

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Division 21, 22, 23, 25, 26, 28 & 33.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada.
 - .2 Indicate on drawings:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
 - .3 Shop drawings and product data accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify current model production.
 - .5 Certification of compliance to applicable codes.
 - .4 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
 - .1 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.
 - .2 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valves schedule and flow diagram.
 - .7 Colour coding chart.
 - .3 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
 - .4 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.

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

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Furnish spare parts as follows:
 - .1 One casing joint gasket for each size pump.
- .3 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 78 00 - Closeout Submittals.
- .4 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .2 Storage and Handling Requirements:
 - .1 Store materials indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not used.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PAINTING REPAIRS AND RESTORATION

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

3.3 SYSTEM CLEANING

- .1 Clean interior and exterior of all systems including strainers.

3.4 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.5 DEMONSTRATION

- .1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.

- .3 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .4 Instruction duration time requirements as specified in appropriate sections.
- .5 Departmental Representative will record these demonstrations on video tape for future reference.

3.6 PROTECTION

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

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Division 21 & 23.

1.2 REFERENCE STANDARDS

- .1 National Fire Protection Association (NFPA)
 - .1 NFPA (Fire) 13, Installation of Sprinkler Systems Handbook, 2019 Edition.
 - .2 NFPA (Fire) 14, Standard for the Installation of Standpipe and Hose Systems, 2019 Edition.
 - .3 NFPA (Fire) 20, Installation of Stationary Pumps for Fire Protection, 2019 Edition.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada.
 - .2 Submit complete plans to Authority of Jurisdiction for review and approval before commencement of work.
 - .3 Indicate grooved joint couplings and fittings on drawings.
- .4 Samples:
 - .1 Submit the following samples:
 - .1 Firehose nozzles.
 - .2 Section of hose.
- .5 Test reports:
 - .1 Submit certified test reports for standpipe and hose assembly from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
- .6 Manufacturers' Instructions:
 - .1 Provide manufacturer's installation instructions.
- .7 Field Quality Control Submittals:
 - .1 Manufacturer's Field Reports: manufacturer's field reports specified.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for standpipe and hose system for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: company or person specializing in standpipe and hose assembly with 5 years documented experience.
- .2 Supply grooved joint couplings, fittings, valves, grooving tools and specialties from a single manufacturer. Use date stamped castings for coupling housings, fittings, valve bodies, for quality assurance and traceability.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Storage and Protection:
 - .1 Store materials in dry location.
 - .2 Store and protect materials from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.
- .3 Packaging Waste Management: remove for reuse by manufacturer of pallets, crates, padding, and packaging materials.

PART 2 - PRODUCTS

2.1 DESCRIPTION

- .1 Design system to NFPA (Fire) 14 and following parameters:
 - .1 Combined with sprinkler systems: hydraulic.

2.2 SUSTAINABLE REQUIREMENTS

- .1 Grooved couplings and fittings made from minimum 90% recycled metal.

2.3 PIPE, FITTINGS AND VALVES

- .1 Pipe:
 - .1 Ferrous: to NFPA (Fire) 14.
 - .2 Copper tube: to NFPA (Fire) 14.
- .2 Fittings and joints to NFPA (Fire) 14:
 - .1 Ferrous: screwed, welded, flanged or roll grooved.
 - .1 Grooved joints designed with two ductile iron housing segments, pressure responsive gasket, and zinc-electroplated steel bolts and nuts. Cast with offsetting angle-pattern bolt pads for rigidity and visual pad-to-pad offset contact.
 - .2 Copper tube: screwed, soldered, brazed.
- .3 Valves:
 - .1 ULC listed for fire protection service.
 - .2 Up to NPS 2: bronze, screwed ends, grooved, OS&Y gate.

- .3 NPS 2-1/2 and over: cast or ductile iron, flanged ends, indicating butterfly valve.
- .4 Check valves: spring actuated swing type, composition disc or seal.
- .4 Pipe hangers:
 - .1 ULC listed for fire protection services.
- .5 Drain valve: NPS 1, complete with hose end, cap and chain.
- .6 Inspector's test connections: NPS 1 gate valve.

2.4 CABINETS

- .1 To NFPA (Fire) 14 and ULC listed: , surface type as indicated, constructed of 1.6 mm thick steel, 180 degrees opening door of 2.5 mm thick steel with hinge same side as water supply and latching device.
- .2 Cabinets to maintain fire resistive rating of construction in which they occur.
- .3 Cabinet door: with 5 mm full glass panel, 1/3 of door area.
- .4 Large enough to accommodate angle valve, hose rack, fire hose nozzle and spanner, and NPS 2-1/2 fire department valve.

2.5 HOSE RACK

- .1 ULC listed, swivel type with pins to permit hose to be hung in folds. Locking device shall prevent flow of water into hose until last fold is removed from rack. Complete with hose, nozzle and angle valve.

2.6 FIRE HOSE AND NOZZLE

- .1 Hose: ULC listed, 38 mm nominal diameter, 30 m long, synthetic jacket, synthetic rubber lined.
- .2 Nozzle: ULC listed, 38 mm nominal diameter, forged brass adjustable combination fog-straight stream with shut-off.

2.7 ANGLE VALVES

- .1 ULC listed for fire service. NPS 1-1/2 cast or forged brass complete with hand wheel, open or drip connections, or hydrolator valve. Where water pressure exceeds 690 kPa, provide ULC listed pressure reducing device.

2.8 FIRE DEPARTMENT VALVE

- .1 ULC listed, NPS 2-1/2 forged or cast brass angle valve: with thread compatible with local fire department, complete with handwheel, cap and chain. Cap to be part of ULC listing for valve.

2.9 FINISHES

- .1 In finished areas, chrome plate valves, nozzles, fittings and hose rack.

- .2 Cabinets.
 - .1 Tub: prime coated.
 - .2 Door and frame: No. 4 satin finish stainless steel.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install and test to acceptance in accordance with NFPA (Fire) 14.
- .2 Install pipework in accordance with Section 23 05 15 - Common installation requirements for HVAC pipework, supplemented as specified.
- .3 Run inspectors test connections to sight glass.
- .4 Install drain pipes and valves to drain parts of systems and so arranged that any one standpipe riser can be drained without shutting down any other parts of systems.
- .5 Install 90 mm diameter pressure gauge at top of risers and in accordance with NFPA (Fire) 14.
- .6 The source of the water supply shall be reliable and capable of providing the required supply for not less than 30 minutes.
- .7 Water supply for standpipe system:
 - .1 Class I Systems:
 - .1 Receive water supply sufficient to provide 1892.50 lpm and 946.25 lpm for each additional standpipe.
 - .2 Total supply not to exceed 9462.5 lpm.
 - .3 Supply system: capable of maintaining residual pressure of 690 kPa at each topmost outlet with 1892.50 lpm flowing from most remote standpipe and 946.25 lpm flowing from each additional standpipe up to maximum of 9462.5 lpm.

3.3 FIELD QUALITY CONTROL

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

3.4 SITE TEST

- .1 General:
 - .1 In accordance with NFPA (Fire) 14, supplemented as specified.
 - .2 In accordance with Section 01 91 13 - General Commissioning Requirements: General Requirements, supplemented as specified.
- .2 Testing witnessed by authority having jurisdiction.
- .3 Disposal of water used in flushing and testing:
 - .1 Discuss appropriate measures with Departmental Representative.
- .4 Timing:
 - .1 Connect fire hoses when flushing out and pressure tests have been completed.
 - .2 Charge system with water when there is no possibility of freeze-up.
 - .3 Perform tests after pressure booster pumps have been tested.
- .5 Co-ordination:
 - .1 Co-ordinate tests with performance verification of:
 - .1 Fire pumps.
- .6 Procedures:
 - .1 Verify that system is complete prior to start-up and testing procedures.
 - .2 Verify that ULC labels are visible.
 - .3 Fill system with water for pressure. Record water supply pressure.
 - .4 Pressure test piping system as required by authority having jurisdiction.
 - .5 Start up fire pumps and jockey pumps.
 - .6 Verify flow switches are operational.
 - .7 Verify valves in system are visible and monitored.
 - .8 Flushing: fill with water, let stand at operating pressure for 1 week. Drain risers separately, then drain main.
 - .9 Flush buried mains and lead-in connections before making connection to indoor sprinkler system.
 - .10 Perform flow tests, including tests of pre-action systems, as required by:
 - .1 Authority having jurisdiction.
 - .2 Applicable NFPA (Fire) standards such as 13, 14, 20, 1273.
 - .3 Local building codes.
 - .11 Record incoming pressure to building for 10 days prior to activating system.
 - .12 Adjust PRV on pump discharge to maximum pressure of 620 kPa at top fire hose station.
 - .13 Adjust PRV's at lower fire hose stations to 550 kPa maximum.
 - .14 Fill glycol legs, confirming proper operation of backflow preventers.
 - .15 Adjust pressure switches.
- .7 Sundry checks:
 - .1 Verify that properly sized pressure restricting discs are installed where required.
- .8 Identification:
 - .1 Verify devices are properly labelled, identifying area served, etc.
- .9 Report:
 - .1 Refer to Section 01 91 13 - General Commissioning Requirements, reports supplemented as specified.
 - .2 In addition to reports required by NFPA (Fire) 14, include the following:
 - .1 Copy of schematic and valve schedule.

- .10 Posted Instructions:
 - .1 Prepare schematic, mount behind glare-free glass and install where directed.
 - .2 Prepare valve schedule, mount behind glare-free glass and install where directed.
- .11 Documentation:
 - .1 Provide written certification to Departmental Representative that system was installed, flushed and tested in accordance with , approved plans and calculations.
 - .2 Certificate to include:
 - .1 Contractors name.
 - .2 Contractors address.
 - .3 Contractors licence number.
 - .4 List of approved materials and devices installed.
 - .5 Description of system test conducted.
 - .6 Dates of flushing and testing.
 - .7 Certification that connections conform to acceptable standards.
 - .8 Certification that system is complete and in service.
 - .9 Approved signage has been provided and attached as appropriate.
 - .10 Hose threads of system and test connections match those of responding fire department.

3.5 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling.

PART 1 - GENERAL

1.1 SUMMARY

- .1 This section describes the design and installation of the new and/or modified portions of the Fire Protection System and a new High-Expansion Foam (HEF) Fire Protection System for Hangar T-58, 200 Comet Private, Ottawa. The design flow rate shall be based on the information indicated on the drawings and this specification. The modified and new portions of the fire protection system shall be in accordance with NFPA (Fire) 13, NFPA (Fire) 11, NFPA (Fire) 409 and as required by the National Building Code and the local fire protection authority having jurisdiction. The Contractor is responsible for designing, furnishing, and installing all Fire Protection services, including but not limited to, piping, wiring, equipment and devices as required for a complete, approved, and functioning system.
- .2 The Contractor shall provide a closed head water, fire sprinkler system for the mentioned areas. Include all detectors, switches, alarms, wiring, and controls.
- .3 The Contractor shall hydraulically calculate and size all Fire Protection equipment, piping and devices to ensure adequate flow to all system components. The Contractor shall use the existing fire protection water storage reservoir of 1,401,000 Litres.
- .4 Refer to Section 21 13 13 - Wet Pipe Sprinklers for requirements of the sprinkler system.
- .5 The system shall include all standard accessories as are necessary for a complete and operational system. The high expansion system shall include but not be limited to the foam concentrates, foam bladder tank(s), foam proportioner(s), high expansion generator(s), foam hose stations, fire main, deluge risers, sprinkler piping and heads, and all accessories necessary for a complete and operational system.

1.2 RELATED REQUIREMENTS

- .1 Drawings and general provisions of Contract, including General and Supplementary conditions and Specification sections, apply to work of this section. The drawings and the specification describe the fire protection requirements. The Contractor shall also coordinate with the other discipline drawings and trades.
 - .1 Documents in Division 01 – General Requirements.
 - .2 Sections in Division 21 – Fire Suppression.
 - .3 Sections in Division 26 – Electrical.
 - .4 Sections in Division 22 – Plumbing.
 - .5 Sections in Division 23 - Heating, Ventilating and Air Conditioning.
 - .6 Sections in Division 25 - Integrated Automation.
 - .7 Sections in Division 28 - Electronic Safety and Security.
 - .8 Sections in Division 33 – Utilities.

1.3 REFERENCE STANDARDS

- .1 Codes and Standards:
 - .1 The Contractor shall install the fire protection systems in accordance with the latest editions of the following Standards:
 - .1 ASME B16.3-2016, Malleable-Iron Threaded Fittings, Classes 150 and 300.
 - .2 ASME B16.9-2018, Factory-Made Wrought Steel Buttwelding Fittings.
 - .3 ASTM A34/A34M-06(2018), Standard Practice for Sampling and Procurement Testing of Magnetic Materials.
 - .4 ASTM A197/A197M-00(2019), Standard Specification for Cupola Malleable Iron.

- .5 ASTM A795/A795M-13, Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.
 - .6 Factory Mutual (FM) standards.
 - .7 National Fire Code of Canada 2015.
 - .8 NFPA (Fire) 11, Standard for Low-, Medium-, and High-Expansion Foam, 2015 Edition.
 - .9 NFPA (Fire) 13, Automatic Sprinkler Systems Handbook, 2019 Edition.
 - .10 NFPA (Fire) 72, National Fire Alarm and Signaling Code, 2019 Edition.
 - .11 NFPA (Fire) 409, Standard on Aircraft Hangars, 2016 Edition.
 - .12 NRCC NBCC-2015, National Building Code of Canada.
 - .13 Underwriters Laboratory, Inc. (U.L.) Publication – Fire Protection Equipment Directory.
- .2 Materials and Equipment:
- .1 All equipment and devices shall be of a make and type listed by ULc or approved by FM, or other nationally recognized testing laboratory for the specific purpose for which it is used.
- .3 Materials and Equipment:
- .1 All equipment and devices shall be of a make and type listed by ULc or approved by FM, or other nationally recognized testing laboratory for the specific purpose for which it is used.
 - .2 The Contractor shall provide fire protection products in accordance with ULc standards; provide ULc label on each product.
 - .3 The Contractor shall provide fire protection products and installations in accordance with Factory Mutual (FM) standards.
 - .4 All products shall be listed for fire protection service.

1.4 SUBMITTALS

- .1 Submit under provisions of Section 01 33 00 – Submittals.
- .2 Product Data: Submit manufacturer's product data, including Type, Model, and physical dimensions.
- .3 All literature and instructions provided by the manufacturer of all installed equipment and devices describing proper operation, maintenance, and safety concerns.
- .4 Piping layout drawings, electrical interface schematics, and hydraulic calculations. Hydraulic calculations and Contract Drawings shall be submitted to, and reviewed by, departmental representative and the local fire protection authority prior to installation.
- .5 Certification indicating that the system is installed in compliance with the applicable codes.
- .6 Verification that the appropriate acceptance tests have been conducted in accordance with the local fire protection authority and the applicable codes.
- .7 The designer of the fire protection systems shall be a registered Professional Engineer in the province of Ontario, Canada. All submittal documents must be stamped by the designer.
- .8 Contractor shall submit detailed design for review by Departmental Representative and final as-built drawings of the fire protection systems including foam systems, indicating location and sizes of equipment (bladder) tanks, deluge valves, foam proportioners, hydraulic control valves, high expansion foam generators, foam water hand hose stations, supervised valves, control systems, pull statins, emergency push buttons for foam discharge and fire detectors).

1.5 HIGH EXPANSION SYSTEMS DESIGN

- .1 Design of the HEF system shall be by hydraulic calculations for uniform distribution of high expansion foam over the entire aircraft hangar protected area and shall conform to the NFPA standards listed above and to the requirements specified herein. Before HEF systems equipment is ordered the Contractor shall confirm the number of foam generators and bladder tanks capacity are selected correctly based on the systems supply calculations. High expansion foam system shall activate upon operation of the associated hangar bay fire sprinkler system, two triple infrared frequency optical flame detectors, or a manual foam discharge station.
- .2 High Expansion System Design:
 - .1 System shall be sized to provide the specified volume of high expansion foam while the fire sprinkler system is discharging simultaneously at the specified total maximum required flow. Foam generators shall deliver expanded foam solution to meet NFPA (Fire) 409 30/60 second coverage of area below aircraft, and to within 1.5 m (5 feet) of perimeter walls and doors within 3 minutes of activation. Application to horizontal surfaces for the high expansion foam system shall be 0.9 cmm/m^2 (3.0 cfm/ft.^2) with automatic closed-head sprinkler system with a minimum design of 69 Lpm/m^2 (0.17 gpm/ft.^2) over any 1394 m^2 ($15,000 \text{ ft.}^2$) area for Group I Hangars, including the hydraulically most demanding area, with simultaneous discharge of two 227 Lpm (60 gpm) foam hose lines. 1892 Lpm (500 gpm) outside hose allowance will be provided through fire hydrants supplied by the Base potable water system.
 - .2 Failure to achieve specified requirements during acceptance testing will be considered a design failure.
- .3 Duration of Foam Discharge:
 - .1 System shall apply 2.0 % or 2.75% foam solution, per manufacturer, over the sprinkler discharge area for a minimum 12 minute duration.
 - .2 Foam hose stations discharge time shall be a minimum of 20 minutes for two hoses operating.
- .4 AFFF foam hose stations discharge time shall be a minimum of 20 minutes based on a minimum of two (2) 226 Lpm hoses operating. Actual total number of foam hose station locations is based on covering the entire protected hangar area to include the interior of the aircraft.
- .5 1892 Lpm outside water hose allowance shall be required.
- .6 High Expansion Discharge Area:
 - .1 Area shall be based upon each entire aircraft hangar servicing area.
 - .2 Mount foam generators to overhead roof support structure in accordance with manufacturer's guidelines.
- .7 Friction Losses:
 - .1 Calculation losses in pipe in accordance with the Hazen-Williams formula with "C" value of 120 for steel pipe.
- .8 Water Supply:
 - .1 Contractor shall use actual fire pump performance curves and hydraulic calculations to verify water demand will meet the system demand requirements.
- .9 Drainage:
 - .1 Each sprinkler and foam system riser shall be arranged to be drained entirely through the main drain.

1.6 FRICTION LOSSES

- .1 Calculate losses in pipe in accordance with the Hazen-Williams formula with "C" value of 120 for steel pipe.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 All equipment and components shall be new, and the manufacturer's current model. All equipment and components shall be installed in strict compliance with manufacturer's recommendations. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place. Fasteners and supports shall be adequate to support the required load.
- .2 All components comprising the foam system shall be sourced from the manufacturer of the foam system control panel (FSCP).
- .3 Provide system components from a single manufacturer, including foam concentrate, foam generators, bladder tanks, proportioners, deluge valves, and valve trim. Foam generators shall be UL listed for use with the foam concentration. Major components of equipment shall have manufacturer's name, address, type or style, model or serial number, and catalog number on plate permanently affixed to equipment.

2.2 DELUGE VALVES

- .1 Valves shall be operated by a detection and control system listed for the releasing service. The deluge valve shall be provided with electrical solenoids compatible with the voltage and current supplied by the control panel. If 150 mm valves are used in larger risers, provide smoothly tapered fittings. In addition to the automatic operation, arrange each valve for manual hydraulic release at the valve. Provide pressure gauges and the other appurtenances at the deluge valve.
- .2 Deluge valve clappers shall incorporate a mechanical latching mechanism that will not be affected by pressure changes in the water system, be externally resettable without opening valve for a maximum working pressure of 1205 kPa (175 PSL).
- .3 Provide pressure gauges and the other appurtenances at the deluge valve. Assembly shall be complete with standard trim piping, drain, and test valves, pressure switches, and other required components.

2.3 SPRINKLER HEADS

- .1 Provide standard sprinkler heads with nominal 13 mm orifice. Sprinkler heads shall be standard upright type in all spaces except that sprinkler heads under grating, pipe racks, equipment, etc. shall be modified with splash guards to maintain their operating integrity. Sprinklers shall have a temperature rating of 102°F to 190°F, and shall have a nominal K-Factor of 5.6 (80-6), refer to Section 21 13 13 - Wet Pipe Sprinkler Systems.

2.4 HIGH-EXPANSION FOAM CONCENTRATE

- .1 Foam concentrate for high expansion system shall be a UL listed 2% concentrate. Foam concentrate shall be metered into the system riser(s) by the use of balance pressure proportioning utilizing a modified venturi proportioner(s) and bladder tank(s). This system shall include all piping and appurtenances necessary to form a complete working system. Contractor shall supply sufficient concentrate to fill the tanks and for testing

of the foam system. Contractor shall supply sufficient concentrate to fill the tank(s) and for all preliminary and final testing of the foam system.

2.5 HIGH-EXPANSION FOAM SYSTEM BLADDER TANKS

- .1 Per NFPA (Fire) 409 Main and Reserve bladder tanks shall be required. Tanks shall be a horizontal cylindrical steel ASME coded pressure rated vessel with a UL approved bladder shaped to conform to the inner pressure vessel configuration. Tanks shall be designed for a working pressure of 12.1 bar and hydrostatically tested to at least 17.6 bar. The tanks interior shall be coated with a high build epoxy sealer for additional corrosion resistance. The bladder tanks shall be UL listed or FM approved together with the type of concentrate and proportioners being used in the system. The Bladder tanks is to have a minimum 3,407 L capacity to provide sufficient foam concentrate for the time specified when the system is discharging foam solution at total discharge flow. The bladder tank shall be complete with all necessary outlets and supports such as a two welded saddles for horizontal bladder tanks or four welded legs for vertical bladder tanks. Associated trim on the bladder tank shall include bronze pipe and fittings, four bronze ball valves, minimum of 25mm, for concentrate and water vents and drains with secured nameplate depicting the valve name and operating position, and a clear PVC sight gauge. The bladder tanks, proportioners and foam concentrate shall be the product of a single manufacturer.

2.6 HIGH-EXPANSION FOAM PROPORTIONER

- .1 The foam proportioners is to be a modified venturi type designed to accurately proportion and control the mixing of pressurized foam concentrate into the water system. The proportioners shall have either NPT threaded (50 mm and 65 mm sizes) or "between flange" type (75 mm, 100 mm, 150 mm and 200 mm sizes) designed to fit between two 150 lb. pipe flanges. Proportioners shall be sized for the specified flow rates and either be UL listed or FM approved with the type of foam concentrate and bladder tanks being used in the system. A fixed metering orifice, secured with a stainless steel retaining ring, shall be sized according to the type and percentage of foam concentrate used. The system shall be designed to proportion at 2% per foam equipment manufacturer.

2.7 HYDRAULIC CONCENTRATE CONTROL VALVE

- .1 The hydraulic concentrate control valve shall be a FM Approved assembly that is factory assembled and tested. It shall include a threaded bronze body ball valve with mounting kit for securely attaching the hydraulic actuator to ball valve. The ball valve shall be designed for a minimum 27.6 bar WOG. The valve shall be fitted with a stainless steel ball, stem, and packing nut. Valve seats shall be of glass reinforced Teflon™ material. The Stainless Steel Hydraulic Actuator must be approved by the manufacturer for using water as the medium to operate the actuator. The actuator shall have a position indicator and have the capability for manual override. The actuator shall be designed to operate the valve with a minimum of 2.1 bar water pressure and shall contain no external moving parts which could cause fouling of adjacent equipment, injury to personnel, misalignment problems common to external linkage systems, or potential for disengagement caused by tampering.

2.8 HIGH EXPANSION FOAM GENERATORS

- .1 The foam generators shall be powered by a water reaction motor. The water reaction motor shall provide both the screen wetting solution and the energy to drive the fan. The foam generators shall not require any outside power source, such as electricity or gasoline engines. All foam generators designed for fixed installation shall be equipped with a stainless steel screen for maximum reliability under fire conditions. The foam generator(s) shall be Underwriters Laboratories (UL) listed and/or Factory Mutual (FM) approved.

- .2 Each foam generator shall be equipped with stainless steel screen and prepiped y-strainer, as required per manufacturer.
- .3 Foam generators shall be supported from building structure on at least two sides.
- .4 Provide additional steel members, hangers, and seismic bracing as required to adequately support each generator in accordance with the manufacturer's guidelines.
- .5 Provide drain valve and cap at each foam generator.

2.9 AFFF FOAM-WATER HAND HOSE STATIONS

- .1 The foam-water hand hose stations shall be metal hose reel with straight-through internal fittings, design to provide a minimum pressure drop, shall be provided. The reel shall be capable of holding 30.5 m of 65 mm hose with nozzle and shall be manual rim rewind. The reel shall be provided with a locking mechanism to prevent unwinding of the hose. The hose shall be continuous flow type, oil and chemical resistant, with a minimum working pressure of 17.2 bar. The nozzle shall be a variable pattern (fog – straight stream), rated for a nominal flow of 359 Lpm at 6.9 bar. Foam concentrate for foam-water hose stations shall be a UL listed aqueous film-forming foam (AFFF) solution for 3% proportioning. Contractor shall supply sufficient concentrate to fill the tank(s) and for testing of the foam system. AFFF foams shall be C6 generation, non-PFOS forming, ULC-5564-06 listed.

2.10 ABOVE GRADE PIPING AND FITTINGS:

- .1 Piping for wet sprinkler systems shall be carbon steel ASTM A795. Fittings shall be malleable iron, ASTM A197, ASME B16.3 threaded, ASTM A34, ASME 16.9, butt weld or grooved end mechanical joints. Pipe and fittings shall be in accordance with NFPA (Fire) 13. Mechanical joints shall be UL and FM approved.

2.11 FOAM SYSTEM CONTROL PANEL (FSCP)

- .1 Refer to Division 28 for Foam System Control Panel Specifications.

2.12 POWER SUPPLY

- .1 Each power supply shall operate on 120 VAC, 60 Hz, and shall provide all necessary power for the foam fire protection system.
- .2 It shall provide a battery charger for 24 hours of standby.
- .3 It shall provide an earth detection circuit.
- .4 It shall provide optional meters to indicate battery voltage and charging current.

2.13 BATTERIES

- .1 Batteries shall be 12 volt.
- .2 Batteries shall have sufficient capacity to power each fire alarm system for not less than 24 hours in standby plus 5 minutes of alarm upon a normal AC power failure.

- .3 Batteries are to be completely maintenance free. No liquids are required. Fluid level checks, refilling, spills, and leakage are not acceptable.

2.14 WET PIPE SPRINKLER SYSTEMS

- .1 Refer to Section 21 13 13 - Wet Pipe Sprinkler Systems.

2.15 STRAINERS

- .1 Where required by the foam system manufacturer, provide basket type strainers upstream of risers on foam-water systems with a cast iron flanged body and cover flange rated for 1206 kPa (175 psi).
- .2 Provide strainer basket formed of perforated stainless steel sheet with 1/4 inch perforations. Basket shall have minimum 50 percent open area. Compute and specify maximum allowable pressure drop due to friction of flow through basket strainer and flow rate when strainer is 50 percent clogged.
- .3 Strainers in contact with HEF concentrate shall have stainless steel construction bodies with strainer basket formed of perforated stainless steel sheet.
- .4 Assembly shall allow access to strainer basket by removing flange on top of strainer.

2.16 IDENTIFICATION

- .1 Provide signage in accordance with NFPA (Fire) 13. Properly lettered metal signs shall be suitably affixed to each control valve, auxiliary drain, and main drain.

2.17 DRAINS

- .1 Main drain piping shall be provided to discharge to the reservoir or to a safe location exterior to the building. Drains shall be provided with signage identifying the function of the valve.

2.18 CONTROL AND DETECTION SYSTEMS

- .1 Refer to Section 28 31 00.01 - Addressable Multiplex Fire Alarm.

PART 3 - EXECUTION

3.1 FOAM SYSTEM INSTALLATION

- .1 Equipment, materials, installation, workmanship, fabrication, assembly, erection, examination, inspection and testing shall be in accordance with the NFPA (Fire) 409 referenced herein. Install piping straight and true to bear evenly on the hangers and supports. Provide fittings for changes in direction of piping and for all connections. Make changes in piping sizes through standard reducing pipe fittings; do not use bushings. Cut pipe accurately and work into place without springing or forcing. Ream pipe ends and free pipe and fittings from burrs. Clean with solvent to remove all varnish and cutting oil prior to assembly. Make screw joints with PTFE tape applied to the male threads only. The Contractor shall hydrostatically test the entire Fire Protection system at 13.8 bar for 2 hours. Bladder tanks shall be isolated by manual valves and not be included in this test. For the hydrostatic test, the water pressure shall be increased in 3.5 bar increments with observations of the joint and gasket stability during each step increase. Only increase pressure to the next

increment after joint and gasket stability has been demonstrated. After the required hydrostatic test pressure has been reached and maintained for one hour, the pressure shall be returned to zero while examining for leakage. The pressure shall be slowly increased again to the required hydrostatic test pressure and maintained for two hours while the leakage measurement is determined. All lines shall be relieved of pressure after completion of the test. In the event of repairs or additions, the affected piping shall be retested at the installation Contractor's expense. A Contractor's Material and Test Certificate shall be furnished by the Contractor and countersigned by the departmental representative. All shutoff valves shall be fully closed and opened under system pressure to ensure proper operation.

3.2 FIELD PAINTING

- .1 Clean, prime, and paint new foam system including valves, piping, conduit, hangers, miscellaneous metal work and accessories. Apply coatings to clean, dry surfaces using clean brushes. Clean the surfaces to remove all dust, dirt, rust, and loose mill scale. Immediately after cleaning, provide one coat of primer to the metal surfaces. Exercise care to avoid painting of the sprinkler heads and operating devices. Upon completion of painting, remove materials, which were used to protect sprinkler heads and operating devices while painting is in process.

3.3 GENERAL

- .1 The Contractor shall coordinate with departmental representative any activity requiring an interface with existing plant services or other contractors to implement fire protection in the building.
- .2 The Contractor shall protect piping and system components from freezing in exterior or unheated spaces.
- .3 Sprinkler piping shall be installed so that the entire system may be drained in accordance with NFPA (Fire) 13.
- .4 Mains, test connections, and other equipment shall be labeled as per FM and NFPA.
- .5 Pipe hangers and supports shall comply with NFPA.
- .6 Penetrations through fire walls and floors shall be provided using appropriate methods to maintain their integrity as per NFPA and NBC.
- .7 Electrical installation shall be in accordance with the NEC, NFPA (Fire) 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.
- .8 All conduit, junction boxes, conduit supports, and hangers shall be concealed in finished areas and may be exposed in unfinished areas.
- .9 All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.
- .10 Provide the service of a competent factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system. The factory representative shall demonstrate that the Foam Fire Protection Systems function properly in every respect.
- .11 Inspectors test connections shall be provided as required by NFPA and the local fire authority.
- .12 All piping shall be closely coordinated with other trades to avoid interferences (process piping, utility piping, HVAC, plumbing, electrical, general construction).

- .13 Foam Fire Protection Systems shall be tested only after all hydraulic testing and flushing is complete and all deficiencies found have been corrected to the satisfaction of the departmental representative.

3.4 FIELD TESTING

- .1 Preliminary Tests:
- .1 Upon completion of the installation, the contractor shall subject the system to a series of preliminary, operational tests to verify the system performance and compliance with this specification. Contractor shall provide HEF concentrate for testing after successful completion of all preliminary and final tests, contractor shall refill HEF tanks to full capacity with concentrate, including piping between tanks and concentrate control valve.
 - .2 Preliminary Tests shall be performed in accordance with approved project phasing plan.
 - .3 To accommodate testing of individual foam generators:
 - .1 Isolate foam generator such that only one foam generator will discharge.
 - .2 Provide temporary folding frame fire fighting water reservoir, 20 ft. x 20 ft. x 3 ft. high, complete with drain tube. Reservoir shall be positioned below single foam generator to catch and contain limited quantity of high expansion foam and effluent during partial system testing. Foam/Water samples can be taken for testing, and remainder disposed of without discharging to below slab effluent system.
 - .3 At completion of preliminary testing, turn over temporary folding frame fire fighting reservoir to Departmental Representative to be used for annual testing.
 - .4 Hydrostatically test the piping system at 1,378 kPa (200 psi) for a 2 hour period with no leaks or reduction in gage pressure.
 - .5 Flush piping with potable water in accordance with NFPA (Fire) 13 at no less than 3 metre per second.
 - .6 All piping and foam system components shall be inspected and approved by the foam system manufacturer.
 - .7 Test every initiating, signaling and trip device, including setting and adjusting all supervisory tamper and water flow switches.
 - .8 Perform a full discharge test of HEF system to measure against performance criteria of NFPA (Fire) 409. Contractor shall measure and record flow rates and pressures.
 - .9 Deficiencies found at this time shall be immediately corrected.
 - .10 Provide a video of the preliminary testing and a letter from the contractor and/or foam equipment supplier certifying successful completion of preliminary testing a minimum of 21 days prior to scheduling final acceptance testing.
 - .11 Upon final acceptance, restore all systems to operational state.
- .2 Final Tests and Demonstrations:
- .1 The system shall be considered ready for such testing only after all necessary preliminary tests have been made and all deficiencies found have been corrected to the satisfaction of the Departmental Representative and CFFM.
 - .2 During inspection, repeat any or all of the required tests as directed.
 - .1 Foam Discharge Testing:
 - .1 Test high expansion system at full design flow to determine that the high expansion output meets the performance criteria of NFPA (Fire) 409.
 - .2 Test all foam-water hose lines by full flow of foam solution for at least 60 seconds to collect a foam solution sample.
 - .3 The manufacturer's representative shall test samples of foam solution taken from each system to ensure proper HEF and AFFF concentration by means of refractive index. Submit report to Departmental Representative. Any solution test concentrations that are above or below the manufacturer's specified limits constitutes failure. Contractor shall repeat concentration tests until successful. A new HEF solution concentration test shall be required for final acceptance.

- .4 Provide protection for all building finishes, floor, electrical fixtures and equipment exposed to possible damage during the tests and protect doors and other openings leading from the protected area, to prevent migration of the foam solution in to other areas or spaces.
- .2 If the tests do not confirm that the specified criteria have been met, the tests shall be considered failed, the system modified as necessary, and tests repeated at no additional cost to the contract.
- .3 Flushing and Rinsing:
 - .1 After completion of final acceptance test(s) flush all piping carrying foam solution with fresh water at no less than 3 metres per second. Piping to be pre-charged with foam solution need not be flushed.
- .4 Environmental Protection
 - .1 Provide temporary measures to prevent foam solution from entering storm drains, sanitary sewers, drainage ditches, streams and water courses.
 - .2 Contain all foam solution on paved surfaces or specific containment area.
 - .3 Collect all discharge foam solution and dispose of it at an EPA approved wastewater treatment facility, which provides a secondary (biological) treatment.
- .5 Foam Concentrate Storage Tank(s)
 - .1 After acceptance of the system testing, bladder tank(s) are to be charged to the full system capacity.
- .6 Foam Concentrate:
 - .1 Provide sufficient foam concentrate for all testing. At the successful completion of all tests, fill the foam tanks prior to substantial completion.
- .7 Reset:
 - .1 Upon final acceptance, restore all systems to operational state.

3.5 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1
- QUALITY ASSURANCE.
- .4 All system testing shall be conducted in accordance with approved test protocols. Submit written test protocols including detailed test procedures, documentation sheets, and expected test results to Departmental Representative, CFFM a minimum of 30 days prior to commencing preliminary and final tests.
- .5 Final acceptance tests shall not be performed until preliminary test report has been submitted and approved by Departmental Representative and CFFM.
- .6 Clean and restore systems and areas to normal conditions after completion of tests. Dispose of discharged HEF by allowing it to break down overnight, and flush remaining residue with water following local environmental requirements.

3.6 CLEANING

- .1 Proceed in accordance with Section 01 74 00 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

- .3 Preparation for and Clean up after Foam System Discharge Testing:
 - .1 To protect adjacent spaces and equipment during foam system discharge testing: provide 4 mil poly temporary foam containment sheeting around entire perimeter of each hangar, and around any columns containing equipment, conduits, or wiring which could be damaged by water. Sheeting shall be taped to floor slab, and extend up minimum 4,500 mm (15 feet) above hangar floor. Provide temporary supports for sheeting at areas such as around mezzanines. Temporary foam containment sheeting shall be inspected and signed off by Departmental Representative prior to foam discharge testing.
 - .2 Refer to '3.4 Field Testing' for temporary folding frame reservoir requirements to contain effluent during partial system testing.
 - .3 Provide rinsing, flushing, and vacuuming of all areas effected by foam system discharge, above and below slab, including hangars, trench drains, effluent piping (interior and exterior), interior effluent pumping pit, and exterior below grade effluent containment tank. Contractor performing effluent cleaning shall be certified as per 3.4 Field Testing requirements.

3.7 TRAINING

- .1 The Contractor shall conduct two training sessions of 4 hours each to familiarize Departmental Representative personnel with the features, operation and maintenance of the HEF system.
- .2 Training sessions shall be scheduled by the Departmental Representative at a time mutually agreeable to the Contractor and the Owner.
- .3 Training Agenda: the Contractor shall submit a proposed training agenda for the Owner's review and approval within 60 days of authorization to proceed. The proposed training agenda shall include the following:
 - .1 Overview of system operation.
 - .2 Overview of system equipment and device locations.
 - .3 Manual controls (manual HEF discharge stations and valve operation).
 - .4 Manual operation, testing and maintenance of deluge valves and the automated HEF concentrate valve.
 - .5 Draining and filling procedures for the HEF tank.
 - .6 Review of the Operation and Maintenance Manual.
 - .7 Detailed maintenance procedures.
 - .8 Periodic testing procedures.

- END OF SECTION -

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Divisions 01, 21, 22, 23, 25, 26 & 33.

1.2 REFERENCE STANDARDS

- .1 National Fire Prevention Association (NFPA)
 - .1 NFPA (Fire) 13, Standard for the Installation of Sprinkler Systems, 2019 Edition.
 - .2 NFPA (Fire) 20, Standard for the Installation of Stationary Pumps for Fire Protection, 2019 Edition.
 - .3 NFPA (Fire) 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances, 2019 Edition.
 - .4 NFPA (Fire) 25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems, 2020 Edition.
 - .5 NFPA (Fire) 409, Standard on Aircraft Hangars, 2016 Edition.
- .2 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN/ULC-S543-2009-R2016, Standard for Internal Lug Quick Connect Couplings for Fire Hose.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada.
 - .2 Indicate:
 - .1 Materials.
 - .2 Finishes.
 - .3 Method of anchorage
 - .4 Number of anchors.
 - .5 Supports.
 - .6 Reinforcement.
 - .7 Assembly details.
 - .8 Accessories.
- .4 Samples:
 - .1 Submit samples of following:
 - .1 Each type of sprinkler head.
 - .2 Signs.
- .5 Test reports:
 - .1 Submit certified test reports for wet pipe fire protection sprinkler systems from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

- .6 Certificates:
 - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .7 Manufacturers' Instructions:
 - .1 Provide manufacturer's installation instructions.
- .8 Field Quality Control Submittals:
 - .1 Manufacturer's Field Reports: manufacturer's field reports specified.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide operation, maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals in accordance with NFPA (Fire) 20.
- .2 Manufacturer's catalogue Data, including specific model, type, and size for:
 - .1 Pipe and fittings.
 - .2 Alarm valves.
 - .3 Valves, including gate, check, and globe.
 - .4 Water motor alarms.
 - .5 Sprinkler heads.
 - .6 Pipe hangers and supports.
 - .7 Flow switch.
 - .8 Fire department connections.
 - .9 Excess pressure pump.
 - .10 Mechanical couplings.
- .3 Drawings:
 - .1 Sprinkler heads and piping system layout.
 - .1 Prepare 760 mm by 1050 mm detail working drawings of system layout in accordance with NFPA (Fire)13, "Working Drawings (Plans)".
 - .2 Show data essential for proper installation of each system.
 - .3 Show details, plan view, elevations, and sections of systems supply and piping.
 - .4 Show piping schematic of systems supply, devices, valves, pipe, and fittings. Show point to point electrical wiring diagrams.
 - .2 Electrical wiring diagrams.
- .4 Design Data:
 - .1 Calculations of sprinkler system design.
 - .2 Indicate type and design of each system and certify that each system has performed satisfactorily in the manner intended for not less than 18 months.
- .5 Field Test Reports:
 - .1 Preliminary tests on piping system.
- .6 Records:
 - .1 As-built drawings of each system.
 - .1 After completion, but before final acceptance, submit complete set of as-built drawings of each system for record purposes.
 - .2 Submit 760 mm by 1050 mm drawings on reproducible Mylar film with title block similar to full size contract drawings.

- .7 Operation and Maintenance Manuals:
 - .1 Provide detailed hydraulic calculations including summary sheet, and Contractors Material and Test Certificate for aboveground piping and other documentation for incorporation into manual in accordance with NFPA (Fire) 13.

1.5 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: company or person specializing in wet sprinkler systems with documented experience.
- .2 Supply grooved joint couplings, fittings, valves, grooving tools and specialties from a single manufacturer. Use date stamped castings for coupling housings, fittings, valve bodies, for quality assurance and traceability.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Provide spare sprinklers and tools in accordance with NFPA (Fire) 13.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Storage and Protection:
 - .1 Store materials indoors in dry location.
 - .2 Store and protect materials from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.
- .4 Packaging Waste Management: remove for reuse by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 DESIGN REQUIREMENTS

- .1 Design automatic wet pipe fire suppression sprinkler systems in accordance with required and advisory provisions of NFPA (Fire) 13, by hydraulic calculations for uniform distribution of water over design area.
- .2 Include with each system materials, accessories, and equipment inside and outside building to provide each system complete and ready for use.
- .3 Design and provide each system to give full consideration to blind spaces, piping, electrical equipment, ducts, and other construction and equipment in accordance with detailed shop drawings.
- .4 Locate sprinkler heads in consistent pattern with ceiling grid, lights, and air supply diffusers.

- .5 Devices and equipment for fire protection service: ULC approved for use in wet pipe sprinkler systems.
- .6 Design systems for earthquake protection for buildings in seismic zones 3 and 4, and only essential and high risk buildings in seismic zone 2.
- .7 Location of Sprinkler Heads:
 - .1 Locate heads in relation to ceiling and spacing of sprinkler heads not to exceed that permitted by NFPA (Fire) 13 for hazard occupancy.
 - .2 Uniformly space sprinklers on branch.
- .8 Water Distribution:
 - .1 Make distribution uniform throughout the area in which sprinkler heads will open.
 - .2 Discharge from individual heads in hydraulically most remote area to be 100% of specified density.
- .9 Density of Application of Water:
 - .1 Size pipe to provide specified density when system is discharging specified total maximum required flow.
- .10 Sprinkler Discharge Area:
 - .1 Area: hydraulically most remote area as defined in NFPA (Fire) 13 and NFPA (Fire) 409.
- .11 Outside Hose Allowances:
 - .1 Include allowance in hydraulic calculations for outside hose streams.
- .12 Friction Losses:
 - .1 Calculate losses in piping in accordance with Hazen-Williams formula with 'C' value of 120 for steel piping, 150 for copper tubing, and 140 for cement-lined ductile-iron piping.

2.2 SUSTAINABLE REQUIREMENTS

- .1 Grooved couplings and fittings made from minimum 90% recycled metal.

2.3 ABOVE GROUND PIPING SYSTEMS

- .1 Provide fittings for changes in direction of piping and for connections.
 - .1 Make changes in piping sizes through tapered reducing pipe fittings, bushings will not be permitted.
- .2 Perform welding in shop; field welding will not be permitted.

2.4 PIPE, FITTINGS AND VALVES

- .1 Pipe:
 - .1 Ferrous: to NFPA (Fire) 13.
 - .2 Copper tube: to NFPA (Fire) 13.
- .2 Fittings and joints to NFPA (Fire) 13:
 - .1 Ferrous: screwed, welded, flanged or roll grooved, Schedule 40.
 - .1 Grooved joints designed with two ductile iron housing segments, pressure responsive gasket, and zinc-electroplated steel bolts and nuts. Cast with offsetting angle-pattern bolt pads for rigidity and visual pad-to-pad offset contact.
 - .2 Copper tube: screwed, soldered, brazed, grooved.

- .3 Provide welded, threaded, grooved-end type fittings into which sprinkler heads, sprinkler head riser nipples, or drop nipples are threaded.
- .4 Plain-end fittings with mechanical couplings and fittings which use steel gripping devices to bite into pipe when pressure is applied will not be permitted.
- .5 Rubber gasketed grooved-end pipe and fittings with mechanical couplings are permitted in pipe sizes 32 mm and larger.
- .6 Fittings: ULC approved for use in wet pipe sprinkler systems.
- .7 Ensure fittings, mechanical couplings, and rubber gaskets are supplied by same manufacturer.
- .8 Side outlet tees using rubber gasketed fittings are not permitted.
- .9 Sprinkler pipe and fittings: metal.
- .3 Valves:
 - .1 ULC listed for fire protection service.
 - .2 Gate valves: open by counterclockwise rotation.
 - .3 Provide rising stem valve beneath each alarm valve in each riser when more than one alarm valve is supplied from same water supply pipe.
 - .4 Check valves: flanged clear opening swing or spring actuated check type with flanged inspection and access cover plate for sizes 10 cm and larger.
 - .5 Provide gate valve in piping protecting machine rooms, and machinery spaces.
- .4 Pipe hangers:
 - .1 ULC listed for fire protection services in accordance with NFPA.

2.5 SPRINKLER HEADS

- .1 General: to NFPA (Fire) 13, ULC listed for fire services and NFPA (Fire) 409.
- .2 Sprinkler Head Type:
 - .1 Type A: upright bronze.
 - .2 Type B: pendant chrome link and lever type.
 - .3 Type C: pendant chrome glass bulb type.
- .3 Provide nominal 1.2 cm orifice sprinkler heads.
 - .1 Release element of each head to be of 162°F to 190°F temperature rating or higher as suitable for specific application.
 - .2 Provide corrosion-resistant sprinkler heads and sprinkler head guards in accordance with NFPA (Fire) 13.
 - .3 Deflector: not more than 75 mm below suspended ceilings.
 - .4 Ceiling cups: not permitted.

2.6 SUPERVISORY SWITCHES

- .1 General: to NFPA (Fire) 13, NFPA (Fire) 409 and ULC listed for fire service.
- .2 Valves:
 - .1 Mechanically attached to valve body, with normally open and normally closed contacts and supervisory capability.
- .3 Pressure or flow switch type:
 - .1 With normally open and normally closed contacts and supervisory capability.
 - .2 Provide switch with circuit opener or closer for automatic transmittal of alarm over facility fire alarm system.

- .3 Connect into building fire alarm system.
- .4 Connection of switch: Section 28 31 0.01 -Addressable Multiplex Fire Alarm.
- .5 Alarm actuating device: mechanical diaphragm controlled retard device adjustable from 10 to 60 seconds and instantly recycle.

2.7 PRESSURE GAUGES

- .1 Maximum limit of not less than twice normal working pressure at point where installed.

2.8 PIPE SLEEVES

- .1 Provide pipe sleeves where piping passes through walls, floors, and roofs.
- .2 Secure sleeves in position and location during construction.
- .3 Provide sleeves of sufficient length to pass through entire thickness of walls, floors, and roofs.
- .4 Provide 2.5 cm minimum clearance between exterior of piping and interior of sleeve or core-drilled hole.
 - .1 Firmly pack space with mineral wool insulation.
 - .2 Seal space at both ends of sleeve or core-drilled hole with plastic waterproof cement which will dry to firm but pliable mass,.
 - .3 In fire walls and fire floors, seal both ends of pipe sleeves or core-drilled holes with ULC listed fill, void, or cavity material.
- .5 Sleeves in Masonry and Concrete Walls, Floors, and Roofs:
 - .1 Provide hot-dip galvanized steel.
 - .2 Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in core-drilled hole are completely grouted smooth.

2.9 ESCUTCHEON PLATES

- .1 Provide split hinge type metal plates for piping passing through walls, floors, and ceilings in exposed spaces.
- .2 Provide polished stainless steel plates in finished spaces.
- .3 Provide paint finish on metal plates in unfinished spaces.

2.10 INSPECTOR'S TEST CONNECTION

- .1 Locate inspector's test connection at hydraulically most remote part of each system, provide test connections approximately 3 m above floor for each sprinkler system or portion of each sprinkler system equipped with alarm device.
- .2 Provide test connection piping to location where discharge will be readily visible and where water may be discharged without property damage.
- .3 Provide discharge orifice of same size as corresponding sprinkler orifice.

2.11 SIGNS

- .1 Attach properly lettered Bilingual and approved metal signs to each valve and alarm device to NFPA (Fire) 13.
- .2 Permanently fix hydraulic design data nameplates to riser of each system.

2.12 SPARE PARTS CABINET

- .1 Provide metal cabinet with extra sprinkler heads and sprinkler head wrench adjacent to each alarm valve. Number and types of extra sprinkler heads as specified in NFPA (Fire) 13.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install, inspect and test to acceptance in accordance with NFPA (Fire) 13 and NFPA (Fire) 25 and NFPA (Fire) 409.
- .2 To accommodate removal and installation of new sprinkler piping: carefully remove, store, and reinstate existing bird netting in two high tail wing bays at high level, and remove and reinstate bird netting above hangar doors adjacent to hangar fitness center, refer to drawings for locations. Repair at no cost to project any sections of bird netting damaged during construction.

3.3 PIPE INSTALLATION

- .1 Install piping straight and true to bear evenly on hangers and supports. Do not hang piping from plaster ceilings.
- .2 Keep interior and ends of new piping and existing piping thoroughly cleaned of water and foreign matter.
- .3 Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter.
- .4 Inspect piping before placing into position.

3.4 ELECTRICAL CONNECTIONS

- .1 Provide electrical work associated with this section under Section 26 05 00 - Common Work Results for Electrical.
- .2 Provide fire alarm system under Section 28 31 0.01 -Addressable Multiplex Fire Alarm.

- .3 Provide control and fire alarm wiring, including connections to fire alarm systems, in accordance with National Electrical Code.
- .4 Provide wiring in rigid metal conduit or intermediate metal conduit.

3.5 CONNECTIONS TO EXISTING WATER SUPPLY SYSTEMS

- .1 Notify Contracting Officer in writing at least 15 days prior to connection date.
- .2 Use tapping or drilling machine valve and mechanical joint type sleeves for connections to be made under pressure.
- .3 Bolt sleeves around main piping.
- .4 Bolt valve to branch connection. Open valve, attach drilling machine, make tap, close valve, and remove drilling machine, without interruption of service.
- .5 Furnish materials required to make connections into existing water supply systems, and perform excavating, backfilling, and other incidental labour as required.

3.6 FIELD PAINTING

- .1 Clean, pretreat, prime, and paint new systems including valves, piping, conduit, hangers, supports, miscellaneous metalwork, and accessories.
- .2 Apply coatings to clean, dry surfaces, using clean brushes.
- .3 Clean surfaces to remove dust, dirt, rust, and loose mill scale.
- .4 Immediately after cleaning, provide metal surfaces with 1 coat of pretreatment primer applied to minimum dry film thickness of 0.3 mil, and one coat of zinc chromate primer applied to minimum dry film thickness of 1.0 mil.
- .5 Shield sprinkler heads with protective covering while painting is in progress.
- .6 Upon completion of painting, remove protective covering from sprinkler heads.
- .7 Remove sprinkler heads which have been painted and replace with new sprinkler heads.
- .8 Provide primed surfaces with following:
 - .1 Piping in Finished Areas:
 - .1 Provide primed surfaces with 2 coats of paint.
 - .2 Provide valves and operating accessories with 1 coat of red alkyd gloss enamel applied to minimum dry film thickness of 1.0 mil.
 - .3 Provide piping with self-adhering red plastic bands spaced at maximum of 6 m intervals throughout piping systems.
 - .2 Piping in Unfinished Areas:
 - .1 Provide primed surfaces with one coat of red alkyd gloss enamel applied to minimum dry film thickness of 1.0 mil in pipe chases, mechanical equipment room, and spaces where walls or ceiling are not painted or not constructed of a prefinished material.
 - .2 Provide piping with self-adhering red plastic bands spaced at maximum of 6 m intervals.

3.7 FIELD QUALITY CONTROL

- .1 Site Test, Inspection:
 - .1 Perform test to determine compliance with specified requirements in presence of Departmental Representative.
 - .2 Test, inspect, and approve piping before covering or concealing.
 - .3 Preliminary Tests:
 - .1 Hydrostatically test each system at 200 psig for a 2 hour period with no leakage or reduction in pressure.
 - .2 Flush piping with potable water in accordance with NFPA (Fire) 13.
 - .3 Piping above suspended ceilings: tested, inspected, and approved before installation of ceilings.
 - .4 Test alarms and other devices.
 - .5 Test water flow alarms by flowing water through inspector's test connection. When tests have been completed and corrections made, submit signed and dated certificate in accordance with NFPA (Fire) 13.
 - .4 Formal Tests and Inspections:
 - .1 Do not submit request for formal test and inspection until preliminary test and corrections are completed and approved.
 - .2 Submit written request for formal inspection at least 15 days prior to inspection date.
 - .3 Repeat required tests as directed.
 - .4 Correct defects and make additional tests until systems comply with contract requirements.
 - .5 Furnish appliances, equipment, instruments, connecting devices, and personnel for tests.
 - .6 Authority of Jurisdiction, will witness formal tests and approve systems before they are accepted.
- .2 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.
- .3 Site Tests:
 - .1 Field test each fire pump, driver and controllers in accordance with NFPA (Fire) 20. Testing shall include:
 - .1 Verification of proper installation, system initiation, adjustment and fine tuning.
 - .2 Verification of the sequence of operations and alarm systems.
 - .2 Testing to be witnessed by authority having jurisdiction.
 - .3 Develop, with Departmental Representative assistance, detailed instructions for O & M of this installation.

3.8 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19
- Waste Management and Disposal.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 All deviations related to the project.

1.2 REFERENCE STANDARDS

- .1 National Fire Protection Association (NFPA)
 - .1 NFPA (Fire) 13, Installation of Sprinkler Systems Handbook, 2019 Edition.
 - .2 NFPA (Fire) 20, Standard for the Installation of Stationary Fire Protection, 2019 Edition.
 - .3 NFPA (Fire) 409, Standard on Aircraft Hangars, 2016 Edition.
- .2 National Research Council of Canada (NRCC)
 - .1 National Fire Code of Canada 2015.
- .3 Underwriters' Laboratories of Canada (ULC)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet for fire pump control and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings for fire pump controller.
 - .2 Indicate:
 - .1 Method of anchorage
 - .2 Number of anchors.
 - .3 Supports.
 - .4 Reinforcement.
 - .5 Assembly details.
 - .6 Accessories.
 - .7 Indicate hydraulic and electrical characteristics including Net Positive Suction Head (NPSH) required, make and model number.
 - .3 Provide power and control diagrams.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals in accordance with NFPA (Fire) 20.

1.5 EXTRA MATERIALS

- .1 Extra Materials:
 - .1 Furnish spare parts for each pump in accordance with Section 01 78 00 - Closeout Submittals and as follows:
 - .1 One set of packing.
 - .2 One casing joint gasket.

1.6 QUALITY ASSURANCE

- .1 Test reports:
 - .1 Submit certified test reports for packaged fire pumps from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
 - .2 Test each pump/driver package at factory to provide detailed performance data and to demonstrate compliance with NFPA and specification. Submit certified test curves for approval of Departmental Representative.
 - .3 Test hydrostatically to meet requirements of fire protection system to which it will be connected.
- .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .3 Instructions: submit manufacturer's installation instructions.
- .4 Manufacturer's Field Reports: manufacturer's field reports specified.
- .5 Qualifications:
 - .1 Installer: company or person specializing in packaged fire pump installations with documented experience approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- .1 Design Requirements:
 - .1 Select fire pump to satisfy fire protection system requirements and NFPA (Fire) 20.
 - .2 Water supply:
 - .1 Base design on NFPA (Fire) 20 to meet equipment determined through hydraulic calculations defined in Section 21 13 00 - Aircraft Hangar High-Expansion Foam Fire-Suppression Systems with Wet Sprinklers.

2.2 DIESEL FIRE PUMP

- .1 Packaged, ULC, CSA listed and labelled vertical shaft turbine fire pump and controller.

- .2 The pump shall be direct connected through flexible coupling to a diesel engine, UL and FM listed and approved with a net continuous rating as indicated in schedules. of elevation above sea level. The diesel engine shall conform to the requirements of the National Fire Protection Association, Pamphlet #20 and shall be specifically approved for fire pump service. It shall operate at a rated speed not exceeding the capacities indicated in schedule and shall develop sufficient horsepower to drive the pump with 10% reserve power.
- .3 The diesel engine shall conform to the requirements of the National Fire Protection Association, Pamphlet 20 (NFPA (Fire) 20) and shall be specifically approved for fire pump service. It shall operate at a rated speed not exceeding the above rpm and shall develop sufficient horsepower to drive the pump. It is the responsibility of the pump manufacturer to properly size the driver taking into account horsepower correction factors for altitude and temperature per the latest edition of NFPA (Fire) 20.
- .4 The following engine accessories shall be included:
 - .1 Stub shaft
 - .2 Air cleaner
 - .3 Exhaust manifold
 - .4 Heat exchanger
 - .5 Mechanical speed governor
 - .6 Fuel filter
 - .7 Lube oil filter and bypass valve
 - .8 Lube oil cooler and relief valve
 - .9 Fuel pump
 - .10 Instrument panel all mounted and complete with tachometer-hour meter, oil pressure gauge, water temperature gauge and ammeter
 - .11 Starting system of suitable voltage including generator/alternator, starting motor and voltage regulator
 - .12 Exhaust silencer, residential type
 - .13 Flexible exhaust tubing
- .5 The diesel engine shall be arranged for automatic operation and include over-speed/over-crank switch and drive, two contractor switches, low oil and high water warning switches and fuel shut-off solenoid, with all wiring terminating in a junction box suitable for field hookup to the automatic engine control panel.
- .6 The diesel engine shall be fully assembled and factory tested by the engine manufacturer prior to shipment.
- .7 Cooling Water System: The cooling water supply for the heat exchanger shall be from the discharge of the pump, taken off prior to the pump discharge valve. The pipe connection shall include four (4) manual shut-off valves (including by-pass line), two strainers, two pressure regulators, a listed automatic solenoid valve and a pressure gauge, piping and fittings all fitted to engine, per NFPA (Fire) 20, by the pump manufacturer.
- .8 Storage Batteries: Two heavy duty lead acid batteries shall be provided and furnished in a dry charge condition with electrolyte liquid in separate containers. Suitable battery rack and 60" of battery cables shall be included.
- .9 Right Angle Gear Drive: The pump and engine shall be connected with a suitable flexible drive shaft and right angle gear drive. The gear drive shall be Factory Mutual (FM) approved vertical hollow shaft type with non-reverse ratchet. The nameplate horsepower rating of the gear drive must exceed the maximum horsepower required by the pump at any point on the pump curve. The gear ratio must be properly selected to match the engine input speed to the pump output speed. The mechanical losses in the gear drive must be taken into account when sizing the diesel engine.

- .10 Fuel System: The fuel system shall be ULC listed and labelled in accordance with use and installation requirements of National Fire Code of Canada, NFC 2015 and shall consist of an above ground storage tank recommended per NFPA (Fire) 20, fill pipe and cap, manual shut-off cock, flame arrestor, oil level gauge and braided flexible connectors. The tank shall be supplied with legs for floor mounting. Approved steel tubing and miscellaneous pipe and fittings shall be supplied by the contractor. Bulk fuel storage tank shall conform to National Fire Code of Canada, NFC, Part 4.
- .11 Pump shall be supplied with the following accessories:
 - .1 One (1) discharge gauge, 3½" (89 mm) dial type
 - .2 One (1) 1½" (38 mm) air release valve
 - .3 One (1) main pressure relief valve and tee
 - .4 One (1) relief cone
- .12 Capacity: as per schedule and to meet hydraulic calculations.
- .13 Anchor bolts and templates:
 - .1 Supply for installation by others.
 - .2 Size anchor bolts to withstand seismic zone 4 acceleration and velocity forces.
- .14 The pressure sensing line shall be located between the fire pump discharge check valve and discharge isolation valve, in compliance with NFPA (Fire) 20, 4.32.
- .15 Hose valve connection is to be located between fire pump discharge and discharge isolation valve meeting NPFA (Fire) 20.
- .16 Provide new monitoring connection between existing wet well water level alarm and new fire pump controller.

2.3 AUTOMATIC DIESEL ENGINE CONTROLLER

- .1 The Fire Pump Controller shall be manufactured in accordance with the latest requirements of the NFPA. Controller shall be listed and labelled by Underwriters Laboratories of Canada (ULC) and/or Underwriters Laboratories (UL) and approved by Factory Mutual (FM).
- .2 All equipment shall be enclosed in approved drip tight enclosure.
- .3 Controller shall function to automatically start the fire pump from the water pressure control switch in the controller. In order to insure that the engine will start in an emergency, the TEST switch (or TEST position of the controller switch) shall start the engine reducing the water pressure to the water pressure control switch in the controller. Pressure sensing line shall be located between fire pump discharge check valve and discharge isolation valve, as per NFPA (Fire) 20.
- .4 Normal stopping of the engine shall be manually initiated by operating a stop push-button on the outside of the controller enclosure.
- .5 Under automatic conditions, the controller shall cause the starting current to be furnished by first one battery and then the other, i.e. it alternates automatically on each cranking cycle. Each cycle to consist of a 15 second cranking attempt followed by a 15 second test period and if the engine has not started after six attempts, the trouble alarms must operate. Crank, rest, and cranking time periods must be fixed and tamper proof. Field adjustments shall not be allowed.

- .6 The controller shall include a dual built-in battery charger that has been specifically approved for fire pump service. This charger, when operating at its rated voltage, shall be capable of fully recharging both batteries (after being completely discharged) within a 24 hour period. The chargers shall have automatic overload protection (current limiting) so that it will not be damaged by the low battery voltage while the engine is cranking. The control and rectifier circuits in the charger shall be completely redundant so that failure of any control component shall only effect the charging of the battery with which it is associated. Charging of the other battery shall not be effected under these circumstances. Individual voltmeters and ammeters shall be provided for each battery.
- .7 The controller shall also be furnished with a pressure recorder per the requirements of NFPA (Fire) 20.
- .8 The controller shall be fully assembled and factory tested by the controller manufacturer prior to shipment
- .9 Fire pumps shall be started automatically by a pressure drop and/or from a signal from the FSCP.

2.4 PRESSURE MAINTENANCE (JOCKEY) PUMP

- .1 General: turbine electrically driven pump and controller.
- .2 Capacity: existing to remain.
- .3 Accessories: to NFPA (Fire) 20.

2.5 FIRE PROTECTION PRESSURE RELIEF VALVE (FP-PRV1)

- .1 Material:
 - .1 Main valve body & cover: Ductile Iron ASTM A536 Grade 65-45-12.
 - .2 Main valve trim: Teflon coated stainless seat, stainless steel Stem.
 - .3 Pilot control system: Cast bronze with stainless steel trim.
- .2 Coating:
 - .1 Protective epoxy resin coating of wetted surfaces of main valve iron components. UL listed HNFEX2855.
- .3 Pressure Rating:
 - .1 Class 150 - 250 psi max; water, to 180°F max.
 - .2 Adjustment range: 20-200 psi (150 Class).
- .4 Size:
 - .1 Flanged, FM approved, ULC listed, diameter as determined by Departmental Representative.
- .5 Performance:
 - .1 The fire pump pressure relief valve shall modulate to relieve excess pressure in the fire protection system, maintaining constant pressure in the system regardless of demand changes. It shall be pilot controlled and back pressure shall not affect its setpoint. It shall be actuated by line pressure through a pilot control system and open fast in order to maintain steady system pressure as system demand decreases. It shall close gradually to control surges and shall re-seat drip-tight within 5% of its pressure setting.

- .2 The main valve shall be of the hydraulically-operated, pilot-controlled, diaphragm-type, globe or angle valve. It shall be equipped with a Teflon coated anti-cavitation seat, a grooved stem guided at both ends, and a resilient disc with a rectangular cross section, being contained on 3-1/2 sides. No external packing glands shall be permitted and the diaphragm shall not be used as a seating surface. The pilot control shall be a direct acting, adjustable, spring-loaded, diaphragm-type valve designed for modulating service to permit flow when controlling pressure exceeds spring setting. This valve shall be UL Listed and Factory Mutual approved.
- .3 Assembly shall be complete with anti-cavitation trim seat.
- .4 Installation shall be to NFPA (Fire) 13, NFPA (Fire) 20 and NFPA (Fire) 409 requirements.

2.6 WASTE CONE (WC1)

- .1 Manufactured in accordance with NFPA (Fire) 20 requirements.
- .2 Designed for use with ULC/FM approved fire pump pressure relief valve.
- .3 Standards:
 - .1 Fusion bonded red epoxy coated.
 - .2 Flanged body, Ductile Iron - ASTM A536-65.
 - .3 2 x 50 mm 316 SS sight glasses per assembly.
 - .4 Single body casting (no welding).
- .4 Pressure Rating:
 - .1 To match performance of FP-PRV1.
- .5 Size:
 - .1 Flanged, FM approved, ULC listed, diameter as determined by Departmental Representative.

PART 3 - EXECUTION

3.1 APPLICATION

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

3.2 INSTALLATION

- .1 Install in accordance with ULC listing, NFPA (Fire) 20, manufacturer's instructions and reviewed shop drawings.
- .2 Align pump and motor shafts to within manufacturer's recommended clearances prior to start-up.
- .3 Install wiring in accordance with manufacturer's instructions and applicable codes.

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.
- .2 Site Tests:
 - .1 Field test each fire pump, driver and controllers in accordance with NFPA (Fire) 20. Testing to include:
 - .1 Verification of proper installation, system initiation, adjustment and fine tuning.
 - .2 Verification of the sequence of operations and alarm systems.
 - .2 Testing to be witnessed by authority having jurisdiction.
 - .3 Develop, with Departmental Representative assistance, detailed instructions for O & M installation.
 - .4 The pump shall be suitable for a maximum working pressure of 1000 kPa. Pump shall be hydrostatically tested at twice the maximum working pressure for at least 5 minutes.
 - .5 The pump shall be performance tested at rated speed. The pump shall furnish not less than 150% of rated capacity at a pressure not less than 65% of rated head. The shut-off total head of the pump should not exceed 140% of total rated head. A certified test curve, indicating the flow, head, power and efficiency shall be supplied.

END OF SECTION