

SECTION 10

Fire Fighting Services

DIVISION 15

MECHANICAL WORKS

SECTION 10.00

FIRE FIGHTING SERVICES

INDEX

<u>CLAUSE NO</u>	<u>TITLE</u>
10.01	Scope of Work
10.02	Pipework
10.03	Valves
10.04	Fire Hose Cabinet
10.05	Portable Fire Extinguishers
10.06	Landing Valves
10.07	Siamese Connection assembly
10.08	Pedestal Fire Hydrant
10.09	Automatic Sprinkler System
10.10	Field Acceptance Tests and Maintenance
10.11	Fire Fighting Pumping Unit

DIVISION 15**MECHANICAL WORKS****SECTION 10.00****FIRE FIGHTING SERVICES****10.01 SCOPE OF WORK**

The fire fighting services shall be executed as shown on the drawings. All fire fighting components shall be approved by the Local Civil Defense Department.

10.02 PIPEWORK**10.02.1 General Requirements**

- All pipes shall be of sizes and general routing as shown on the contract drawings.
- Valves shall be of the same size as the pipe run in which it is installed.
- Piping material shall be as specified hereafter.
- Pipes shall be installed in a neat manner to present a neat and pleasing appearance.
- Pipes shall be installed in a manner to permit free expansion and contraction without causing damages to piping or construction. Adequate off-sets and change of direction in the piping shall be provided to accomplish this. On long pipe runs expansions loops or expansion joints shall be provided. where expansion joints are used careful consideration shall be given to anchoring and guiding the pipes for controlled expansion and contraction.
- Adequate clearance shall be left between pipes and adjacent surfaces or existing installations for the easy installation of valves and accessories.
- Drain valves shall be provided at all low points and as required to permit draining any part of the system for maintenance and repair irrespective whether they are shown on the Contract drawings or not. Drain valves shall also be provided for alarm valves as shown on the Contract drawings for the purpose of testing the system.
- When water filled supply pipes pass through open areas or other areas exposed to freezing, the pipe shall be protected against freezing by insulating coverings, frostproof casings, or other reliable means capable of maintaining a minimum temperature of 4 C.
- The Contractor shall inspect the site conditions for verifying the required clearance and space necessary for the installation of all pipe work.

10.02 PIPEWORK (CONT'D)**10.02.2 Pipes and Fittings**

- All fire fighting and drain piping shall be standard weight seamless steel pipe to ASA schedule 40 or equal approved.
- Black steel piping shall be used for fire fighting system, and galvanized steel piping shall be used for drain pipework.
- Black steel pipes size 50mm and smaller shall be joined by threading, and pipes size 65 mm and larger shall be joined by welding.
- Galvanized steel pipes shall be joined by threading for all sizes. welding of galvanized pipes will not be permitted.
- Fittings on black steel pipes shall be black, and on galvanized steel pipes shall be galvanized. The use of black fittings on galvanized pipes will not be permitted.
- All fittings for black steel pipes size 50 mm and smaller shall be screwed malleable iron fittings, to ANSI B16.3
- All fittings for black steel pipes 65mm and larger shall be steel of the seamless but welded type with 37 degree beveled ends to ANSI B16.5 and ANSI B16.11.
- All fittings for galvanized steel pipes shall be screwed malleable iron fittings for all pipe size to ANSI B16.3.
- All threaded and welded fittings shall be of 16 bar working pressure rating.
- All threaded fittings and pipe shall have threads cut to ANSI/ASTME Standard B1.20.1.
- All fittings shall have the same thickness and be the same schedule and rating as the pipe of the corresponding size.
- All changes in direction, change in pipe size, branching and jointing of pipes shall be made with regular pipe fittings such as elbows, reducers, tees, coupling, unions, flanges, etc. Bending of pipes for elbows and field fabricated fittings will not be permitted.
- Elbows shall be of the long radius type.
- Branch connection on black steel pipes may be made with forged steel weldolets or thredolets where the branch pipe is not larger than one half the size of main pipe.
- Pipes shall be cut square and to the exact length with a hacksaw or pipe cutting device and the cut end of the pipe shall be reamed with a special tool to the full inside diameter and all chips shall be removed.
- Threads shall be cut with new dies and all burrs and chips formed in the threading operation shall be removed with wire mesh.

10.02 PIPEWORK (CONT'D)

- Threaded joints shall be made up tight with approved teflon tape thread sealant. Lampwick, cord, wool, or any other similar material will not be permitted in making up threaded joints.
- Welded joints on black steel pipes shall be made with electric arc welding.
- Care shall be taken that the pipe does not enter into the fittings sufficiently to reduce the water flow.

10.02.3 Welding

All welding shall be executed by first class certified welders working under skilled supervision. The name of the welder with his full qualification shall be submitted to the Engineer.

- The Engineer shall have the right to request any welder to execute a standard weld in the presence of the Engineer or his representative on site and for this weld to be submitted to any reasonable tests which the Engineer may require, in the event of the test failing to satisfy the Engineer's requirements, the welder who executed the faulty work may be required to leave the site and the contractor shall at once replace him with a competent welder.
- Black steel pipes to be welded shall be cleaned thoroughly from rust, scale and oxide and shall be beveled for a V-butt weld. Welds shall have a minimum of two and half times the pipe wall thickness and shall be symmetrical with respect to the centre line of the joint. All welds shall be of sound metal and shall be free from laps, gas pockets, slab inclusions, interior protrusions or other imperfections.
- Welds shall be hammer cleaned and piping shall be flushed out after welding to remove scale, welding slag and other debris.
- Welding procedure shall comply with the requirements of American Welding Society Standard AWS D10.9.
- All required and necessary precautions against fire and other damage shall be taken when welding or cutting any part of the site.
- Welding sections of pipework in place inside the building shall not be permitted. Sections of branch lines and pipe mains may be shop welded.
- Sections of shop welded piping shall be joined by means of flanged joints.
- Where branch lines are welded to the pipe mains, the holes in piping for outlets shall be cut to the full inside diameter of fittings prior to welding in place of the fittings. Openings cut into piping shall be smooth bore and all internal slag and welding residue shall be removed.
- Fittings used for welding shall not penetrate the internal diameter of the piping. Steel plates shall not be welded to the ends of piping or fittings. Blind flanges shall be used on the ends of piping or fittings.

10.02 PIPEWORK (CONT'D)

- Nuts, clips, eye rods, angle brackets, or other fasteners shall not be welded to pipe or fittings.

10.02.4 Unions and Flanges

- Pipe unions or flanges, depending on size and material of piping, shall be provided at piping connections to equipment and valves, control valves, and other accessories that need to be taken out for replacement, cleaning or repair.
- Unions or flanges shall also be provided at adequate intervals, in the piping to permit easy disassembly for alteration and repair.
- Disconnecting unions or flanges shall be installed between the equipment and the isolating valves.
- Unions used on threaded pipe size 50mm and smaller shall have female threaded ends and ground metal to metal seats.
- Flanges shall always match the flanges provided on valves and equipment as far as pressure rating, facing, drilling and thickness.
- Flanges on black steel piping shall be black, forged steel of the slip-on or welding neck type. Flanges on galvanized steel piping shall be galvanized steel of the threaded types.
- Flanges joints shall be made perfectly square with the pipes and shall be fitted with proper thick rubber ring gaskets and assembled with steel, square head machine bolts and hexagonal nuts. Gaskets for flat face flanges shall be of the full face ring type with pouched bolt holes.

10.02.5 Return Bends

Return bends shall be installed for pendent type sprinklers except for dry pendent sprinklers. Return bends shall be connected to the top of branch lines in order to avoid accumulation of sediment in the drop nipples connected to the pendent sprinklers. Return bends shall be installed as detailed on the drawings.

10.02.6 Pipe Hangers and Supports

- All piping shall be supported on steel hangers and supports of adequate strength and design to carry the weight of piping and contents without sagging, swaying, vibrating, failing or deforming. Hangers and supports shall allow free movement of pipes due to expansion and contraction without causing noise or damage to piping or construction. Hanging pipes from other pipes will not be permitted.
- Hangers and supports shall be of a design that permits removal without dismantling the pipes and shall be supplied complete with all required rods, bolts, nuts, turnbuckles, swivels, coupling brackets and all other components and accessories.

10.02 PIPEWORK (CONT'D)

- Hangers and supports shall be securely fastened to the building construction by means of expansion bolts without causing overstress to any part of the construction.
- Hangers and supports shall be designed and tested to sustain a load 8 times the actual support load.
- Vertical pipes shall be supported by steel pipe clamp comprising two flat bar yokes formed to fit the pipe and drilled and fastened to the pipe with bolts and nuts. The extended ends of the clamp shall be hung from the underside of the floor slab by two rods fastened to the concrete.
- Vertical pipes shall be supported at their base and at their base and at a minimum of every story height.
- Horizontal pipes shall be hung from the ceiling by individual steel hangers of the adjustable clevis type with rod, nuts and turnbuckle.
- All rods shall be threaded for a sufficient length to allow for vertical adjustment of pipes. Each rod shall be provided with two nuts: one for positioning and one for locking.
- The minimum size of hanger rod for individually supported horizontal pipes shall be : 10mm for pipe size up to 50 mm, 13 mm for pipe size 65mm to 80 mm, 16 mm for pipe size 100mm to 125mm, 20mm for pipe size 150mm and 22 mm for pipe size 200 mm and larger.
- The maximum support spacing for horizontal drainage pipework shall be : 1.5m, 1.8m, 2.0m, 2.5 m, 2.7 m, 3.0 m, 3.3 m, 3.6 m, 4.2 m, 4.8m, 5.2m, for pipe sizes 15mm, 20mm, 25mm, 32mm, 40mm, 50mm, 65mm, 80mm, 100mm, 125mm, 150mm, respectively.
- The maximum support spacing for horizontal sprinkler pipework shall be 4.5m for pipe size 40mm and larger and 3.6m for pipe size less than 40mm.
- At least one hanger shall be provided for each section of branch line and between each two branch lines of sprinkler piping.
- The distance between a hanger and the centerline of an upright sprinkler shall not be less than 0.60m.
- The unsupported length between the end sprinkler and the last hanger on the line shall not be greater than 0.60m when this limit is exceeded additional hanger shall be provided.
- The length of an unsupported armover to a sprinkler shall not exceed 0.60m. The hanger closest to sprinkler shall be of type that prevents upward movement of the piping.
- Wall mounted sidewall sprinklers shall be restrained to prevent movement.

10.02 PIPEWORK (CONT'D)

- Types of hangers to be used for pipe support shall be in accordance with NFPA 13.
- The contractor shall submit show drawings of pipe hangers and supports to be used showing the fixation details and location of hangers, for the Engineer approval.

10.03 VALVES**10.03.1 General**

- All valves used shall be of 250 psi or 16 bar cold water pressure rating.
- All valves connected to water supply and sprinkler piping shall be of indicating type.
- Gate valves used for drain and shutoff purposes shall be solid wedge disk, non rising stem and bronze trim, and shall be screwed, bronze body with screwed bonnet for valves size 50 mm and smaller, and flanged, cast iron body with bolted bonnet for valves size 65 mm and larger.
- Globe valves where required, shall be screwed, bronze body and trim, integral seat, revolving disk, and screwed bonnet for valves size 50mm and smaller, and flanged, cast iron body, bronze trim, renewable seat and disk and bolted bonnet for valves size 65mm and larger.
- Check valves shall be bronze trim, swing pattern, renewable disk, and shall be screwed, bronze body and screwed cap for valves size 50mm and smaller, and flanged, cast iron body and bolted cap for valves size 65mm and larger.
- All check valves shall be suitable for horizontal or vertical installations.

10.03.2 Indicating Valves

- All indicating valves shall be outside screw and yoke "O.S. & Y" gate valves with rising stem that indicates if the valve is open or closed.
- Indicating valves shall not close in less than 5 seconds when operated at maximum possible speed from the fully open position to avoid damage to piping by water hammer.
- Indicating valves shall be flanged, bronze trim, solid wedge disk.
- Indicating valves shall be bronze body with screwed bonnet for valves size 50mm and smaller, and cast iron body with bolted bonnets for valve size 65mm and larger.

10.04 FIRE HOSE CABINET (FHC)**A. Fire Hose Cabinet (FHC)**

The fire hose cabinet shall be automatic swinging recessed type.

Hose reels shall be in accordance with BS 5274. The hose reel shall have a 30 meters long of 25 mm. internal diameter reinforced non-kinkable rubber hose capable of withstanding a working pressure of 16 bar. The hose shall be wound on a fabricated steel drum with circular side plates.

The hose reel shall turn on automatically when 1.5 - 1.8 meters of hose is withdraw from the reel.

The hose reel shall be equipped with shut-off valve and pressure reducing valve for connecting with pipework.

The hose nozzle shall be of chrome plated brass, JET/SPRAY/SHUT/OFF nozzle, and shall have 6mm orifice

The cabinet shall be heavy steel construction finished with red colour paint labelled "FIRE HOSE REEL" and in Arabic.

The fire hose cabinet shall include a dry chemical fire extinguisher of the ABC type as specified hereafter.

The fire hose cabinet shall be of dimensions sufficient to include the hosereel, the shut-off valve and the fire extinguisher and to fit with the available space as shown on the Drawings.

B. Fire Hose Rack (FHR)

The fire hose rack shall consist of:

- a. Cabinet: Cabinet and door leaf shall be made of 1.5 mm steel sheet with all around folded edges, door leafs hinged flush mounted or door frame.

Cabinet shall be equipped with vertical wired glass window on front door. The cabinet shall be painted red with electrostatic powder paint and labelled fire hose rack.

The door shall be recessed type base with aluminum turn handle chrome plated.

- b. Fire hose, synthetic of 65 mm diameter and 40 mm long equipped with brass male coupling for the connection with the landing valve, and with aluminium alloy nozzle to Civil Defense approval.

The fire hose rack shall be located at 1000 mm above finish floor level.

10.05 PORTABLE FIRE EXTINGUISHERS**a. General**

The fire extinguishers shall be of the rechargeable type and shall be supplied complete with the operating charge from the factory.

All portable fire extinguishers shall be mounted on special wall brackets that shall be supplied with the extinguishers from the factory.

The brackets shall be specifically supplied for the extinguisher type and size concerned.

b. Type FE-1

Dry chemical fire extinguishers shall be of the ABC type with a rugged all-brass operating valve, large size operating lever, full vision pressure gauge, discharge hose and heavy duty drawn steel cylinder with hard, scratch resistant finish. The capacity shall be 6 kg.

c. Type FE-2

Carbon dioxide fire extinguishers shall be of the pull-pin, squeeze-handle type with double braided hose, non-conducting discharge horn and heavy duty drawn steel cylinder with hard, scratch resistant finish. The capacity shall be 4.5 kg.

d. Type FE-3

Pressurized water fire extinguishers shall be of the air pressurized type with stainless steel finish. The capacity shall be 9 kg.

e. Type EF-4

Halon type 1211, ceiling mounted, including sprinkler (r.t.68 C), BCF, 12kg

10.06 LANDING VALVES**Not included in this Contract**

Landing valves shall be installed on the wet risers for the use of Fire Brigade inside buildings as shown on the Drawings.

Landing valve shall be gunmetal globe valves, high pressure type to BS. 5041 with 65 mm. dia. bore fitted with 65 mm. instantaneous female coupling to conform to BS 336 and a brass blank cap secured by a suitable length of chain. The landing valve shall have 65 mm. dia flanged inlet for attachment to the dry riser.

The valve shall be equipped with spindle not less than 22.2 mm dia. and fitted with a gunmetal hand wheel of about 150 mm dia. marked with OPEN and CLOSED directions. Opening shall be anti-clockwise.

The whole valve fittings shall be sound construction and hydraulically tested to a pressure of 20.7 bar before being connected to the dry riser.

10.06 LANDING VALVES (CONT'D)

The valve shall be installed about 760 mm. above finished floor level. The valve shall be finished with red colour paint.

10.07 SIAMESE CONNECTION ASSEMBLY

Siamese connection assembly shall be installed for the use of Fire Brigade, as shown on the Drawings.

The Siamese connection assembly shall be gunmetal with two inlets. Each inlet shall consist of a 65 mm dia instantaneous male coupling and a non-return valve and protected with a cap secured by a suitable length of chain.

The coupling shall conform to B.S. 336.

The Siamese connection assembly shall have 100 mm dia flanged outlet for attachment to the dry riser or wet main.

The Siamese connection assembly shall be finished with red colour paint, and enclosed inside stainless flush mounted box with a labelled wired glass door.

The Siamese connection assembly shall be located 1000 mm. above ground level.

10.08 PEDESTAL FIRE HYDRANT

Pedestal fire hydrant shall be constructed of cast iron castings to BS. 1452 complete with 100 mm dia. flange inlet and two 65 mm dia. valves with instantaneous outlets to BS.336 and with brass male couplings protected with cap secured by a suitable length of chain.

The fire hydrant shall be sound construction and hydraulically tested to a pressure of 20.7 bar before being connected to the fire fighting network.

The fire hydrant shall be installed about 760 mm above ground level and finished with red colour paint.

The fire hydrant shall be provided with an isolating valve installed underground complete with extension tube, operating key and cover.

A fire hose unit shall be installed to serve each fire hydrant, it shall comprise 65mm dia. textile fire hose 40 m long with male and female couplings, nozzle jet and spray with male coupling, and cabinet.

10.09 AUTOMATIC SPRINKLER SYSTEM (Not Included in this Contract)**10.09.1 General Requirements**

Sprinklers shall be installed as shown on the drawings and in accordance with the requirements of NFPA 13-1991.

Shop drawings prepared by the Contractor shall show the exact location, spacing and types of sprinklers.

10.09 AUTOMATIC SPRINKLER SYSTEM (Not Included in this Contract) (CONT'D)

All sprinklers shall be manufactured, tested and approved in accordance with the applicable standards of Underwriters Laboratories and Factory Mutual.

The following limitations and requirements shall be strictly followed:-

- Orifice size of the sprinkler shall be 15mm with 15mm NPT thread type.
- The pipe size supplying one sprinkler shall be 25mm.
- Return bends shall be used for pendent type sprinklers to avoid accumulation of sediment in sprinklers except for dry pendent type sprinklers.
- Type, spacing, and position of sprinklers shall be as specified here under.
- Sprinklers located in skylight area shall be protected with approved sprinkler shield.
- Sprinklers so located as to be subject to mechanical injury shall be protected with approved sprinkler guard.
- All sidewall sprinklers and ceiling mounted pendent sprinklers shall be provided with escutcheons plates of the same colour as of the walls or ceiling on which the sprinklers are mounted.
- Sprinklers shall not be altered in any respect or have any type of ornamentation or coating applied after shipment from the place of sprinklers manufacturer.
- When painting the sprinkler piping or painting in areas near sprinklers, care shall be taken to avoid any coating applied to sprinklers.
- Any sprinklers that have been painted or coated except by the sprinklers manufacturer, or damaged shall be replaced with new approved sprinklers of the same characteristics. Cleaning of painted sprinklers, or repairing damaged sprinklers will not be permitted.
- The protection area per sprinkler shall not exceed 18 m² for light hazard occupancy.
- The protection area per sprinkler shall not exceed 12 m² for ordinary hazard occupancy.
- The protection area per sprinkler shall not exceed 9 m² for extra hazard occupancy.

10.09.2 Spacing, Location, and Position of sprinklers

All sprinklers shall be located and spaced as shown on the Contract drawings and in compliance with the following limitations.

10.09 AUTOMATIC SPRINKLER SYSTEM (Not Included in this Contract) (CONT'D)**A. Upright and Pendent Sprinklers**

- The distance between branch lines and between sprinklers on the branch lines shall not exceed 4.6 m.
- The distance from the walls to the end sprinklers on the branch lines shall not exceed one-half of the allowable distance between sprinklers on the branch lines.
- The distance from the walls to the end branch lines shall not exceed one-half of the allowable distance between the branch lines.
- Sprinklers shall be located a minimum of 100 mm from a wall.
- A minimum clearance of 450 mm shall be maintained between top of storage and sprinkler deflector.
- Deflectors of sprinklers shall be parallel to ceilings and located 25 mm to 300 mm below ceilings.
- Deflectors of sprinklers under beams shall be located 25 mm. to 100 m below beams and not more than 500 mm below roof or floor deck.
- Deflectors of sprinklers in bays shall be at sufficient distance from the beams as shown on Table 4.4.1.3.1.2 and Figure 4.4.1.3.1.2 of NFPA 13-1991 to avoid obstruction to the sprinkler discharge pattern, otherwise the spacing of sprinklers on opposite sides of the beams shall be measured from the centerline of the beam and the distance shall not exceed one-half of the allowable distance between sprinklers.
- The operating elements of all sprinklers shall be located below the ceilings.
- Where sprinklers located in area containing piping, light fixtures, ducts, etc. which are likely to interfere with the proper distribution of water from sprinklers, the sprinklers should be so located or spaced that any interference is held to a minimum.

Sprinklers shall be installed beneath duct over 1.2 m wide unless sprinklers can be spaced in accordance with Table 4.4.1.3.1.2 of NFPA 13-1991.

B. Sidewall Sprinklers

- The distance between sprinklers on the branch lines shall not exceed 4.0 m.
- Deflectors of sprinklers shall be at a distance from walls and ceilings not more than 150 mm or less than 100 mm unless special construction arrangements make a different position advisable for prompt operation and effective distribution.

10.09 AUTOMATIC SPRINKLER SYSTEM (Not Included in this Contract) (CONT'D)**10.09.3 Sprinklers Specification**

- All sprinklers shall be of k-factor 5.3-5.8 unless otherwise specified, and manufactured of brass finish pattern, frame, and deflector, except for dry pendent type which shall have chrome plated components.
- Sprinkler shall be integrated with sensitive glass bulb operated at the required temperature rating. Fusible element will not be accepted.
- Unless otherwise indicated on the drawings, all sprinklers shall have a temperature rating 68 C (155 F) with bulb color Red.
- Sprinklers having a temperature rating 93 C (200 F) shall have bulb color Green and white frame color.
- Corrosion - resistant coated sprinklers shall be installed where required.
- Sprinklers equipped with protection guards or shields shall be installed where required.

10.09.4 Sprinklers Types**A) Standard Pendent Sprinklers:**

Sprinklers designed to be installed in such a way that the water stream is directed downwards against the deflector.

Pendent sprinklers shall be installed for all ceiling mounted sprinklers.

Standard Pendent sprinklers shall be marked SSP and shall be installed in Pendent position only.

B) Standard Upright Sprinklers:

Sprinklers designed to be installed in such a way that the water spray is directed Upwards against the deflector.

Upright sprinklers shall be installed in all areas containing exposed sprinklers piping.

Standard Upright sprinklers shall be marked SSU and shall installed in Upright position only.

C) Sidewall sprinklers:

Sprinklers having special deflectors that are designed to discharge most of the water away from the nearby wall in a pattern resembling one quarter of a sphere with a small portion of the discharge directed at the wall behind the sprinkler.

10.09 AUTOMATIC SPRINKLER SYSTEM (Not Included in this Contract) (CONT'D)

All sidewall sprinklers shall be of quick-response extended coverage type with special extended directional and discharge patterns.

Sidewall sprinklers shall be installed horizontally and marked with SIDEWALL-TOP.

D) Dry Pendent Sprinklers:

Sprinklers for use in a pendent position in cold storage rooms. Patten, frame and deflector shall be manufactured of chrome-plated finish.

Return bends shall not be installed for dry pendent sprinklers.

10.09.5 Alarm Valves Assemblies

Each alarm valve assembly shall comprise:

- Control check valve with motor gong
- Indicating gate valve equipped with tamper switch
- Water flow Switch
- Test Connection
- Pressure gauge

Water flow switch shall be so constructed and installed that any flow of water from a sprinkler system equal or greater than from a single automatic sprinkler will actuate the alarm system.

Water flow switch including alarm circuits shall be tested by an actual water flow through use of the test connection.

Tamper switch provided for the indicating gate valve shall initiate an alarm when the indicating valve is moved from the normal position. A test connection not less than 50mm in diameter, terminating in a smooth bore corrosion-resistant orifice to provide a flow equivalent to one sprinkler, shall be installed and be equipped with sight glass, drain valve and shutoff valve.

Test connections may be used for draining the system sections.

All alarm valve assemblies shall be provided with identification signs.

10.10 FIELD ACCEPTANCE TESTS AND MAINTENANCE**10.10.1 General Requirements**

The Contractor shall perform all tests including but not necessarily limited to the following:

- Flushing Test
- Hydrostatic testing of pipe network
- Testing of alarm valves
- Testing of sprinklers
- Testing of hose reels, fire hydrants and Siamese connection
- Maintenance inspection test

No part of any piping system shall be painted, covered or enclosed until it has been tested, inspected and accepted.

All tests shall be conducted in the presence of the Engineer, as directed by him and to his entire satisfaction.

The Contractor shall provide all labour, equipment, material, instruments, power and connections required to execute all testing, balancing and adjusting as directed.

All expense incurred by the testing shall be borne by the Contractor including the cost of repair or replacement of defective work, cost of restoring, repairing or replacing damaged work resulting from the tests and the cost of replacing defective or inadequate equipment and material all as directed by the Engineer.

10.10.2 Hydrostatic Testing of Pipe network

All piping systems including drainage piping shall be hydrostatically tested for ensuring complete tightness at not less than 16 bar pressure for 2 hours.

Systems can be tested as a whole or in sections to facilitate the progress of the work.

No part of any piping system shall be tested to a pressure less than the specified test pressure measured at the lowest point of the system.

Care shall be taken not to subject any equipment, apparatus or device to a pressure exceeding its prescribed test pressure as obtained from its name plate data or from manufacturer's published data. Pressure tests shall be applied before connecting piping to equipment. Relief valves, instruments, automatic air vents, and all devices that might be damaged by the test pressure shall be removed, disconnected or blanked off.

No pressure shall be applied against the closed gate of gate valves. All valves shall be in the open position but not completely back seated during testing. End valves shall be capped.

10.10 FIELD ACCEPTANCE TESTS AND MAINTENANCE (CONT'D)

In testing flanged piping, temporary blank flanges shall be installed and firmly anchored to accommodate all developed end thrust.

All piping that can be damaged by end thrust developing from hydrostatic testing shall be properly anchored during testing especially at changes of direction.

The piping system to be tested shall be closed by plugging and blanking all openings in the system and filled slowly with water making sure to vent all entrapped air. Plugs shall be released temporarily to ensure that water has reached all parts of the system.

Pressure shall be applied to the system by means of a hand pump drawing from a water container.

The pump discharge shall be connected to the system through a globe valve, check valve and recently calibrated pressure gauge of suitable range to have the test pressure read in the middle of the range.

After the test pressure is reached, the pump shall be blocked off by closing the globe valve and the variations of pressure in the system monitored on the pressure gauge.

While the system is under pressure, a careful inspection shall be made of all pipes and joints and if any leaks in joints or evidence of defective pipe or fitting is disclosed the defective work shall be corrected immediately by replacing defective parts with new joints and materials. No make shift repairs or application of any repair compound will be permitted.

After the correction is made the pressure test shall be repeated until a completely tight system is ensured.

The test pressure shall be released slowly so as not to produce shocks and sudden contraction that might damage the piping.

10.10.3 Flushing Test

- All provisions shall be made to properly drain all parts of the system. Flushing test shall be performed for the fire fighting system.
- Flushing of each main pipe supplying branch lines of sprinkler system shall be made through the test connection installed at each alarm valve assembly and other test connections installed.
- Flushing of the risers shall be made through the hose reels.
- Additional drain connections shall be provided, where needed to perform the flushing test for all parts of the fire fighting system.

In any case if lines become plugged during the flushing test or flow test, piping must be dismantled and cleaned.

10.10 FIELD ACCEPTANCE TESTS AND MAINTENANCE (CONT'D)**10.10.4 Test of Alarm Valves
Not included in this Contract**

- Flow switches shall be tested by opening the test connections installed at the alarm valve assemblies and the other test connections installed.

The water flow shall be observed through use of the installed sight glass and the pressure shall be read from the installed pressure gauges.

Water flow detecting devices including the associated alarm circuits and alarm signals located in the central control panel shall be tested by an actual water flow through use of the test connection.

- Tamper switches mounted on the indicating valves including the associated alarm circuits and alarm signal located in the central control panel shall be tested by playing with the indicating valve.

**10.10.5 Test of sprinklers
Not included in this Contract**

Operating test of automatic sprinklers shall be performed in accordance with Civil Defense Department instructions and requirements.

All automatic sprinklers shall be replaced when the representative samples fail to meet test requirements.

10.10.6 Maintenance

The Contractor shall perform during maintenance period all weekly, monthly quarterly and annual inspections test and maintenance for the sprinkler system, in accordance with the requirements of NFPA 13 A-1987. Records shall be maintained on all work performed.

The Contractor shall submit to the Owner a copy of NFPA 13 A standards.

10.11 FIRE FIGHTING PUMPING UNIT**10.11.1 Description**

The work under this specification shall include the following:-

- One duty pump (electric driven)
- One emergency pump (diesel engine driven)
- One jockey pump (electric driven)
- Pump controller and all control devices
- All pipework, valves and instruments connected to the pumps.

10.11 FIRE FIGHTING PUMPING UNIT (CONT'D)

- All electrical work connected and required for the operation and control of the pumps.
- All water measuring devices required for testing the pumps.
- Testing and operation of the pumps.

The pumping unit consisting of duty pump, emergency pump, jockey pump, drivers and controllers shall be assembled and supplied from one supplier.

10.11.2 General Requirements

- The pumping unit shall meet the requirements of NFPA 20-1990 and listed and approved by UL and FM for fire fighting use.
- All pumps and their drivers shall be mounted on a reinforced concrete foundation of an adequate construction and dimensions.
- All pumps shall be located in accessible locations for ease of repair and maintenance.
- All pumps shall be constructed of materials having a pressure rating not less than 16 bar.
- All pumps shall be provided from the factory with plugged connections for casing vent, drain and suction and discharge pressure.
- Each pump shall be tested at the factory to provide detailed performance data and to demonstrate its compliance with the specification.
- Each pump shall be hydrostatically tested by the manufacturer for a pressure not less than 16 bar.
- Piping shall be supported independently of pumps nozzles to prevent piping weight or stresses from bearing on or being transmitted to the pump nozzles.
- Drain from base plate, pump, relief valves, etc. shall be piped to the floor drain located in pump room.
- All pipes, fittings, valves and instrumentation shall have a pressure rating not less than 16 bar unless otherwise specified.
- Other requirements of pipe work and valves shall be as called for in this specifications.
- All conduit for electrical work shall be heavy gauge galvanized steel.

10.11.3 Shop Drawings

Shop drawings of the pumping unit shall be submitted to the Engineer for approval, prior to shipment from the factory.

10.11 FIRE FIGHTING PUMPING UNIT (CONT'D)

The shop drawing shall include the following requirements:-

- Certified performance curves showing job number, customer, customer order number, date of manufacture, model number, pump size, impeller diameter, impeller type, rpm, flow-head characteristic curve, consumed horsepower curve and pump efficiency curve.
- Pump cross-sectional drawing showing major components with parts numbers and parts list.
- Pumps and controllers outline dimensional drawing showing overall dimensions of all pumps and controllers enclosure, location of foundations bolts holes and size, location and rating of suction and discharge nozzles of pumps.
- Detailed wiring diagrams of pumps controllers, and any other electrical devices or accessories.
- Installation, operation and maintenance instruction manuals.

10.11.4 Horizontal Split Case Pump**A) Foundation and Setting**

The pump and driver shall be mounted on a common steel base plate adequately reinforced against deflection and provided with drip rim and bolt holes.

The pump shall be directly connected to the driver through a heavy duty flexible coupling and provided with heavy gauge coupling guard from the factory. The base plate shall be securely supported on the foundation in such a way that proper pump and driver shaft alignment will be assured.

The base plate, with pump and driver mounted on it, shall be set level on the foundation and secured with proper size anchor bolts and completely grouted in to provide a rigid non deflecting support. Pump and driver shall be aligned at the factory.

Realignment is required after grouting in of base plate and after connecting piping.

B) Pump Construction

The pump casing shall be of high tensile strength close-grained cast iron fitted with bronze wearing rings.

The impeller shall be bronze of the enclosed type and fitted to the shaft with stainless steel key. The impeller shall be dynamically balanced at the factory.

The shaft shall be stainless steel amply sized to carry all axial and radial thrust. The shaft shall be protected by stainless steel sleeves.

10.11 FIRE FIGHTING PUMPING UNIT (CONT'D)

The pump rotating element shall be supported by heavy duty grease lubricated ball bearings mounted in a heavy iron housing. The bearing shall be lubricated by screw type grease cups.

The pump shall be fitted with two mechanical shaft seals which shall be easily removable from the stuffing boxes without disturbing motor and pump alignment.

The pump shall be provided from the factory with mating flanges for suction and discharge connections. the pump shall be provided with nameplate.

C) Operating Characteristics

The pump shall be selected so that the operating point of specified flow and head falls near the point of maximum efficiency as obtained from the manufacturer published data. The pump shall never be selected to operate near the end of its curve.

The pump shall deliver not less than 150 percent of rated flow at a pressure not less than 65 percent of rated pressure. the shutoff pressure shall not exceed 120 percent of the rated pressure.

D) Pump Instrumentation**1) Circulation Relief Valve**

The pump shall be provided with a relief valve set below the shutoff pressure to provide circulation of sufficient water to prevent the pump from overheating when operating with no discharge. A 20mm relief valve shall be used.

Provision shall be made for a discharge to drain.

Circulation relief valve shall be used for the duty pump only (electric driven).

2) Main Relief Valve

The pump shall be provided with pressure relief valve and shall be set to prevent pressure on the fire protection system greater than it can withstand. This application is useful when the shutoff pressure plus the static suction pressure exceeds the pressure rating of the system components.

Size of the pressure relief valve and discharge size shall be as indicated on the drawings.

The relief valve shall be located between the pump and pump discharge check valve. The relief valve shall discharge into the water reservoir at a point as far from the pump suction as is necessary to prevent the pump from drafting air introduced by the drain pipe discharge.

The drain pipe shall enter the reservoir below the normal water level.

10.11 FIRE FIGHTING PUMPING UNIT (CONT'D)

A shutoff valve shall not be installed in the relief valve supply or discharge piping.

3) Automatic Air release Valve

Each pump shall be provided with float operated air release valve not less than 15mm size, to automatically release air from the pump.

4) Pressure Gauges

A pressure gauge shall be connected to the discharge side of the pump casing.

A compound pressure and vacuum gauge shall be connected to the suction side of pump casing with a pressure range not less than 100 psi (7 bar).

E) Valves

Gate valve of O.S & Y indicating types shall be installed on the suction and discharge piping of the pumps.

Check valve of the silent, non-slam, spring loaded type shall be installed on the pump discharge piping.

The check valve shall be of 300 psi (20 bar) pressure rating.

Valve size shall be same as the pipe on which it is installed.

F) Pipes and Fittings

Suction pipes shall be laid carefully to avoid air pockets. When suction pipe and pump suction flange are not of the same size, they shall be connected with an eccentric tapered reducer in such as way as to avoid air pockets.

The entrance of suction pipe in the water reservoir shall be provided with vortex plate.

Flexible coupling shall be installed on the suction pipe connected to water reservoir.

Discharge piping extended from the pump discharge flange to the fire fighting system shall be hydrostatically tested as specified.

G) Water Measuring Devices

Water measuring devices shall be provided to test the fire pumping unit.

Water measuring devices shall consist of flow meter and sensor. They shall be capable of water flow of not less than 175 percent of pump rated capacity and of size not less than that given in Table 2-19 of NFPA20-1990.

10.11 FIRE FIGHTING PUMPING UNIT (CONT'D)**10.11.5 Jockey Pump**

A jockey pump is used to maintain the desired pressure of the fire protection system.

The pump shall be either centrifugal end suction vertical, multistage type.

The pump casing shall be cast iron.

The pump impeller shall be bronze.

The shaft shall be stainless steel.

The pump shall be fitted with the following:-

- Gate valves of O.S & Y indicating type on suction and discharge pipes.
- A check valve on discharge pipe
- A relief valve on pump discharge, size 15mm
- An automatic air release valve on top of pump casing.
- One pressure gauge on pump discharge
- One compound pressure and vacuum gauge on pump suction.

10.11.6 Motors

The motors of all electric driven pumps shall be of squirrel cage induction type and rated for continuous operation at ambient temperature not less than 40 c.

The motors shall be totally enclosed fan cooled type with insulation class F and IP 54 protection. The motor shall be rated for 380/220 volt, 3 phase and 50 cycle. The motor shall be designed for Star-Delta Start for fire pump, and across the line start for jockey pump.

The locked rotor current of the motor shall not exceed approximately six times the full load current. The motor shall be sized so that the full load ampere rating will not be exceeded.

All motor terminals shall be marked in accordance with NEMA Standard MG1-part 2.

All motors shall be provided with nameplates in accordance with NFPA 70.

The power supply feeder of the fire pumping unit shall be sized at 125 percent of the sum of the full load currents of duty fire pump, jockey pump and auxiliary loads.

Motor used at altitude above 1000 m shall be operated or derated according to NEMA standard MG1-part (14).

Motor power factor shall not be less than 0.85.

The horsepower rating of the motor driving the pump shall be of such magnitude as to ensure non-overloading of the motor throughout the capacity range of the pump for the impeller size selected.

10.11 FIRE FIGHTING PUMPING UNIT (CONT'D)**10.11.7 Diesel Engine Drive****A) Engine Rating**

The emergency fire pump shall be driven by a UL listed and F.M approved diesel engine. The engine shall be rated at standard SAE conditions of 91.5m above sea level and 25 C ambient temperature.

The engine horsepower rating shall be of a magnitude capable to drive the emergency pump at its maximum BHP, at altitude and ambient temperature as indicated on the drawings.

The engine speed shall not exceed 2900 rpm. The engine shall have a 4-hour minimum horsepower rating equal to or greater than the brake horsepower required to drive the pump at its rated speed under any conditions of pump load.

The engine shall be of the self-contained open type mounted on a suitable fabricated base.

B) Instrumentation and Control

The engine shall be provided with the following instrumentation and controls.

- Warning light: to indicate engine running and crank termination.
- Temperature gauge: to indicate cooling water temperature.
- Oil pressure gauge: to indicate lubricating oil pressure.
- Tachometer of totalizing type, to indicate rpm.
- Hour meter: to record engine operation time.
- Ammeter: to indicate ampere rating.
- Speed governor: to regulate engine speed.
- Overspeed shutdown device: to shut down the engine at speed approximately 20 percent above the rated speed.

All engine instruments shall be placed on a proper panel secured to the engine at a suitable location.

C) Engine Starting

The engine shall be equipped with a reliable device for electric starting.

Electric starting device shall take current from the storage batteries.

10.11 FIRE FIGHTING PUMPING UNIT (CONT'D)**D) Storage Battery**

The engine shall be provided with two storage battery units of Leaf Acid Type.

Each battery unit shall have capacity, at 4.4 C, sufficient to maintain cranking speed recommended by the engine manufacturer through a 6-minute cycle (15 seconds cranking and 15 second rest in 12 consecutive cycles).

The manufacturer shall provide a certification that the battery furnished complies with this requirement.

Batteries shall be recharged by two means. One shall be the generator or alternator furnished with the engine. The other shall be automatically controlled charger taking power from an alternating current power source.

Each battery shall have battery charger listed and approved for fire pump service.

The charger shall be furnished with an ammeter to indicate the operation of charger.

The charger shall be designed so that it will not be damaged or blow fuses during the cranking cycle of the engine.

Storage batteries shall be rack supported above the floor, secured against displacement, and located where they will not be subject to excessive temperature, vibration, mechanical injury, or flooding with water. They shall be readily accessible for servicing.

E) Engine Cooling System

The engine cooling system shall be the closed-circuit type, including a circulating pump driven by the engine, a heat exchanger, and a reliable engine jacket temperature regulating device.

An opening shall be provided in the circuit for filling the system, checking coolant level, and adding make-up coolant when required.

The coolant shall comply with the recommendation of the engine manufacturer.

The cooling water supply for the heat exchanger shall be from the discharge of the emergency pump, taken off prior to the pump discharge valve.

The cooling water supply piping with all valves and instruments shall be arranged as shown on the drawings. Pressure regulator used in the cooling system shall be of such size and type that it is capable of and adjusted for passing approximately 120 percent of the cooling water required when the engine is operated at maximum brake horsepower, and when the fire pump is pumping 150 percent of its rated capacity at the pump pressure.

10.11 FIRE FIGHTING PUMPING UNIT (CONT'D)**F) Fuel Supply System**

The fuel supply system shall include fuel supply tank, piping and valves.

The fuel supply tank shall be located above ground in the pump room. The tank shall be provided with sight tube for determining the amount of fuel in the tank. The connection of fuel supply piping to the engine fuel pump shall be made by flame resistant flexible hoses approved for this service.

The fuel tank shall be provided with the required openings for the pipe connections of fuel supply, fuel return, drain, vent, fill, sight tube.

Size of fuel piping shall be according to the engine manufacturer.

Excess fuel may be returned to fuel pump suction if recommended by the engine manufacturer.

Fuel return pump shall be used if recommended by the manufacturer.

The type and grade of diesel fuel shall be as specified by the engine manufacturer.

Arrangement of fuel supply system shall be as shown on the drawings.

G) Engine Exhaust

Exhaust from the engine shall be piped to a safe point outside the pump room. Exhaust gases shall not be discharged where they will affect persons or endanger buildings.

A seamless or welded corrugated flexible connection shall be made between the engine exhaust outlet and exhaust pipe.

The exhaust pipe size shall not be less than the engine exhaust outlet and shall be short as possible.

The exhaust piping shall be covered with high temperature insulation. The exhaust pipe shall be provided with muffler suitable for the use intended and the exhaust back pressure shall not exceed the engine manufacturer's recommendations.

H) Operation and Maintenance

The operation and maintenance of the diesel engine shall comply with the requirements of NFPA 20 and as per the engine manufacturer instructions.

The Contractor shall submit operation and instruction manual furnished by the manufacturer.

10.11 FIRE FIGHTING PUMPING UNIT (CONT'D)**10.11.8 Controllers and Accessories****A) General**

All electric drive controllers shall be specifically listed for electric motor driven fire pump service and marked "Electric Fire Pump Controller".

All engine drive controllers (if diesel pump is applicable) shall be specifically listed for diesel engine driven pump service and marked with "Diesel Engine Fire Pump Controller".

All controllers shall be completely assembled, wired, and tested by the manufacturer before shipment from the factory.

All controllers shall indicate plainly the name of the manufacturer, the identifying designation, and the complete electrical rating.

The Contractor is fully responsible to make necessary arrangement for the services of a manufacturer's representative for service and adjustment of the control equipment during the installation, testing and warranty periods.

All costs incurred by such services shall be on the Contractor's own expense.

All controllers shall be so located or protected that they will not be injured by water escaping from pumps on pump connections.

All controllers shall be mounted in a proper panel enclosed in a moisture and dust tight housing.

All enclosures shall be grounded.

Busbars and other wiring elements of controllers shall be designed on a continuous duty basis.

A fire pump controller shall not be used as a junction box to supply other equipment. Electrical supply conductors for jockey pump shall not be connected to the fire pump controller.

All switching equipment for manual use in connecting or disconnecting, or starting, or stopping the motor shall be externally operable.

Wiring diagrams and complete instructions covering the operation of the controllers shall be provided and permanently attached to the inside of the controller enclosure.

The controllers shall be of combined automatic and manual type.

Each operating component of the controller shall be labelled to indicate an identifying number referenced to the circuit diagram.

10.11 FIRE FIGHTING PUMPING UNIT (CONT'D)**B) Components of Electric Drive Controller**

Electric drive controllers for fire pump and jockey pump shall be provided with the following components and controls devices in accordance with NFPA 20 requirements.

- Isolating switch of molded case type externally operable having an ampere rating not less than 115 percent of the motor full load current.
- Circuit breaker for protecting the motor branch circuit of molded case time delay type having a continuous current rating not less than 115 percent of the rated full load current of the motor, and an interrupting rating equal to or greater than the available short circuit current for the circuit in which it is used.
- Locked rotor overcurrent protective device of time delay type having trip setting approximately six times the rated full load current of the motor.
- Motor starter of magnetic type capable of being energized automatically through the pressure switch or manually by means of an externally operable handle.
- Pressure-actuated switch having independent high and low calibrated adjustment in controller circuit. This pressure switch shall be responsive to water pressure in the fire protection system.
- The pressure sensing element of the switch shall be capable of withstanding a momentary surge pressure of 27 bar without losing its accuracy.
- The pressure sensing line shall be 15mm nominal size of copper or stainless steel suitable for the system pressure. The connection of the sensing line shall be made between the pump discharge check valve and gate valve.
- Manual operated switch for manual starting the pump motor.
- The pump shall remain in operation until manually shutdown.
- Manual mechanical control to provide for non automatic continuous running operation of the motor independent of any electric control circuits.
- Manual shutdown of automatic controller by reset push button to the controller full automatic position.

C) Components of Engine Drive Controller

Engine drive controller shall be provided with the following components and controls devices in accordance with NFPA 20 requirements.

- Pressure-actuated switch: similar to the electric drive controller.

10.11 FIRE FIGHTING PUMPING UNIT (CONT'D)

- Manual operated switch for manual starting the engine. The engine shall remain in operation until manually shutdown.
- Changeover: To provide starting current by first one battery and then the other battery on successive operations of the starter for manual and automatic starting.
- In the event that one battery is in-operative or missing, the control shall lock-in on the remaining battery unit during the cranking sequence.
- In the event that the engine does not start after completion of its "attempt to start" cycle, the controller shall stop all further cranking and operate a visible indicator and audible alarm on the controller.
- Manual shutdown by operation of main switch inside the controller enclosure.
- Manual shutdown by operation of a stop button on the outside of the controller enclosure.
- The controller shall shutdown the engine automatically only after all starting causes have returned to normal and a 30 minutes minimum run time has elapsed.
- The controller shall shutdown the engine without time delay and lock out until manually reset when the engine overspeed device operates.
- The engine shall not shutdown automatically on high water temperature or low oil pressure when any starting cause exists.

D) Alarms and Signal Devices on Controllers

Separate visible indicators and a common audible alarm shall be provided on the controller for the following:-

- a. Duty and Jockey Pumps
 - Power available (pilot light only)
 - Power failure
 - Phase failure
 - Phase reversal
 - Pump running (automatic and manual)
 - Low water level in the water supply tank
 - Transfer switch and isolating switch positions
- b. Emergency Pump (for Diesel Emergency pump if applicable)
 - Pump running (automatic and manual)
 - Low oil pressure in the lubricating system

10.11 FIRE FIGHTING PUMPING UNIT (CONT'D)

- High engine jacket coolant temperature
- Failure of engine to start automatically
- Shutdown from overspeed
- Low fuel level in the fuel tank
- Battery failure (each battery)
- Battery charger failure

E) Alarms and Signal Devices Remote from Controllers (Not Applicable)

All alarms and signal devices provided on the controllers in the pump room shall be located in the central control panel which is supervised continuously.

10.11.9 Field Acceptance Test**A) General**

The field acceptance test shall be carried out in the presence of the Engineer, the pumps and controllers manufacturers or their designated representatives, the owner representative, and the Civil Defense Department Representative.

A copy of the manufacturer's certified pump test characteristic curve shall be available for comparison of results of field acceptance test.

The fire pumps as installed shall equal the performance as indicated on the manufacturer's certified shop test characteristic curve within the accuracy limits of the test instruments.

A pump shall be rejected and replaced under the following conditions:-

- If the pumps does not deliver its specified flow requirements under the existing friction loss and static pressure of the system.
- If the pump motor or engine is overloaded at design flow and head requirements or at higher flow rate.
- If the pump produce excessive noise or vibration.
Apparent defective pumps or associated equipment shall be repaired and such adjustment made to the pumps or other equipment as may be necessary, all to the satisfaction of the Engineer.

After pump or equipment is adjusted, repaired, or replaced any or all defective or inoperable parts shall be retested to the entire satisfaction of the Engineer.

10.11 FIRE FIGHTING PUMPING UNIT (CONT'D)**B) Test Instruments**

The Contractor shall furnish the following instruments for testing the pumping unit.

- Clamp on volt ammeter: for voltage and current measurements.
- Tachometer: for RPM measurement.
- Any test gauge or devices may be needed.

The test instruments shall be of high quality and accurate and shall be calibrated.

C) Test Procedure

The fire pumping unit shall be tested in accordance with the requirements of NFPA 20-1990.

- The flow test shall be performed by using the installed flow meter and hose valves.
- Various readings shall be achieved by regulating the discharge valve of the meter

The important test points are:

- * 150 percent of rated flow
- * Rated flow
- * Shutoff
- The following data at each test point to be recorded:-
 - * Pump RPM
 - * Suction Pressure
 - * Discharge pressure
 - * Amperes
 - * Volts
- Pumps head should be calculated
- Corrections of tested flow, head, and horsepower to the rated speed of the pump shall be made for purposes of plotting the performance curve.
- A head-flow and ampere-flow curves shall be plotted for each pump.
- A test report shall be submitted to the Engineer for approval.

10.11 FIRE FIGHTING PUMPING UNIT (CONT'D)**D) Controller Acceptance Test**

Fire pumps controllers shall perform not less than 10 automatic and 10 manual operations during the test. A fire pump driver shall be operated for a period of at least 5 minutes at full speed during each of the above operation.

The automatic operation sequence of the controllers shall start the pump from all provided starting features. This shall include pressure switches. Test of engine drive controllers shall be divided between both sets of batteries.

E) Alarms

Alarms conditions, both local and remote shall be simulated to demonstrate satisfactory operation.

F) Test Duration

The fire pumps shall be in operation for not less than one hour total time during all of foregoing tests.

G) Annual Fire Pumps Tests

The annual flow test of the pumping unit assembly and automatic transfer switch shall be performed to determine its ability to continue to attain satisfactory performance at shutoff, rated and peak loads. All alarms shall operate satisfactorily. All valves in the suction line shall be checked to assure that they are fully open.

The annual test shall be performed by personnel trained in the operation of the fire pump. Test results shall be recorded.

Any significant reduction in the operating characteristics of the fire pumping unit assembly shall be reported to the owner and repairs made immediately.

10.11.10 Fire pumps Operation

The fire pumps shall be maintained in readiness for operation. After any test, the fire pumps shall be returned to automatic operation, all valves shall be returned to normal operating position.

The fire pumping unit shall be operated weekly and at least one start shall be accomplished by reducing the water pressure.

Qualified operating personnel shall be in attendance during pump operation.

The satisfactory performance of the pump driver, controller and alarms shall be observed and noted.

Fire pumps settings shall comply with the requirements of NFPA 20-1990.

10.11 FIRE FIGHTING PUMPING UNIT (CONT'D)

10.11.11 Maintenance

The contractor shall perform during the maintenance period all the weekly and the annual test, as described in this specification, for the pumping unit.

The contractor shall also perform all the preventative periodic maintenance requirements as recommended by the manufacturer instructions. Records shall be maintained on all work performed on the fire pumping unit.

END OF SECTION