings, walls and floors shall equal or exceed those recommended for the offices. Draw to the Architect's attention the fact that if, for maintenance reasons, dark finishes must be used, they should be limited to the baseboard.

5.1.4 Changes in elevation in corridors where one or two steps are necessary shall have attention drawn to the change by locating small shielded lighting units recessed into the walls at the steps or by painting the edges of the steps in a distinctive colour.

5.2 Stairways

5.2.1 Locate and shield lighting equipment so that persons neither cast shadows on the stairs nor encounter glare at eye level.

5.2.2 Locate units at least on every landing and closer if necessary.

5.2.3 Specify battery operated Lighting Units in all stairways and exit corridors as emergency lighting backup.

5.3 Elevators

5.3.1 Design adequate lighting at the threshold to call attention to any difference in level between the landing and the car.

5.3.2 Draw the Architect's attention to the fact that the interior finish off the car should be as light as possible, consistent with reasonable ease of maintenance.

5.4 Exits

5.4.1 All exit doors and passageways other than the exits serving as the main entrance to a room or building shall have exit signs placed over them as described in paragraphs 5.4.3, 5.4.4 and 5.4.5, and as required by the National Building Code, Subsection 3.4.5[3]. These signs shall be LED lighting and illuminated continuously while the building is occupied and be connected to a separate emergency lighting circuit.

5.4.2 Exits and paths of exit travel are to be indicated by electrically illuminated bilingual exit signs. Size of lettering to meet the National Building Code and the requirements of the local Fire Department.

5.4.3 Illuminated exit signs are to be provided in stairwells at points of egress to outdoors and/or to corridors leading to exits.

5.4.4 Specify additional sockets and lamps in each EXIT sign fixture to be connected to a battery system. If there is no provision for a standby generator, specify self contained battery powered exit lights.

5.4.5 All exit doors leading to the outside of buildings shall have lighting fixtures above the exits, on the outside of the building.

6. LIGHTING FIXTURES

6.1 General Requirements

In specifying lighting fixtures follow the following general criteria:

6.1.1 Fluorescent fixtures utilizing low brightness pure virgin acrylic lenses and LED luminaires are preferred.

6.1.2 Minimize the use of incandescent fixtures and maximise the use of LED.

6.1.3 Where more than 100 fixtures are used, specify that the Contractor submit a sample fixture for approval, if requested by the Engineer. Select the sample at random from those delivered on site for approval of all fixtures for installation.

6.1.4 Specify that the Contractor submit complete photometric data, based on the actual fixtures proposed to be furnished for the Project.

6.2 Fixture Construction

The following features should be considered:

6.2.1 Free of light leaks

6.2.2 Ventilation for lamps and ballasts

6.2.3 No crossbars over light shields.

6.2.4 Weatherproof enamel finish, including hangers for weatherproof and vapour tight fixtures.

6.2.5 Fluorescent fixtures to be suitable for operating with specified ballasts without tripping under conditions of maximum 10% voltage above and below nominal.

6.2.6 Maximum 38°C ceiling cavity ambient for recess mounted units.

6.2.7 Maximum 38°C surrounding air ambient for pendant mounted units.

6.2.8 Maximum 27°C surrounding air ambient for surface mounted units.

6.2.9 Aluminium to concrete contact surfaces with coating of polyurethane base paint.

6.2.10 Minimum 20 gauge sheet steel for fluorescent fixture housings.

[3] National Building Code of Canada, Volume 2, Thirteenth Edition, 2010, National Research Council Canada

6.2.11 Interior reflecting surfaces of fluorescent fixtures finished with polymerized baked white coating to achieve a reflectance of at least 85%.
6.2.12 Exterior surfaces of fluorescent fixtures finished with basked white enamel.
6.2.13 Bonderized and painted after fabrication.

6.3 Ballasts

6.3.1 For fluorescent fixtures specify ballast of the following characteristics, meeting *ANSI C82.1-2004*[4] and *CSA C22.2 No. 74-96 (R2005)*[5]:
6.3.1.1 Instant start, electronic ballasts with 20% THD or less are preferred.
6.3.1.2 Internal non resetting thermal protector for core and coil and non-resetting, end of life protector for capacitor.
6.3.1.3 Low NEMA rated noise level.
6.3.1.4 Energy efficient, high power factor, having long life and low operating temperature.
6.3.2 HID's ballasts to meet or exceed the performance requirements to *ANSI C82.4-2002*[6]. Ballast to be of constant wattage and have isolated secondary.

6.4 Lamps

6.4.1 Fluorescent: Energy efficient type; 32 Watt, T8 lamp, 5000 K, high CRI.
6.4.2 LED lamps, Induction lamps, HPS and LPS lamps.

6.5 LED Luminaires

6.5.1 Luminaires must comply with the following standards:

6.5.1.1 ***CSA-C22.2 No. 250.13-12***
6.5.1.2 IESNA LM-79-08
6.5.1.3 IESNA LM-80-08

6.5.2 LED Luminaires to meet or exceed the following characteristics:

6.5.2.1 50 000 hours rated but higher would be preferred.
6.5.2.2 80 CRI colour rendering.
6.5.2.3 20% THD or less is preferred.
6.5.2.4 0.9 power factor or higher is preferred.
6.5.2.5 Valid IES photometric data file.
6.5.2.6 cULus listed.
6.5.2.7 All of the luminaires parts warrantied for at least five years.

7. CELL LIGHTING FIXTURES

7.1 Fixture Type

Cell light fixtures may be supplied by CSC at a cost per unit to the Contractor. The fixture will be manufactured for CSC. Specify storing, installing etc. by Contractor, unless instructed by CSC otherwise.

[4] C82.1-2004 – American National Standard for Lamp Ballasts—Line Frequency Fluorescent Lamp Ballasts
[5] CAN/CSA-C22.2 No. 74-96 (R2005) – Equipment for Use with Electric Discharge Lamps
[6] C82.4-2002 – American National Standard for Ballasts for High-Intensity Discharge and Low-Pressure Sodium (LPS) Lamps (Multiple-Supply Type)

7.2 Power Requirement

The fixture shall include a 2/32 W fluorescent lamp rapid start ballast. It shall operate on 120 VAC 60Hz on a separate circuit than receptacles. It will also have a small lamp as night light. LED strip lighting may be used instead of fluorescent.

7.3 Installation

Specify installation of fixture to suit the dimensions given in "Plate E-4-1" at end of this section.

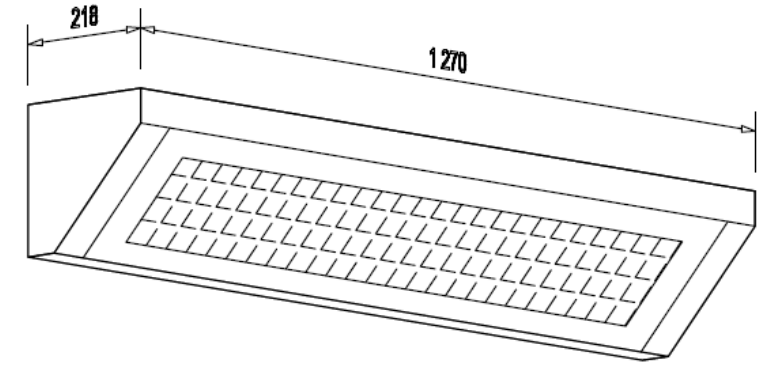
7.4 Use

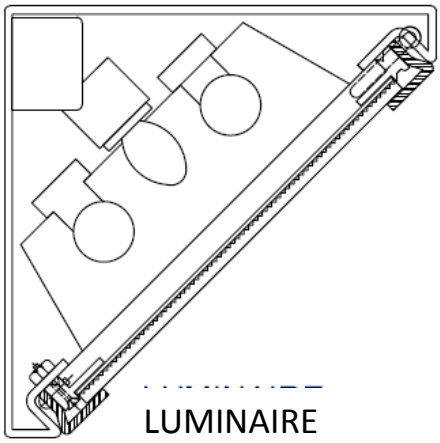
Specify use of this fixture for all medium, maximum, and multi security institutions. The fixture is to be used in all cells and similar inmate secure areas.

8. LEVELS OF ILLUMINATION

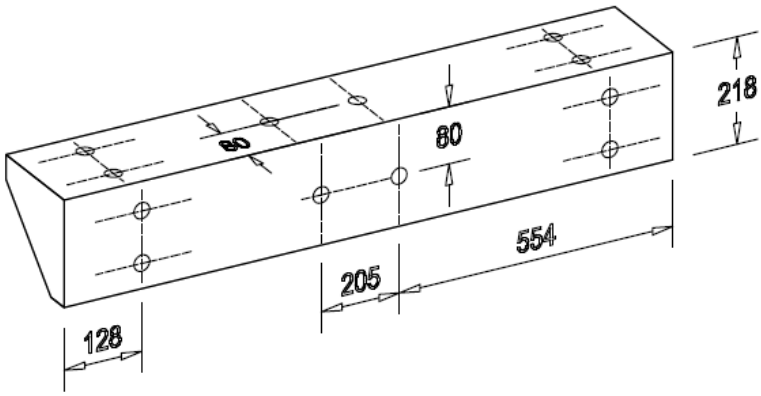
8.1 General

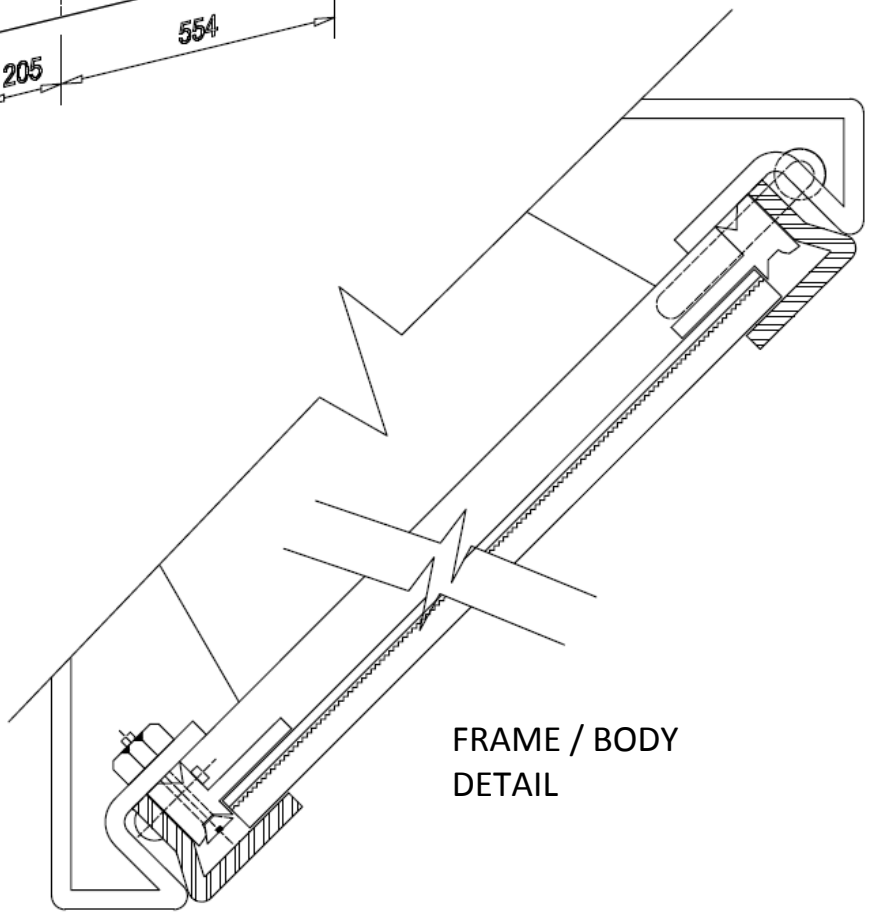
8.1.1 Lighting levels should be in accordance with Illuminating Engineering Society Handbook, Latest Edition – IESNA. Submit to CSC detail calculations of light intensities to support the design.





LUMINAIRE
CROSS - SECTION





FRAME / BODY
DETAIL

PLATE E–4–1 – CELL LIGHTING FIXTURES

E-5 ELECTRICAL – LIGHTNING PROTECTION

1. SCOPE

This section outlines guidelines for determining the need for lightning protection and for the design and specification of an appropriate system.

2. RELATED SECTIONS

SU–4 – Power Supply and Electrical Power Distribution
E–1 – General Electrical Engineering & Electrical Distribution

3. CODES AND STANDARDS

3.1 The standard for design of the protection system described herein is *CSA B72-M87 (R2008)*[1].

3.2 Approval, inspections and testing by Authorities having jurisdiction must be obtained.

3.3 Other applicable codes and standards:

- *Canadian Electrical Code, Part I CSA C22.1-09*[2].
- Canadian Labour Code, Part IV.

4. GROUNDING

4.1 Special attention must be paid to obtain good grounds. The Installation Code calls for a ground resistance of 50 ohms or less. This may suffice for general building structures, for protection of communication and alarm systems the ground resistance may have to be much lower.

4.2 For information refer to *ANSI/IEEE 142-2007*[3] and *IEEE 487-2007*[4].

[1] CAN/CSA-B72-M87 (R2008) – Installation Code for Lightning Protection Systems
[2] C22.1-09 – Canadian electrical code, part I (21st ed.), safety standard for electrical installations
[3] 142-2007 – IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems
[4] 487-2007 – IEEE Recommended Practice for the Protection of Wire-Line Communication Facilities Serving Electric Supply Locations

E-6 ELECTRICAL - EMERGENCY ELECTRICAL

1. SCOPE

This section outlines the emergency power requirements with regard to light and power provisions and essential generating equipment.

2. RELATED SECTIONS

SU–4 – Power Supply and Electrical Power Distribution
E–1 to E–6 inclusive

3. ADDITIONAL REFERENCES

3.1 The following standards (including latest revisions) and texts should be referenced when designing emergency electrical installations:

3.1.1 *CSA Standard C282-09*[1]
3.1.2 *CSA Standard Z32-09*[2]
3.1.3 *EEMAC Standard M1-6, 1986*[3] (See related Standard Ref. 5)
3.1.4 *NEMA Standard MG 1-2009*[4]
3.1.5 Beeman D – McGraw Hill Systems Publications – Industrial Power Handbook
3.1.6 *IEEE Standard 446-1995*[5]
3.1.7 *CSA Standard C22.2 No. 178.1-07*[6]
3.1.8 *CSA Standard C22.2 No. 178.2-04 (R2009)*[7]
3.1.9 Fire Commissioner of Canada - FCC No. 501 Standard for Emergency Lighting Services

4. REQUIREMENTS FOR MINIMUM SECURITY LEVEL INSTITUTIONS

4.1 Standby power is not required for minimum security level Institutions as there is more flexibility in allowing temporary refuge.

4.2 Consider battery powered backup for use in critical areas.

5. REQUIREMENTS FOR MEDIUM SECURITY LEVEL INSTITUTIONS

5.1 General Requirements

Standby power is a requirement for medium security level institutions. Requirements can be broken down into three categories as follows:

5.1.1 Total Standby power is required as follows:

5.1.1.1 Cells and Living units all lighting and receptacles. For S-3 units, consider the use of battery back-up.
5.1.1.2 Kitchen and dining areas; Kitchen equipment, lighting, refrigerators, freezers and walk in coolers
5.1.1.3 Medical Centre and maintenance building
5.1.1.4 Segregation

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1 CSA Standard C282-09 – Emergency electrical power supply for buildings.
2 CSA Standard Z32-09 – Electrical safety and essential electrical systems in health care facilities.
3 EEMAC M1-6, 1986 – EEMAC Standard for Motors and Generators
4 NEMA Standard MG 1-2009 – Motors and Generators
5 IEEE Standard 446-1995 – IEEE Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications
6 CSA Standard C22.2 No. 178.1-07 – Requirements for Transfer Switches
7 CSA Standard C22.2 No. 178.2-04 (R2009) – Requirements for Manually Operated Generator Transfer Panels

5.1.1.5 Control Posts and UPS equipment.
5.1.1.6 All systems and devices such as: telephone, intercommunication, fire alarm, riot alarm, door control and alarm, P.A. etc.
5.1.1.7 Outdoor security lighting
5.1.1.8 Equipment and alarms associated with the site water supply
5.1.1.9 Sump pumps, fire pumps, chillers and associated alarms
5.1.1.10 All night lights and battery operated lights
5.1.1.11 Several convenience outlets throughout complex
5.1.1.12 Power to provide full heating and ventilation for control posts, medical centre, kitchen and dining rooms and to provide partial heating to prevent freezing in other areas.

5.1.2 No Standby power (except for night lights) for:
5.1.2.1 Industrial shops
5.1.2.2 Vocational shops
5.1.2.3 Meeting rooms
5.1.2.4 Academic rooms
5.1.2.5 Library
5.1.2.6 Chapel
5.1.2.7 Outdoor recreation areas.

5.1.3 Partial standby power for:
5.1.3.1 Administration offices (25% lighting)
5.1.3.2 Indoor recreation areas (50% lighting).

5.2 Battery Backup

Refer to Article 7. Battery Backup this section.

5.3 Emergency Lighting

Refer to Article 8. Emergency Lighting this section.

6. REQUIREMENTS FOR MAXIMUM AND MULTI SECURITY LEVEL INSTITUTIONS

6.1 General Requirements

Requirements apply also to Regional Reception Centres, Regional Mental, Psychiatric Centres and Special Handling Units.
Standby power is required for the entire complex of maximum and multi Security level Institutions with the following exceptions:

6.1.1 No standby power for:
6.1.1.1 Outdoor recreation areas
6.1.1.2 Industrial shops equipment

6.1.2 Partial standby power for 50% reduced lighting in the following areas:
6.1.2.1 Industrial shops
6.1.2.2 Vocational shops
6.1.2.3 Meeting rooms
6.1.2.4 Schools
6.1.2.5 Libraries
6.1.2.6 Chapels
6.1.2.7 Administration Offices

6.2 Battery Backup

Refer to Article 7. Battery Backup this section.

6.3 Percentage of Emergency Lighting

Refer to Article 8. Emergency Lighting Systems this section.

7. BATTERY BACKUP FOR MEDIUM, MAXIMUM, AND MULTI-LEVEL INSTITUTIONS

7.1 Need for Battery or UPS System Back up

7.1.1 Design to include battery back-up or UPS system for the areas or systems as listed. All systems indicated below are tied to institutional Emergency Power to ensure uninterrupted operation.

7.1.2 Control Posts and MCCP

- For ease of maintenance battery units may be located remotely.
- Capacity 1 hour full load continuous operation.

7.1.3 Critical Security and Life Safety Signal Systems

- For security and ease of maintenance battery units may be located remotely.
- Capacity 1 hour continuous operation.

7.1.4 Equipment Rooms

- Emergency generator room.
- Main electrical rooms
- Main security, life safety signal system control equipment rooms
- Main fire protection pump and heater rooms.
- Capacity 1 hour.

7.2 Requirements

7.2.1 When a battery powered system is required for secondary emergency backup for use in extra critical areas use the following type of unit.

7.2.2 Type of Battery backup:

- Unit emergency lighting equipment integral and remote heads. Voltage (6 volt, 12 volt, 24 volt) and capacity to suit the application. Automatic charging, automatic switching in event of power failure. Unit to meet *CSA Standard C22.2 No. 141-02 (2007)*[8] as a minimum.
- Unit plugs into circuit connected to the room lighting circuit that is fed from the emergency power distribution system. Plugs to be secured to receptacles.
- Do not consider use of central battery banks for emergency lighting. A central battery bank, for example, would not provide lighting in critical areas where individual circuits only have failed while there is no general power failure.

8. EMERGENCY LIGHTING SYSTEMS

8.1 Specify that the emergency lighting system operates automatically in the event of an interruption of the power supply to the normal lighting.

[8] C22.2 No. 141-02 (R2007) -- Unit Equipment for Emergency Lighting

8.2 Design lighting system to provide adequate levels of illumination at all means of egress from a building such as doorways, corridors, lobbies, stairways, ramps or other facilities provided for the speedy evacuation of persons from a building or room to a public thoroughfare or other approved open space in case of emergency.

8.3 Battery powered backup units for secondary emergency backup is provided for lighting in extra critical areas.

9. EMERGENCY STANDBY SYSTEM

Emergency standby power set may be installed indoor inside a building or outdoor in a well equipped trailer. The building or the trailer may be located inside or outside the institution security fence.

9.1 General Requirements

9.1.1 Design an emergency standby based on the use of an emergency generator designed to serve the Institution's critical loads via automatic transfer switches and distributed throughout the premises in a separate wiring system.

9.1.2 Base emergency system design on the use of a diesel generator set, of capacity sufficient to supply the Institution's emergency loads and capable of generating on a standby basis the required kW rating at 0.8 power factor continuous.

9.1.3 Design total diesel generator capacity to be able to carry the total connected load, including definitely known “future loads” plus 25% spare capacity.

9.1.4 Specify security grill barriers for air intake Louvers as covered in this Technical Criteria Section M-4.

9.1.5 Optional depending on institution’s acceptance and site conditions; the emergency generator may supplied by an off-site utility natural gas supply, conditions of *CSA Standard C282-09*[9] shall be met as a minimum.

9.1.6 Specify engine capable of operating at light loads for extended periods of time providing for pre-combustion of the fuel or a similar means for the prevention of carbonization.

9.1.7 To maintain environmental quality, engine is to be provided with a pre-combustion chamber fuel system or have suitable emission control equipment to ensure that gaseous exhaust emissions do not exceed the established maximum levels.

9.1.8 Generator set must be able to carry the institutional load within ten (10) seconds after failure of normal power. (Note: this exceeds *CSA Standard C282-09*, see footnote 9).

9.2 Engine (Diesel)

In specifying the engine, consider the following features and characteristics:

9.2.1 Reciprocating Engine: 2 or 4 cycle.

9.2.2 Minimum net brake power designed for continuous operation.
At altitudes above 500 meters and air intake temperatures above 32°C engines must be down rated for the elevation and temperature of the site of installation.

9.2.3 RPM - 1800.

[9] CSA C282-09 -- Emergency electrical power supply for buildings

9.2.4 Radiator and cooling 405 fan sized for continuous operation based on 40°C ambient air and 12.7 mm (½ inch) water gauge external static pressure.
9.2.5 Fuel transfer system, fuel injection system, lube oil system and associated pumps, filters, etc.
9.2.6 Jacket water heating system designed to maintain minimum 37.8°C water temperature based on 10°C ambient and associated pump, heaters, etc.
9.2.7 Engine freeze up protection to -29°C ambient.
9.2.8 Starting Motor.
9.2.9 Governor electronic with hydraulic activator and load sensing, provision for paralleling, designed to ensure generator voltage, frequency and performance, and to provide backup protection to prevent engine runaway.
9.2.10 Heavy duty type air cleaners.
9.2.11 To be able to run on No. 2 Heating and Diesel oil.

9.3 Fuel Supply System

9.3.1 Main aboveground storage tank as per SOR/2008- 197 "Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations" and "Federal Regulations and Canadian Council of Ministers of Environment CCME Code of Practice 2003". Size of tank to be at least 2 days continuous operation at full load ultimate system.
9.3.2 Day tank: 1000 ℓ.
9.3.3 Automatic fuel transfer pumping system as well as manual pumping capability.
9.3.4 For fuel supply and return for engine consider need to return unused fuel from engine to main tank (not day tank). This may be required to prevent fuel in day tank from overheating.
9.3.5 Where the emergency generator is supplied by an off-site utility natural gas, the conditions of CSA C282-09 (see footnote 9) shall be met.

9.4 Engine Instrument Panel

9.4.1 Engine instrument panel containing:
9.4.1.1 All the necessary pressure, temperature and time gauges and indicators.
9.4.1.2 All the required high and low pressure and temperature alarm actuators for water, oil and over speed.
9.4.1.3 Terminal cabinet to accommodate internal and remote wiring.
9.4.1.4 Note engine instrument panel to be mounted independently from engine/generator set either mounted on pipe stand from floor or where practical in main control panel.
9.4.2 Required Controls and Instrumentation
9.4.2.1 Automatic and manual starting.
9.4.2.2 Manual remote emergency stop.
9.4.3 Automatic shut down and alarms on:
9.4.3.1 Overcranking
9.4.3.2 Over speed; out of frequency range.
9.4.3.3 High engine temperature
9.4.3.4 Low lube oil pressure
9.4.3.5 Short circuit
9.4.3.6 Alternator over and undervoltage
9.4.3.7 Lube oil high temperature.

9.4.4 Alarms only (below shutdown levels) on:
- 9.4.4.1 High engine temperature
- 9.4.4.2 Low lube oil pressure
- 9.4.4.3 Lube oil high temperature
- 9.4.4.4 Low fuel
- 9.4.4.5 Low battery
- 9.4.4.6 Low engine temperature

9.5 Generator

9.5.1 Heavy duty, single bearing, revolving field, brushless.

9.5.2 0.8 PF, 60 Hz.

9.5.3 Drip proof.

9.5.4 Alternator windings.

9.5.5 Dynamically balanced rotor permanently aligned to engine by SAE flexible disc coupling.

9.5.6 Exciter: rotating brushless or static with permanent magnet or series boost option.

9.5.7 EEMAC Class F insulation on rotor.

9.5.8 Alternator winding temperature rise not to exceed 80°C as measured by resistance at an ambient temperature of 40°C.

9.5.9 Voltage regulator to be solid state, silicon controlled rectifiers with phase controlled sensing circuit, regulation +1% no load to full load. Provide auto manual control module, hand trimmer adjustment and located inside control cubicle, suitable for parallel operation.

9.5.10 Voltage stability: plus or minus 0.5% maximum deviation about rated generator terminal voltage at any constant load, from no load to full load.

9.5.11 Voltage transient: 20% maximum deviation from rated generator terminal voltage on one step application or removal of full load.

9.5.12 Frequency stability: ¼% maximum deviation from rated generator terminal frequency at any constant load from no load to full load.

9.5.13 Frequency transient: 7% maximum deviation from rated generator terminal frequency one step application or removal of full load.

9.5.14 Voltage and frequency transient recovery time: 4 seconds maximum between one step application or removal of full load and the time generator terminal voltage and frequency recovers and remains within respective stability limits.

9.5.15 Terminal cabinet to accommodate internal and outgoing wiring with grounding provisions.

9.5.16 Identify alternator windings with metal tags. Bring windings to insulated terminals in a metal junction box mounted on the alternator. Size junction box to permit mounting of engine and alternator low voltage controls and wiring terminal blocks. Provide barrier in junction box to separate low and high voltage wiring.

9.5.17 Design generator set to minimize radio frequency interference (RFI) under all operating conditions. Balanced Telephone Influence Factor (TIF) to meet or better requirements of *EEMAC Standard M1-6, 1986*[10].

[10] EEMAC Standard M1-6, 1986 -- EEMAC Standard for Motors and Generators

9.5.18 The alternator shall be capable of sustaining 300% rated current for a period not less than 10 seconds which would allow for selective tripping of down line protective devices when a short circuit occurs. Alternator protection breaker trip curves to be matched against alternator damaged and decrement curves such that breaker trips before over-current situation damages alternator.

9.6 Motor Starting

9.6.1 Specify motor starting capability
- integrated system requirement including:
  - engine and governor
  - alternator and voltage regulator

9.6.2 Motor starting capability required in parallel and independent mode.

9.6.3 Indicate maximum motor horsepower _____.
or maximum motor starting KVA _____.
with system preloaded at _____kW and _____kVA.

9.6.4 Maximum voltage and frequency transient and recovery to be as indicated under 9.5 for full load step.
Note: In case of large high inertia motors it may be necessary (to avoid oversizing) to indicate that full recovery time to be calculated from instant motor reaches breakaway speed.

9.7 Standby Plant Control Panel

9.7.1 Specify enclosure of the following construction:

9.7.1.1 Dead front type, free standing, moisture proof, metal enclosed structure, bolted or welded steel framing of sufficient strength to maintain alignment and withstand maximum interrupting capacity.

9.7.1.2 Louvered, No. 12 gauge steel panels with locked hinged access covers.

9.7.2 Specify control panel to consist of 2 full height sections
- Section one for AC power, main breaker and terminations specify auxiliary transformer breakers and interlocks for control of ventilation
- Section two for engine start, control, alarm system.

9.7.3 As a minimum specify all alarms and controls to *CSA C282-09*[11].

9.7.4 Specify cranking cycle as follow:
Three automatic starting attempts shall be made. Each attempt shall be for 15 seconds with 15 second rest periods between cranking periods. At the end of the third unsuccessful starting attempt the overcrank alarm shall come on and enough battery capacity shall be remaining to conduct four more manual starting attempts.

9.7.5 Control Section to contain completely electronic, solid state control and alarm components for concept refer to PWGSC Standard (see Reference No. 1.3).

9.8 Main Circuit Breaker

Specify main protective device of rating compatible with generator output characteristics. Provide state protective relaying with adjustable long time and intermediate adjustable ranges.

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9.9 Battery Charger

Specify automatic dual rate battery charger of the following characteristics and features:

9.9.1 Solid state, dual rate
9.9.2 AC line compensated
9.9.3 Stabilized output voltage with low voltage alarm, and limited output current.
9.9.4 Ampere rating, approximately 10 percent of 8 hour ampere/hour rating of battery.
9.9.5 With ammeter and voltmeter in front panel.
9.9.6 Housed in separate wall mounted enclosure adjacent to control panel, or mounted in control panel cover.
9.9.7 Low battery or malfunction alarm for connection to control room.

9.10 Batteries

Specify engine starting batteries to the following characteristics:

9.10.1 Lead calcium in transparent flame retardant jars and covers providing the required starting voltage.
9.10.2 Ampere/hour capacity sufficient to crank engine at constant firing speed in minimum room ambient of 21°C for a minimum of seven 15 second cranking cycles with 15 seconds of rests between attempts.

9.11 Silencer

Specify heavy duty, residential type exhaust silencer with companion flanges and piping, expansion joints, drain plug, finished in high temperature resistant paint.

9.12 Vibration Isolators

Specify vibration isolators of the following characteristics and features:

9.12.1 Spring type with neoprene acoustical pads, levelling devices and vertical limit stops.
9.12.2 25 mm minimum static deflection.

10. EMERGENCY POWER DISTRIBUTION

10.1 General Requirements

10.1.1 Arrange electrical distribution system so that no power interruption takes place on the non essential side of the distribution system while the generator is being exercised carrying all of its connected loads.
10.1.2 Arrange electrical distribution system so that sufficient capacity mobile generator can be connected to a box located on outside of the building. This box shall be protected against sabotaged etc. Connection of mobile generator should be possible without disconnecting any electrical cabling of distribution system.
10.1.3 Connection point for load bank should be provided for annual maintenance of generator. Connection should be possible without disconnecting any electrical cabling of distribution system.
10.1.4 Study ground fault protection considerations in systems with multiple neutral to ground connections. Neutral switching with overlapping contacts as part of the transfer switches may be one possible solution.

10.2 Automatic Transfer Switches

10.2.1 Specify the following accessories:

10.2.1.1 All engine controls to be part of the main engine generator control panel.

e.g. • time delay – auto start (signal received instantly from transfer switch(es)
• engine cool down – timing after normal power restored and all transfer switches returned to normal.

10.2.2 Each transfer switch equipped with:

- Voltage sensing, normal and emergency
- Instantaneous signal to control of normal power failure and return.
- Time delay on transfer to emergency (adjustable 0-60 sec.).
- Time delay on retransfer to normal after power returned (adjustable 0-300 sec.)
- Closed auxiliary contacts 2 on normal and 2 on emergency.
- Green pilot light to indicate "Normal" position amber pilot light to indicate "Emergency" position push-to-test emergency indicating pilot light with long life lamps and fuses.
- Test circuit for connection to central control (remote)
- Solid state type phase monitor with advance angle initiation, inhibiting transfer between two live sources until their phase angle difference is within plus or minus 5 electrical degrees.

10.2.3 Specify automatic transfer switches in accordance with *CSA C22.2 No. 178.1-07*[12] and relevant sections of *CSA C282-09*[13].

10.2.4 Specify contactor type transfer devices with single solenoid actuator.
Maximum transfer time from signal initiation 3 cycles. Standard of Acceptance "ASCO".

10.2.5 Consider available short circuit and transfer switch withstand capacity.
Short circuit operation - minimum 6 times rating (Standard)
Short circuit withstand - minimum 20 times loading rating (Standard)
Consider increasing switch size to attain withstand requirement.

10.2.6 If necessary to use current limiting fuses (in breakers), ensure fully co-ordinated throughout system.

10.2.7 Specify neutral only if required in which case specifies overlapping switched neutral.

10.2.8 Enclosing cabinet with flush mounted tumbler lock or switchboard mounted as indicated.

11. ENGINE/GENERATOR SWITCHBOARD

11.1 Switchboard for protection and control of engine/generator.

11.2 If suitable, subject to space layout and configuration specify engine/generator control panel to be included as part of the switchboard.

[12] CSA C22.2 No. 178.1-07 – Requirements for Transfer Switches

[13] CSA C282-09 – Emergency electrical power supply for buildings

11.3 Switchboard to be equipped with output breaker for the generator. Circuit breaker shall be electrically operated ACB Type.

12. REMOTE MONITORING SYSTEM

Emergency power system shall have remote monitoring capability located at the maintenance building to follow up the emergency power status from the chief of maintenance office.

13. OTHER DESIGN CONSIDERATIONS

13.1 Ensure adequate air supply for cooling and combustion system to consist of modulating damper arrangement discharge, intake, circulates to room, powered from emergency supply and arranged to open intake louver immediately on engine start.

13.3 Consider separate exhaust fan and heater to maintain acceptable temperatures in engine generator room throughout the year.

13.3 Specify installation of safety signs near generating plants. Signs to be 250 x 500 mm in size and to read as follows:

THIS UNIT OPERATES AUTOMATICALLY AND MAY START AT ANY MOMENT

DANGER

CET APPAREIL AUTOMATIQUE PEUT DEMARRER SUBITEMENT

14. TESTING

14.1 Specify factory testing and submission of results comprising 23 hrs at 100% load and one hr at 110% load. Readings of load tests to be taken at 30 minute intervals.

14.2 Specify on site testing, commissioning by manufacturer/ suppliers diesel/electric technician and submission of results.
Include - 8 hour full load test including 1 hour with 10% overload. Full function tests - all instruments, alarms and operation Vibration analysis.
All transfer switches and complete sequence testing.

14.3 Specify submission of forms for PWGSC/CSC approval 10 days before commencement of tests.

15. COMPUTER POWER SUPPLIES

15.1 Specify “Uninterruptible Power Supply” (UPS) systems for computers where short interruptions of power, such as between the loss of normal power and the start up of an emergency generator could result in loss of computer memory or information. Where computers are relatively close, a single UPS system may be used to serve several pieces of equipment.

15.2 UPS systems are required for Data Centers, LAN rooms, T&E rooms, CER, etc. Coordinate exact requirements for data network equipment with IMS infrastructure standards.

16. COMMISSIONING

16.1 Specify preparation of a load study as part of contract. Load study is to be reviewed and commented on design by the design engineer. Study is then to be submitted to CSC.

16.2 Load study is to contain full load current readings at the feeders connected to 50 ampere circuit interrupting devices and larger. Currents are to be read at the line side of the feeders if possible.

16.3 Load study is to contain voltage readings taken at the load side of the feeders. Adjust transformer taps to within 2% of rated voltage of equipment.

16.4 Load study is to identify loads ie. are they motors, lighting or heating.

16.5 Specify balancing of loads.

16.6 Specify for contractor to demonstrate that systems operate as design intended them to operate and that contractor must be prepared to operate each device, such as switches, relays etc., to the satisfaction of CSC and PWGSC involved in the acceptance procedure.

E-7 ELECTRICAL – FIRE ALARM SYSTEMS

1. SCOPE

1.1 This section outlines specific requirements for a fire alarm system in federal institutions. Refer to the National Building Code of Canada (NBCC) and other documents listed below for all other requirements not covered in this section. Additional requirements or modifications may be specified by CSC for a particular project or installation.

1.2 Unless specified herein, this section is not intended to apply to existing installations nor to require retro-active modifications unless these are undergoing a significant renovation (See Sentence 1.1.3).

1.3 "Significant renovations" include (but are not limited to):

- Projects identified as "Fire Alarm Upgrade",
- Replacement of a fire alarm panel,
- Replacement of more than 50% of the fire alarm devices on an existing fire alarm system,
- Addition of fire alarm devices to a fire alarm system increasing the number of devices to greater than that which is calculated using Sentence 2.2.15.

1.4 This section describes the overall institutional networking of fire alarm systems and the monitoring of this network.

1.5 This section describes the requirements for the design, construction and installation of fire alarm systems in

- New buildings;
- Major alteration and reconstruction of existing buildings; and
- Upgrading of a fire alarm system to remove an unacceptable fire hazard.

2. RELATED SECTIONS

2.1 Technical Criteria Document sections:

G-2 - Fire Authorities and Classification
A-13 - Control Posts
M-3 - Fire Protection Requirements
M-4 - Heating, Ventilating and Air Conditioning Requirements
E-6 - Emergency Electrical

2.2 CSC Standards:

ES/SPEC-0102 - Electronics Engineering Specifications for Data Logger in Federal Correctional Institutions

2.3 Standards:

2.3.1 If not specified herein, the applicable version/edition of a referenced standard or document is as referenced in the currently applicable edition of the National Building Code of Canada or, if not referenced by the National Building Code, the latest published edition.

In cases of discrepancies between this section and applicable codes and standards, the codes and standards will prevail unless specifically stated otherwise.

2.3.2 The following ULC Standards are to be referenced:

- CAN/ULC-S524, Standard for the Installation of Fire Alarm Systems.
- CAN/ULC-S527, Control Units for Fire Alarm Systems
- CAN/ULC-S536, Standard for the Inspection & Testing of Fire Alarm Systems.
- CAN/ULC-S537, Verification of Fire Alarm Systems.
- CAN/ULC-S561, Standard for Installation and Services for Fire Signal Receiving Centres and Systems

Note: Treasury Board Chapter 3-4 "*Standard for Fire Alarm Systems*" and Treasury Board Chapter 3-6 "*Fire Protection Standard for Correctional Institutions*" have been rescinded by Treasury Board effective April 1, 2014. Relevant portions of those documents have been moved to this document.

3. DEFINITIONS

3.1 Terminology used in this section is first to be defined per the definitions found within the National Building Code of Canada. If the term is not defined therein, the dictionary definition is to be used.

3.2 Buildings in this section are mostly distinguished according to type of living unit or by the type of restrictions which are imposed to egress and exiting conditions. The following clarifications are to be understood:

3.2.1 Free Egress buildings are buildings which can freely be exited at all times without the need of keys, special devices or specialized knowledge. Minimum security buildings should typically meet this definition.(Free Egress buildings may be located within a medium or maximum security facility.)

3.2.2 Impeded Egress buildings are to mean buildings in which egress is restricted. This includes buildings with impeded egress zones and contained use areas. (Medium and Maximum security living units are typically of this configuration.)

3.2.3 Health Care facilities and administrative buildings are to be addressed in keeping with the egress conditions of the building and may fall as "minimum", "medium", or "maximum" security buildings.

3.3 Where a Duty Office is used in lieu of an MCCP, references to "MCCP" in this document shall apply to the Duty Office.

4. FIRE ALARM SYSTEM

4.1 System Overview

4.1.1 A fire alarm system shall have the following characteristics:

4.1.1.1 In medium and maximum security buildings, all exposed components shall be resistant to vandalism and sabotage.

4.1.1.2 Fire alarm systems shall be designed to provide audible and visible signals per CAN/ULC-S524.

4.1.1.3 A fire alarm signal shall be of a distinctive sound to other sounds or institutional alarm signals.

4.1.1.4 The trouble signal at panels and annunciators shall be distinct in sound from that of the fire alarm signal.

4.1.1.5 A fire alarm system shall be capable of providing signaling to selected areas and zones as well as selected inmate population and staff.

4.1.1.6 A fire alarm system shall be highly resistant to nuisance alarms such as those caused by environmental conditions, interference and similar. The design of the fire detectors shall incorporate features which can discriminate between products of a fire and other possible products in the air not related to fire.

4.2 System Description

4.2.1 A fire alarm system shall be installed in each building as required by the National Building Code of Canada's determination of requirement for a fire alarm system.

4.2.2 A fire alarm system shall be installed in each building provided with sleeping accommodation.

4.2.3 A fire alarm system shall be designed and installed in accordance with CSA C22.1, Canadian Electrical Code, Part I, and CAN/ULC-S524, "Standard for the Installation of Fire Alarm Systems" and the National Building Code of Canada.

4.2.4 Each building is to be provided with its own independent fire alarm system which shall be monitored from the Main Communication and Control Post (MCCP).

4.2.5 Each building's fire alarm system is to be networked to the institution's MCCP which is to be designed as a campus-style network. Each system is to be connected to the MCCP in peer to peer topology.

4.2.6 Where multiple buildings abut to one another and operate in a similar operational manner (complexes), it may be permissible to install one fire alarm system, providing for selective activation of alarm signals by zones or groups of zones provided that the building incorporates such features of design and construction that partial or phased evacuation procedures may be safely used.

4.2.7 Along with the provisions of Sentence .8, the MCCP is to receive all alarm and trouble signals from all fire alarm systems within the institution.

4.2.8 Provisions are to be made for direct monitoring to the Local Municipal Fire Department or other approved fire alarm receiving centre. This capability shall be channeled through the MCCP.

4.2.9 Each fire alarm system shall have the capability of operating interchangeably as either a 2-stage or as a single-stage fire alarm system. See Section 4. of this document for specific operational requirements.

4.2.10 Each fire alarm system shall be fully addressable.

4.2.11 New systems shall be microprocessor based using latest technology and must be capable of fully integrating into the existing fire alarm network.

Note: The requirement to use latest technologies must not be construed as a requirement to upgrade existing components of a fire alarm system or network.

4.2.12 Each building's fire alarm shall be designed to operate independently in case of failure of the communication link between the fire alarm panel and the MCCP. Loss of communication with the MCCP shall cause a trouble signal at the MCCP.

4.2.13 Fire alarm systems shall monitor each device and each zone of grouped devices for alarm and trouble and shall display each zone individually. See Section 3.4 for annunciation requirements.

4.2.14 The time required to complete a single monitoring sequence for all zones and devices shall not exceed 5 seconds.

4.2.15 The capacity of each fire alarm system shall be such that it can accommodate, at minimum, all present and known future requirements plus 50%.

4.2.16 The Fire Alarm System shall be independent of all other Security, Communication and Monitoring systems. It shall have independent hardware and software, but with the capability of ready integration with the Facility Alarm Annunciation System (FAAS).

4.3 Fire Alarm Zoning

4.3.1 The buildings and areas shall be divided into zones.

4.3.2 Alarm signaling zones shall be logical subdivisions generally related to Control Posts (CP's).

4.3.3 Signaling devices shall correspond to initiating zones. Further subdivision of alarm signaling zones within an SCP area shall be based on:

- Fire separations
- Sprinkler zone
- Floor levels
- Each cell as one address
- Fire suppression systems (Kitchen Extinguishing System)

5. EQUIPMENT

5.1 Installation of Equipment

All fire alarm equipment and associated components are to be ULC/cUL listed and installed per its specified listing.

5.2 Protection of Equipment

Protection of fire alarm components is required in order to prevent tampering, vandalism, hiding of contraband and eliminating potential suspension points.

5.2.1 In inmate-occupied areas, rigid steel conduits for fire alarm wiring, if exposed, as well as all fire alarm devices shall be securely anchored to the wall in such a manner as to prevent the forceful removal of the conduit. Security fasteners shall be used.

5.2.2 Audible/visible fire alarm devices shall not be hidden. If protective guards are to be installed, these must not impede the visibility or the audibility of the device.

5.2.3 A spot-type heat detector or smoke detector, when installed in inmate areas, shall lock onto its base using a feature that prevents removal of the detector without the use of a tool.

5.3 Initiating Devices

Fire alarm initiating devices are to be installed in locations specified by the National Building Code of Canada as well as in additional locations specified in this section or as modified herein.

5.3.1 Manual Pull Stations:

- 5.3.1.1 In a 2-stage fire alarm system, manual pull stations shall be 2-stage type utilizing a key to operate the 2nd stage.
- 5.3.1.2 Pull stations shall be robust and of metal construction and must not incorporate glass rods or other removable parts.
- 5.3.1.3 Manual pull stations shall be addressable.
- 5.3.1.4 Wall-mounted manual pull stations shall be mounted not less than 1200 mm nor more than 1400 mm above the floor.
- 5.3.1.5 A two-stage manual pull station shall be installed in a readily visible and accessible location on the security console at every Control Post.
- 5.3.1.6 In administrative and non-inmate areas, single-stage manual pull stations are to be wall-mounted within a horizontal distance of 1500 mm of every exit door, preferably on the latch side of the door if possible.
- 5.3.1.7 In inmate-occupied work areas (kitchen, industrial shops, heating plant, etc), two-stage (keyed) manual pull stations are to be wall-mounted outside the instructor/supervisor office within a horizontal distance of not more than 1500 mm from the door opening.
- 5.3.1.8 In free egress buildings, single-stage manual pull stations shall be installed in all locations required by the National Building Code of Canada
- 5.3.1.9 Except as noted in the following sentence, exit doors leading from areas with impeded egress or from contained use areas shall be provided with two-stage pull stations having a keyed second stage.

5.3.1.10 Where the exit door noted in the previous sentence is within a direct line of site of a continuously staffed Control Post (ex: S4-S6 living units), the pull station at the exit door may be omitted in favour of the pull station discussed in Sentence 5.3.1.5 of this Section (in accordance with NFPA 101).

5.3.2 Heat Detectors (not including sprinklers)

5.3.2.1 In addition to the locations specified by the National Building Code of Canada, in non-sprinklered buildings, heat detectors are to be located in workshops (ex: machine shops, electrical shops, carpenter shops, paint shops, maintenance shops), storage areas, garbage rooms, tunnels, and perimeter observation towers.

5.3.2.2 Heat detectors shall be suitable for the specific installation environment.

5.3.3 Smoke Detection

5.3.3.1 Smoke detection is required by the National Building Code of Canada in each room and corridor in a contained use area.

5.3.3.2 Institution grade multi-tube addressable Aspirating Smoke Detection (ASD) is to be installed in sleeping rooms in medium and maximum security facilities (except for S-3) as well as cells in segregation, health care and psychiatric locations. ASD sample points are to be directly within the cell and not within a duct. (See Sentence 5.3.3.7)

5.3.3.3 Aspirating Smoke Detection systems shall be capable of pinpointing the cell where the smoke originated (single point detection).

5.3.3.4 Aspirating Smoke Detection systems shall be capable of pinpointing blocked sample points and display blocked points as a Trouble condition on the fire alarm system.

5.3.3.5 Aspirating Smoke Detection sample points shall consist of metallic, flush-mounted points and shall be installed using security fasteners.

5.3.3.6 In open common areas such as range corridors, either multi-hole ASD systems or spot type detectors may be installed.

5.3.3.7 In S-3 Living Units, the institution may choose to use addressable ASD or addressable spot-type smoke detection within sleeping facilities

5.3.3.8 Spot-type smoke detectors are required (in addition to typical code-required locations) within record storage rooms/vaults, the MCCP/CER, enclosed Security Command Posts and LAN rooms.

5.3.3.9 Spot-type smoke detectors shall be highly stable, photo-electric type.

5.3.3.10 Spot-type smoke detectors shall be equipped with self-compensating circuitry to provide maximum stability against effects of aging, dust and film accumulation. The detector sensitivity shall be adjustable.

5.3.3.11 Duct-type smoke detectors in air handling systems shall be listed for air-duct installation consisting of a highly stable, addressable, photo-electric type detector in an enclosure mounted to the duct wall with connected sampling tubes installed across the duct interior.

5.3.3.12 When duct-type detectors are required by the NBCC, duct-type smoke detectors shall be installed at a location in the main supply air duct on the downstream side of the filter units; and at a location in the return air duct prior to exhausting from the building or prior to being diluted by outside fresh air.

5.3.4 Other Initiating Devices

A number of other initiating devices may be provided in a building. Such devices must also initiate the fire alarm signal. These devices may include:

- Kitchen fire suppression systems,
- Automatic sprinkler system alarm and flow valves,
- Fire pump flow valves.

5.4 Supervisory Devices

Fire alarm supervisory devices are to be installed in locations specified by the National Building Code of Canada and its associated documents and standards. Examples of supervisory devices include (but are not limited to):

5.4.1 Sprinkler tamper and pressure monitoring switches (as per NFPA 13 “Standard for the Installation of Sprinkler Systems”).

5.4.2 Fire pump monitoring devices (as per NFPA 20 “Standard for the Installation of Stationary Pumps for Fire Protection”).

5.4.3 Fire protection water supply monitoring devices for municipal supply valves, Post Indicator Valves (PIV), water tower level and temperature, and reservoir levels as applicable.

5.5 Audible and Other Signaling Devices

5.5.1 Audible signal devices shall only be used for fire emergency purposes associated to the fire alarm system.

5.5.2 Audible signal devices shall continue to operate until the system has been restored to normal or until silenced from the control panel (See Silencing Procedures in Sentence 4.3).

5.5.3 Audible signal devices shall be located in common areas (not within cells) and should ideally be located where they are under continual surveillance such as outside the Control Posts or in easily recognized secure enclosures designed to not impede the audibility of the device.

5.5.4 Audible signal devices shall consist of addressable combination Audible/Visible devices being red coloured, wall-mounted combination horn/strobe units.

5.5.5 The sound pattern of an alarm signal shall conform to the temporal pattern per the requirements of the NBCC.

5.5.6 Sound and light output capability shall be suitable for the environment.

5.5.7 Devices shall have the capability of multiple audible and multiple candela settings.

5.5.8 Synchronized strobes are required only when more than one strobe is visible at any one time.

5.5.9 Audible and visual combination devices shall not share a common output circuit unless devices can be programmed for independent operation of the horn and the strobe.

5.5.10 Fire alarm audibility and visibility shall be suitable to the nature of the individuals using the building, subject also to security oversight. For example:

- Hearing and Visual impairments: Institutions shall ensure that means are provided to ensure that persons with sensory impairments are capable of being notified of a fire alarm within their usual living unit. This may include additional devices within a cell, devices not otherwise covered in this standard or administrative provisions to varying combinations.

Note: *CSC's Fire Safety Manual 345 may be used for additional guidance on this matter.*

5.6 Fire Alarm Annunciators

5.6.1 The activation of a fire alarm or supervisory alert in a building shall be annunciated at the following locations:

- MCCP,
- Control Posts in the building,
- At the primary entrance to the building, and
- In the Chief of Works office where applicable.

There may be additional annunciators in staffed locations in shops or other inmate areas depending on operational requirements of the institution.

5.6.2 Bulk annunciation shall be provided indicating building and functional area as well as detailed annunciation by device and location. Annunciation shall display over multiple lines. It shall be possible to scroll through the various events.

5.6.3 At the MCCP, annunciation shall be provided by an LCD screen (or similar) at the video terminal connected to a data logger capable of providing a readout of multiple events per the requirement of CAN/ULC-S524. All institutional fire alarm related events shall annunciate at the MCCP.

5.6.4 At the primary entrance to each building having a fire alarm system, annunciation shall be provided. All fire alarm events related to the building shall annunciate at the building annunciator.

5.6.5 At Command Posts (CP), the annunciator shall receive and display alarm and alert signals which originate in areas within the CP's operational control. Alert signals (stage 1) originating in other parts of the building need not annunciate at the CP. Alarm signals (stage 2) originating in other parts of the building shall annunciate.

6. OPERATION

6.1 Sequence of Activation

The system shall operate so that the activation of any heat/smoke detector, fire suppression system or manual fire alarm station operates the fire alarm system in the following ways:

6.1.1 Minimum institution (general):

- The fire alarm system shall be a single-stage fire alarm system.

6.1.2 Minimum institution with sleeping accommodations:

- The fire alarm system shall be a single-stage fire alarm system.
- Smoke detectors shall be installed in lieu of smoke alarms per NBCC 3.2.4.21.(8) sounding a localized alarm only within the individual suite of detection. This shall result in a trouble condition on all required annunciators. The local alarm shall clear once the detector no longer detects smoke.

Note: this is only applicable to smoke detectors which are used in lieu of required smoke alarms. All other smoke detectors and fire alarm devices are to operate per standard fire alarm requirements (CAN/ULC-S524).

6.1.3 Medium and Maximum security with sleeping accommodations (including common areas):

- The fire alarm system shall be a two-stage fire alarm system.
- First-stage (alert) shall sound a local piezo-electric alarm at the SCP responsible for the area containing the activated device. (Common areas and mechanical rooms shall annunciate at all SCPs in the building.)
- First-stage (alert) shall also initiate visible strobes throughout the operational area of detection.
- Provided that the first stage alarm has not been attended to and corrected, upon a delay of 5 minutes, a 2nd -stage audible alarm shall take place in the building or area affected for general evacuation purposes.
- Manual 2nd stage may be initiated by key at any manual station.

6.1.4 Medium and Maximum security – Operational (ex: Corcan, Kitchens, etc):

- The fire alarm system shall be a two-stage fire alarm system.
- Detection devices shall initiate 2nd stage alarm (general evacuation).
- Manual fire alarm pull stations shall be located at all exit doors and shall consist of two-stage pull stations. Normal operation of the pull station shall result in a first stage alert. Key-operation of a pull station shall result in 2nd stage alarm.

6.2 Controls

In addition to the required controls for a fire alarm panel, each annunciator panel shall be provided with the following controls:

6.2.1 Alert/Alarm Status

6.2.1.1 Each control unit shall have a reset switch with visual indicators.

6.2.1.2 Control Posts not associated with the zone of alarm origin shall not be able to reset/clear a fire alarm condition originating elsewhere in the building.

6.2.1.3 The MCCP shall not be able to reset/clear a fire alarm condition resulting in a separate building.

6.2.2 Silencing of alarm/alert signal

6.2.2.1 Each control unit shall have signal silence and trouble silence switches with visual indicators.

6.2.2.2 Control Posts shall be capable of only silencing the alert/alarm bells and buzzers located within their own area of operational control.

6.2.2.3 The MCCP shall not be capable of silencing the alarm in a building other than the building in which it is located.

6.2.2.4 Silencing of an alarm condition at the local alarm panel (or Control Post) shall not be possible during the first

- - 20-seconds of that condition in a two-stage fire alarm system.
- - 1-minute of that condition in a single-stage fire alarm system.

6.2.2.5 A silenced alarm signal shall re-initiate after 10-minutes of silence if the condition remains unchanged.

6.2.2.6 A silenced alert signal shall initiate an audible alarm signal 5-minutes after initiation of the alert signal regardless of when it was silenced.

6.2.2.7 Means shall be provided to manually re-initiate the audible signal from a “silence” condition.

6.3 Trouble/Supervisory

Troubles and Supervisory monitoring shall occur in accordance with CAN/ULC standards.

6.4 Door Controls

6.4.1 In impeded egress facilities, fire exit doors provided with remote electric release features shall **not** be connected to the fire alarm system. Independent door release devices shall be installed in Control Posts.

6.4.2 Automatic door openers (ex: barrier-free operators) installed on doors located in a fire separation shall be connected to the fire alarm system so as to disconnect the automatic opening feature of the power door operator.

7. AIR HANDLING SYSTEMS

7.1 Smoke detectors as stipulated in NBCC are to be installed in re-circulating heating, ventilating and air conditioning (HVAC) air handling systems.

7.2 Air handling system in buildings which do not need detectors in air handling systems are to be shut off automatically by tripping the power supply should a local zone alarm be activated. These may be restarted manually once the alarm is cleared.

7.3 Unless provided with an engineered smoke control system, the operation of smoke detectors installed in air handling systems shall:

7.3.1 Cause an alarm signal at the local building, Control Post and MCCP;
7.3.2 Indicate the origin of the alarm signal at the annunciator(s);
7.3.3 Shut down all HVAC fans. Commercial kitchen hoods and associated make-up air units are an exception to this configuration.

8. INCIDENT RECORDING

All panels shall provide a means to recall alarms and trouble conditions in chronological order for the purpose of recreating an event history. A separate alarm and trouble log shall also be provided.

8.1 Printer/keyboard

8.1.1 A printer/keyboard shall be provided within the MCCP and/or the CER in order to record all alarm, supervisory, and trouble events.
8.1.2 A printer/keyboard shall also be provided in the Chief Facilities Maintenance (CFM) office where applicable.
8.1.3 The printer/keyboard shall be ULC listed and compatible with the fire alarm system.
8.1.4 The printer shall be capable of listing:
- 8.1.4.1 Fire alarm with time, date and location.
- 8.1.4.2 Trouble alarms with time, date and location.
- 8.1.4.3 Status of output functions, "on" or "off".
- 8.1.4.4 Sensitivity of addressable smoke detectors if used.
- 8.1.4.5 Detection device type and location.
- 8.1.4.6 Status of remote relays, "on" or "off".
- 8.1.4.7 Acknowledgement time and date.
- 8.1.4.8 Signal silence time and date.
- 8.1.4.9 Reset time and date.

8.1.5 The printout is required to differentiate alarm signals from all other printed indications (ex: different font).
8.1.6 Printer paper shall be 8.5 inch wide, fan fold, tractor feed.

8.2 MCCP Data Logger Interface

8.2.1 A data logger (also known as FAAS) shall be provided to record the occurrence of all fire alarms, listing the time and zone location of each alarm, time of occurrence, acknowledgement, cancel and alarm disable/enable. This system is independent from the fire alarm system.

8.2.2 A fire alarm system shall include an output for an external data logger connection.

- Display unit to be equipped with 3 LED's: Alarm; Trouble; Power;
- System to be suitable for serially connecting or multiplexing to a main "Host" Building Security/ Management Central Processor System to duplicate display on a terminal screen.

9. INSTALLATION AND WIRING

9.1 Power Supply Sources

9.1.1 Fire Alarm systems shall be supplied by essential power source.

9.1.2 Fire alarm systems shall be arranged so that in the event of failure of the main power supply, the system shall switch automatically to the stand-by or auxiliary supply.

9.1.3 The fire alarm system shall monitor and record on its printer the loss and return of the AC supply and the return of its DC supply and provide annunciation at the central control panel and MCCP.

9.1.4 Fire alarm systems shall be provided with a 24V DC power supply consisting of gel cell type rechargeable batteries with charging means so arranged as to automatically maintain the batteries in a fully charged condition.

9.1.5 In all buildings having a fire alarm system, the battery power source shall be capable after having supervised the system for 24 hours, of operating the alarm and fire alarm system under general alarm conditions for an additional period per that which is required by the NBCC. Following this general alarm condition, the batteries must still have 85% of their rated voltage. The source shall be capable of full recovery within 24 hours.

9.2 Power Supply Circuit

9.2.1 Power supply circuit conductors for building fire alarm systems shall be stranded copper of adequate size to handle the current required to supply the maximum capacity of the system in accordance with the manufacturer’s recommendations plus 50% for future expansion of the building.

9.2.2 The power supply circuit shall be dedicated for the fire alarm system, and connected to the terminals of the automatic transfer switch (ATS) or the transformer terminals where transformation is required.

9.3 Wiring Methods

9.3.1 Wiring methods for all input (initiating) and output (signaling) circuits shall be 2 conductor in accordance with manufacturers recommendations.

9.3.2 Conductor Sizes - minimum No. 16 AWG. Refer to manufacturer recommendations for line drop and use larger conductors where required. Particularly note capacitance limits for each multiplex circuit.

9.3.3 The main fire alarm panel and the panels in the Control Posts (CP) and the Main Communications Control Post (MCCP) shall be interconnected via supervised class "A" wiring. Panel-to-panel wiring shall be protected in a non-combustible conduit where feasible (except where buried).

9.3.4 In a building, circuits for initiating and signaling to be class A loop. Tee taps are not permitted.

9.3.5 Class "B" Loop circuits may be used with smaller Fire Alarm Systems such as those in single-storey PFV's, 8-bed units, etc.

9.3.6 The wiring installation shall be carried out in a manner which physically separates the outgoing and return portion of each loop in order to ensure circuit integrity.

9.3.7 Wiring to each major signaling zone shall enter through a main remote terminal cabinet. Returning portion shall also connect through a remote terminal cabinet.

9.3.8 Remote terminal cabinet shall be factory assembled and pre-wired with all devices and terminals by the fire alarm system manufacturer/supplier.

9.3.9 All conductor terminations shall be on device terminals, or numbered terminal blocks in terminal cabinets.

9.3.10 Both ends of each conductor to be identified using numbered markers. The numbering is to be shown on shop drawings and to be subject to approval.

9.3.11 All fire alarm wiring in areas exposed to inmates shall be concealed or in rigid conduits.

10. VERIFICATION AND CERTIFICATION

10.1 Verification and Certification shall be in accordance with CAN/ULC-S537 "Standard for the Verification of Fire Alarm Systems".

10.2 In addition, final system check out shall be by representatives of the Crown with presence of qualified representatives of manufacturer and contractor.

11. INSPECTION AND TESTING

11.1 Ongoing Inspection and Testing shall be in accordance with CAN/ULC-S536 "Standard for the Inspection and Testing of Fire Alarm Systems".

12. WARRANTY

12.1 Guarantees in writing against defective material and workmanship shall be provided for a period of 2 years, from the date the building or system (or portion thereof) is granted occupancy by CSC Fire Protection Engineering, Technical Services.

13. TRAINING AND INSTRUCTION

13.1 Subject to the scope and scale of the work, training and documentation shall be provided. Subject to negotiation with the end users, provide training and documentation by the contractor and Fire Alarm Manufacturer - minimum of 3 days.

13.2 Training to take place after completion and verification but prior to final acceptance.

13.3 The manufacturer of the fire alarm equipment and the contractor installing the system shall conduct lectures and demonstrations, as necessary, on site, to train personnel in the use and maintenance of the systems.

13.4 The contractor shall develop and deliver a thorough training plan to CSC for comments and final approval. This plan must be submitted to CSC at least 60 days in advance of provision of the training, allowing at least 30 days for CSC review. As a minimum the training material shall contain:

13.4.1 Training Plans - one each, for contractors, instructors and two CSC supervisors.

13.4.2 Manuals - one for each student (up to six copies) to add notes.

13.4.3 Training Aids, consisting of a portable panel upon which system components are mounted and interconnected to enable "Hands-On" operations of pull stations, detectors, sprinkler flow and tamper switches, bells etc.

13.4.4 Student materials, including manuals.

It is anticipated that at least two submissions will be required to obtain final approval. This material shall be produced in English. Sufficient copies of all student materials shall be provided by the Contractor at the beginning of a training course to assure one copy for each student. The contractor must discuss this with CSC and his proposal should confirm that he will train the number called for. Upon final approval by the CSC project officer, six (6) sets plus one (1) set of reproducible copies of all materials shall be delivered to the CSC Design Authority.

13.4.5 Language of instructions, student materials and manuals shall be available in English and French. Actual language of training manuals and materials supplied, to be determined by CSC.

14. MAINTENANCE MANUALS

14.1 The Contractor shall submit at least two draft copies of maintenance manuals for CSC approval 30 days prior to submission of training material.

14.2 The Contractor shall provide, prior to the start of training, at least six copies of CSC approved manuals to support ongoing maintenance of system(s). The manuals shall be prepared to best commercial standards, and shall be consistent in format, quality and content, with sample manuals submitted with the proposal for approval by CSC. The final maintenance manuals shall meet the following minimum requirements:

- A title page
- A warranty page - explaining the warranty and expiry date
- A revision notice page, lined, with columns for revision numbers, dates and initials.
- Table of contents
- Introduction - general information including a full description of equipment for system(s), technical summary/specifications and detailed block diagram.
- Theory of operation, including an in-depth explanation of all circuits and parts
- Alignment and test procedures
- Repair procedures, including step-by-step fault finding or fault localizing
- Block and riser diagrams
- Circuit schematics (clear, easy to read, fold-out type)

- Complete parts lists
- Mechanical drawings, chassis layout illustrations where applicable, and wiring data lists
- Drawings, including as-built and as installed drawings.

14.3 The Contractor shall provide before the date of the interim certificate, five additional sets of updated final maintenance manuals. The Contractor shall update the approved manuals through the warranty period, and provide revision bulletins when the need arises to record manufacturer -recommended modifications, etc. to be made during the life of the equipment. Within thirty (30) days prior to expiry of the warranty, the Contractor shall submit for CSC approval one set of final, updated revision bulletins.

15. MAINTENANCE AND SPARES

The Contractor shall develop maintenance and spare support plans for CSC approval.