

**APPENDIX H – OPERATION AND MAINTENANCE MANUAL
REQUIREMENTS FOR ELECTRICAL AND
MECHANICAL SYSTEMS**

Attachment H1 – Electrical Operation and Maintenance Manual

Attachment H2 – Mechanical Operation and Maintenance Manual

ATTACHMENT H1

**ELECTRICAL OPERATION AND MAINTENANCE MANUAL
REQUIREMENTS**

1. INTENT

- .1 The Contractor is responsible for maintenance manuals of the electrical systems. The Contractor shall obtain all specified operation and maintenance data. Using this data, Contractor shall prepare and submit three (3) Electrical Operation and Maintenance Manuals to the Province.

2. MANUAL SYSTEM CATEGORIES

- .1 Organize manual into the following major system categories:
 - .1 PDS - Power Distribution System
 - .2 CAS - Communication and Security Systems
 - .3 LTG - Lighting Systems
 - .4 FSS - Fire Safety Systems
 - .5 SPS - Special Systems
- .2 Provide master divider tabs and index for each major system category, with white tabs, 75 mm in length.

3. SUB-SYSTEM DIVISIONS

- .1 Divide major system categories into subsystems as follows:
 - .1 PDS - Power Distribution System:
 - .1 High Voltage Systems (Above 750 Volts)
 - .2 Low Voltage Systems (Below 750 Volts)
 - .3 Emergency Systems
 - .4 Motor Control Systems
 - .2 CAS - Communication and Security Systems, if required:
 - .1 Security System
 - .2 Programmable Clock System
 - .3 LTG - Lighting Systems:
 - .1 Interior Lighting
 - .2 Exterior Lighting
 - .3 Lighting Control
 - .4 FSS - Fire Safety Systems:
 - .1 Fire Alarm System

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- .2 Emergency Voice Communication System
- .5 SPS - Special Systems:
 - .1 Isolated Power Systems
 - .2 Uninterrupted Power Supplies
 - .3 Other Systems
- .2 Organize each sub-system into the following sections:
 - .1 Operations Section
 - .2 Maintenance Section
 - .3 Contract Documentation Section
 - .4 Standards Section
- .3 Provide an index and divider for each subsystem and section, colour coded as follows:
 - .1 PDS Subsystems - Blue
 - .2 CAS Subsystems - Green
 - .3 LTG Subsystems - Yellow
 - .4 FSS Subsystems - Red
 - .5 SPS Subsystems - Orange
- .4 Use 45 mm tabs for each subsystem and 40 mm tabs for sections, use same colour for section tabs as for subsystem tabs.

4. OPERATIONS SECTION

- .1 In each system or category and/or subsystem, include an operations section which includes:
 - .1 System Description
 - .2 System Operating Instructions
 - .3 Schematic Diagrams
 - .4 Equipment Data Sheets
- .2 System Descriptions: prepare descriptions which, at a minimum, include the following:
 - .1 Power Distribution System - PDS:
 - .1 Calculated demand in kVA of entire system and on each transformer 150 kVA and above.
 - .2 Short Circuit analysis of entire system, including incoming fault level.

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- .3 Protective Device Coordination study for entire system, including emergency system.
- .4 Description of protection, transfer and metering scheme for both normal and emergency systems supported by schematic diagrams.
- .5 Calculated system operating power factor together with method of improvement and anticipated improvement.
- .6 Calculated demand in kVA of Emergency Power System.
- .7 Single line diagram of entire power system indicating all breaker, switches, protective devices and instrumentation.
- .8 Calculated demand on UPS systems where installed.
- .2 Communication and Security Systems - CAS:
 - .1 Security Systems:
 - .1 Manufacturer and model numbers of system and all components.
 - .2 System installer.
 - .3 Integral transient and memory protection.
 - .4 System type and composition.
 - .5 Location in School and areas served.
 - .6 Function of major components.
 - .2 Programmable Clock System, if applicable:
 - .1 Manufacturer and model numbers of system and all components.
 - .2 System installer.
 - .3 Integral transient and memory protection.
 - .4 Master Clock:
 - .1 Location.
 - .2 Supervisor and connection periods.
 - .3 Manual control.
 - .4 Daylight savings feature.
 - .5 Program control points (i.e. control of lighting, bells, mechanical equipment, etc.).
 - .5 Clocks:
 - .1 Digital or analog.
 - .2 12 or 24 hour system.
 - .3 Mounting.
 - .6 Interval Timer Clock:

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- .1 Stop, start, reset buttons.
 - .2 Pilot lights.
 - .3 Clock descriptions.
- 3 Lighting Systems - LTG:
 - .1 Interior Lighting:
 - .1 Include following in description of interior lighting system:
 - .1 Calculate and include energy consumption in Watts per square metre.
 - .2 Include any areas where ambient lighting has been supplemented with task lighting.
 - .3 On a room by room basis, anticipated design lighting levels.
 - .4 Describes all ballast and light sources/lamps used.
 - .5 Include description of diffusers.
 - .6 Include battery lighting units and exit lights.
 - .2 Exterior Lighting:
 - .1 Include following in description of exterior lighting:
 - .1 Include anticipated designed lighting levels for parking lots, roadways, etc.
 - .2 Describe ballasts and light sources to be used.
 - .3 Include description of diffusers and distribution pattern for each fixture to be used.
 - .3 Lighting Control System:
 - .1 Interior Lighting:
 - .1 Describe method of switching. Include switching of corridors, large general use

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- areas and any lighting connected to emergency or standby power.
- .2 For low-voltage switching systems, include following:
 - .1 Manufacturer and model number of system.
 - .2 Type of switch used.
 - .3 Relay.
 - .4 Interface card in panels.
 - .5 Time clock/computer controlled and zone(s) of control.
 - .6 Location of any master switches and area they control.
- .2 Exterior Lighting:
 - .1 Describe method of controlling exterior lighting (i.e. photocell, timelock, override switch, master switch, etc.)
 - .2 Include location of all control equipment.
- .4 Fire Safety Systems - FSS:
 - .1 Fire Alarm System:
 - .1 Manufacturer and model number of system.
 - .2 General description i.e. single or two stage, zoned, non-coded, etc.
 - .3 Interconnection to other system i.e., security system, BMCS, etc.
 - .4 Fire alarm control unit.
 - .5 Power supply for system.
 - .6 Communicators.
 - .7 Pull Stations.
 - .8 Heat Detectors.
 - .9 Smoke Detectors.
 - .10 Signal Device - bell or speaker.
 - .11 Amplifiers (if speakers used).
 - .12 Door Holder.
 - .13 Sprinkler flow and tamper devices.
 - .14 End-of-line device.
 - .15 Printers.
 - .16 Floor fire alarm panel.

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.17 Integral transient and memory protection.

.2 Emergency Voice Communication System:

.1 Manufacturer and model number of system.

.2 Command centre.

.3 Power supply.

.4 Amplifiers.

.5 Zoning and Zone Control.

.6 Speakers - types, enclosures, power requirements.

.7 Microphone/Telephone.

.8 Integral transient and memory protection.

7. SYSTEM OPERATING INSTRUCTIONS

.1 Prepare system operating instructions, with the manufacturers' and suppliers bulletins as backup. Provide the following:

.1 Power Distribution System - PDS:

.1 Provide an overall description of operation of power system in both normal and emergency mode.

.2 For high voltage systems, provide detailed instructions for system switching, equipment isolation, discharging and grounding.

.3 Automatic Power Factor improvement equipment detailing method of input summation, protection, switching and size of incremental increase/decrease in kVAR.

.4 Protective schemes such as overcurrent, short circuit, undervoltage, ground fault, including lock out and restraint as applicable.

.5 Transfer schemes both normal and emergency.

.6 Emergency power generation, including load shedding and peak shaving.

.2 Communication and Security Systems - CAS:

.1 Security System:

.1 Describe in "Operator Layman" language, specific instructions for operating and programming system and components of system.

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- .2 Exact type and specific location of each device used.
 - .3 Identify safety devices, detection equipment and other conditions that must be satisfied in order for equipment to be operated.
 - .4 Do not include individual passwords, access codes and similar confidential data in Operation & Maintenance Manual. Include reference to whom to contact should this information be required.
- .2 Programmable Clock System:
 - .1 Monitor Clock:
 - .1 Manual/automatic control.
 - .2 Programming instructions.
 - .3 List features used/not used.
 - .2 Clocks.
 - .3 Interval timer clock.
 - .1 Control panel.
- .3 Lighting Systems - LTG:
 - .1 List type of lamps that can be used with ballasts provided to obtain results.
 - .2 Timelock.
 - .3 Photocell.
 - .4 Low Voltage Setting:
 - .1 Details of systems type and composition.
 - .2 Location in the building.
 - .3 Function of each component.
 - .4 Provisions for future expansion.
 - .5 Computer controlled - specific instructions for operating and programming system.
- .4 Fire Safety Systems - FSS:
 - .1 Fire Alarm System:
 - .1 Fire alarm control unit.
 - .2 Wiring class.
 - .3 Zoning.

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- .4 Programming instructions if microprocessor / addressable.
 - .5 Supervisory zone operation.
 - .6 Systems trouble.
 - .7 System reset.
 - .8 CRT/Printer Operation.
 - .9 Communication.
 - .10 First stage alarm:
 - .1 System operation.
 - .2 Auxiliary relay operation:
 - .1 Door release.
 - .2 Elevator homing.
 - .3 Smoke damper operation.
 - .4 Fan shutdown.
 - .5 Sprinkler system.
 - .6 Security system.
 - .7 Fire department "alert" or "alarm".
 - .11 Second stage alarm:
 - .1 Zone evacuation.
 - .2 Automatic evacuation.
 - .3 Signal silence.
 - .4 Auxiliary relay operation (if different from first stage alarm).
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- .2 Emergency Voice Communication System:
 - .1 Central control unit.
 - .2 Zoning control.
 - .3 Station operation.
 - .4 Connection to other systems (paging system).
 - .5 Tones / recorded messages / etc.
 - .6 Volume control.

8. SYSTEM SCHEMATICS

- .1 Include all schematics that are applicable, which will assist in operation and maintenance of system.

10. MAINTENANCE SECTION

- .1 General:
 - .1 Summarize data for recommended maintenance, supplemented by any additional appropriate data.
 - .2 Include recommended maintenance as a section of each system.

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- .3 Organize data into sections, with divider tabs as follows:
 - .1 Recommended Maintenance Tasks and Schedules
 - .2 Spare Parts
 - .3 Suppliers and subcontractors
 - .4 Tags and Directories
 - .5 Maintenance Brochures
- .2 Recommended Maintenance Tasks and Schedules:
 - .1 Organize data according to system category, with further breakdown into individual systems as used in operations division of the manual. Provide section index and divider tabs for each system category. Summarize recommended maintenance tasks from maintenance manufacturer's brochures, for each component of system in following format:
 - .1 Daily
 - .2 Weekly
 - .3 Monthly
 - .4 Semiannually
 - .5 Annually
 - .6 When required
- .3 Parts List:
 - .1 Organize data according to system category, with further breakdown into individual systems as used in operations division of manual. Provide section index and divider tabs for each system category. Summarize recommended maintenance tasks from maintenance manufacturer's brochures, for each component of system.
- .4 Suppliers and Contractors List:
 - .1 Provide summary of suppliers and subcontractors for each component of the system. List name, address and telephone number of each.
- .5 Tags and Directories:
 - .1 Provide a copy of tags and directories.
- .6 Maintenance Brochures:

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- .1 Include copies of all manufacturers' printed maintenance brochures pertaining to each product, equipment or system. Provide section index and divider tabs.

11. DOCUMENTATION AND STANDARDS SECTION

- .1 Coordinate collection of data required for this section.
- .2 Organize all data into sections, with divider tabs, as follows:
 - .1 Drawing List
 - .2 Shop Drawings and Product Data
 - .3 Certificates
 - .4 Reports
 - .5 Standards Division
- .3 Drawing List: provide a list of all drawings required for performance of the Project and the M&R.
- .4 Shop Drawings and Product Data: provide final copies of all shop drawings and product data. Include section index and divider tabs.
- .5 Subcontractor Certifications: provide copies of subcontractor certifications for the performance of the product and systems, and test reports verifying performance of products and systems. Include section index and divider tabs with maximum of twenty-five sheets or one report per tab. This should include, but not be limited to the following:
 - .1 Electrical systems inspection.
 - .2 Utility company inspection.
 - .3 Occupational Health and Safety inspection.
 - .4 Fire Alarm Verification certificate.
- .6 Reports: include copies of all reports relating to the testing, adjusting and balancing of equipment and systems. Include section index and divider tab for each report.
- .7 Standards Division: allow 25 mm binder space for standards.

ATTACHMENT H2

**MECHANICAL OPERATION AND MAINTENANCE MANUAL
REQUIREMENTS**

1. INTENT

- .1 The Contractor is responsible for maintenance manuals of the mechanical systems. The Contractor shall obtain all specified operation and maintenance data. Using this data, Contractor shall prepare and submit three (3) Mechanical Operation and Maintenance Manuals to the Province.

2. MANUAL DIVISIONS

- .1 Organize manual into following divisions:
 - .1 Operations Division
 - .2 Maintenance Division
 - .3 Standards Division
- .2 Provide master divider tab and index for each division.

3. OPERATIONS DIVISION - MECHANICAL SYSTEMS

- .1 Organize all data into sections according to system category, with divider tabs, as follows:
 - .1 AIR - Air Systems
 - .2 CTL - Control Systems
 - .3 CLG - Cooling Systems
 - .4 FPN - Fire Protection Systems
 - .5 HTG - Heating Systems
 - .6 MIS - Miscellaneous Systems
 - .7 PLG - Plumbing Systems
- .2 Organize data for each system category (section) into individual systems (subsections). Provide an index for each system category and a divider tab for each individual system.
- .3 For each individual system, except Controls System, include following data.
 - .1 System Description: provide details of system type, composition, areas served, location in building, design criteria and function of major components. All equipment arranged to operate together as one system shall be considered part of that system description.

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Design criteria shall, at minimum, include following where applicable:

- .1 Occupied space conditions.
 - .2 Outdoor ambient conditions.
 - .3 Air circulation rate.
 - .4 Exhaust air rate.
 - .5 Minimum outside air.
 - .6 Building pressurization.
 - .7 Future load allowances.
 - .8 Standby capabilities.
 - .9 Calculated load and design capacity of domestic water supply mains.
 - .10 Calculated load and design capacity of drainage mains.
- .2 System Schematic: provide a system schematic showing all components comprising central system. Identify each component using its BMCS mnemonic and generic name designation. Use this mnemonic in all references to equipment throughout manual.
- .3 Operating Instructions: provide, in "operator" layman language, specific instructions for start-up, shutdown and seasonal change over of each system component. Include following:
- .1 Exact type and specific location of each switch and device to be used in system operation.
 - .2 Identify safety devices and interlocks that must be satisfied in order for equipment to start.
 - .3 List conditions to be fulfilled before attempting equipment start up, i.e. valves position correct, glycol mixture concentration proper, piping filled with fluid, filters/strainers in place, etc.

6. OPERATIONS DIVISION - CONTROLS SYSTEM HARDWARE

- .1 BMCS Hardware:
- .1 System Description
 - .2 System Schematic
 - .3 Operating Instructions
 - .4 Equipment Identification

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- .2 Complete BMCS Hardware subsections according to general format and contents outlined in “Operations Division - Mechanical Systems”.

7. OPERATIONS DIVISION - CONTROLS SYSTEM SOFTWARE

- .1 System Introduction:
 - .1 Provide a brief description of overall control philosophy.
 - .2 Describe hardware interlocks with other equipment that may affect or override action of software control modules.
 - .3 Describe procedure for operating staff to interface with software control modules to override system or component operation, to adjust system or building control set points, etc. Name virtual points provided in software for this purpose and recommend adjustment increments and limits where applicable.
- .2 System Schematic: provide a labeled schematic indicating locations, point mnemonics, and proper names of physical control points in system. Include RCU panel wiring diagrams with field point termination addresses. Good quality shop drawings may be used for this purpose.
- .3 Software Modules:
 - .1 For each module provide a description of purpose and logic of module.
 - .2 Provide a description of each software Input and Output Variable on Point Mnemonic Descriptions Sheet.
 - .3 Provide a hard copy listing of software module.

8. MAINTENANCE DIVISION

- .1 Summarize data for this section from Supplier and Sub-trade maintenance submissions, supplemented by appropriate additional data.
- .2 Organize data into sections, with divider tabs as follows:
 - .1 Maintenance Tasks and Schedules
 - .2 Spare Parts
 - .3 Suppliers and Contractors
 - .4 Tags and Directories

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- .3 Maintenance Tasks and Schedules: organize data according to system category, with further breakdown into individual systems as used in operations division of the manual. Provide section index and divider tabs for each system category. Summarize maintenance tasks from manufacturers' maintenance brochures, for each component of each system in following format:
 - .1 Daily
 - .2 Weekly
 - .3 Monthly
 - .4 Semi-annually
 - .5 Annually
 - .6 When required
 - .4 Suppliers and Contractors List: provide summary of suppliers and contractors for each component of each system. List company name, address and telephone number of each.
 - .5 Tags and Directories: provide a copy of tag and other directories.

9. CONTRACT DOCUMENTATION DIVISION

- .1 Organize operation and maintenance data into sections, with divider tabs, as follows:
 - .1 Drawings List
 - .2 Shop Drawings and Product Data
 - .3 Certifications
 - .4 Warranties and Bonds
 - .5 Maintenance Brochures
 - .6 Reports
- .2 Drawings List: provide a list of all drawings used in performance of the construction contract.
- .3 Shop Drawings and Product Data: provide final copies of all shop drawings and product data. Include section index and divider tabs. Maximum of twenty-five sheets or one shop drawing per tab.
- .4 Certifications by Contractor: provide copies of Contractor certifications for performance of products and systems, and test reports verifying performance of products and systems. Include section index and divider tabs with maximum of twenty-five sheets or one report per tab.

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- .5 Certifications by Inspection Agency: collect and include copies of following inspection certification reports:
 - .1 Plumbing and Gas Standards
 - .2 Building Standards and Fire Prevention
 - .3 Boilers and Pressure Vessel Standards
 - .4 Utility Company
 - .5 Other Reports Required by Authorities
- .6 Maintenance Brochures: include copies of all manufacturers' printed maintenance brochures pertaining to each product, equipment or system. Provide section index and divider tabs. Maximum of twenty-five sheets or one brochure per tab.
- .7 Field Reports: collect and include field reports. Include section index and divider tab for each report:
 - .1 Valve tag directory.
 - .2 Hydronic systems pipe pressure test certificates.
 - .3 Chemical treatment and cleaning reports.
 - .4 Start-up and testing reports.
 - .5 Manufacturer's start-up reports.
 - .6 Acoustic reports.
 - .7 Testing, Balancing and Adjusting reports.
 - .8 BMCS physical point confirmation and calibration reports.
 - .9 BMCS software verification report.

END OF SECTION