

BALUCHISTAN ENERGY COMPANY LIMITED

DEVELOPMENT OF LPG TESTING LABORATORY AT TAFTAN

Specifications for UL/FM Listed Fire Water Pump Package



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SPECIFICATIONS FOR FIRE WATER PUMPS

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SPECIFICATIONS FOR FIRE WATER PUMPS

1.0 GENERAL

1.1. Scope

This specification covers the minimum requirements for the design, supply, manufacture inspection and testing for new diesel engine/motor driven centrifugal pumps to be used in firewater service. The pump driver is included in this specification.

1.2. Definition

Following shall apply within this specification:

Owner: Means entity who shall purchase the firewater pump package
Vendor Means the Manufacturer/Supplier of package

1.3. Unit Responsibility

- i. The Vendor shall assume full unit responsibility for the complete centrifugal pump package and all ancillaries. The Vendor shall handle and expedite drawings and data, and supervise and coordinate all inspection and testing specified.
- ii. Pump with drive shall be properly aligned by the Vendor

1.4. Conflicting Requirements

- i. In the event of a conflict between this specification and other specifications, Vendor shall consult Owner for a ruling in writing before any work is started.
- ii. In the event of a conflict this specification and governmental requirements, the more rigid requirement shall govern.

1.5. Design Basis

- i. Equipment shall be of manufacturer's standard design and shall be designed as per NFPA 20 and must be approved for UL & FM.
- ii. Vendor shall certify that the equipment supplied is suitable for the purpose intended, and that it will meet or exceed the Owner's needs as specified in this document.
- iii. Vendor is responsible for providing any material, accessory items or equipment, in addition to that referred to in this specification, which is required to provide a safe and efficient package.



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- iv. Fire water Pump Package shall be provided with 2 years spares and commissioning spares.

2.0 CODES, STANDARDS & SPECIFICATIONS

The following codes, standards, specifications and drawings (latest edition, addendum and revisions) shall be considered as part of this specification and minimum requirements of these documents are mandatory.

2.1. International

- NFPA 20 Installation of Stationary Pumps for Fire Protection Service
- ASME B31.3 Chemical Plant & Petroleum Refinery Piping
- ASTM American Society for Testing of Materials
- ASME VIII Div. 1 Rules for Construction of Pressure Vessels.
- UL Standards Product Equipment Safety Testing

3.0 SCOPE OF SUPPLY AND SUPPLIER'S RESPONSIBILITIES

3.1. The Supplier shall provide diesel engine/motor driven pumps (as per requirement of datasheets) for Firewater Service in accordance with NFPA 20 and must be approved for UL & FM.

3.2. The Supplier shall furnish all equipment and necessary ancillaries. For the safe and reliable operation of pump set, following shall be included in firewater pump package but not be limited to:

a) 100% duty diesel driven pump set complete with the following:

- Centrifugal pump(s).
- Pressure gauges at suction and discharge as per NFPA 20
- Lubrication system
- Suction Strainer
- Air Release Valve, for fire pump service
- Diesel engine(s).
- All seals, couplings and guards (spark proof)
- Lubrication systems for pump and engine.



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- Engine cooling system.
 - Fuel system with day tank.
 - Primary battery starting system.
 - Backup starting system.
 - Exhaust system with muffler, stainless steel expansion joint and connecting exhaust section.
 - One (1) starter/control panel, including engine governor system.
 - The following instrumentation shall be supplied as a minimum:
 - Engine tachometer
 - Engine jacket outlet temperature gauge
 - Engine jacket outlet temperature alarm
 - Coolant level gauge
 - Low coolant level alarm
 - Air intake manifold temperature gauge (if turbo charged)
 - Exhaust gas temperature gauge
 - Fuel inlet pressure gauge
 - Fuel filter differential pressure gauge
 - Engine oil inlet temperature gauge
 - Engine oil pressure gauge
 - Engine oil filter differential pressure gauge
 - Engine oil pressure low alarm and trip
 - Engine oil temperature high alarm
 - Engine oil level gauge
 - An auto trip device independent of speed governor to safety shutdown on over speed of engine.
- b) Spares required for commissioning
- c) All necessary drawings, documentation and manuals.
- d) All special tools necessary for installation and maintenance of the Firewater Main Pumps.
- e) Foundation Bolts.



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4.0 SITE CONDITIONS AND UTILITIES

4.1. General

- 4.1.1 The pump sets will be installed outdoors without shelter.
- 4.1.2 The presence of sea-salts, dust and humidity renders the ambient very corrosive.

4.2. Environmental

- 4.2.1 The site environmental conditions are as follows:

- a) Ambient Temperature
 - Maximum 50°C
 - Normal 35°C
 - Minimum 10°C
- b) Relative Humidity
 - Maximum 85%
 - Minimum 35%
- c) Wind Velocity
 - Maximum 160 Km/hr

4.3. Utilities

The following utilities will be available at the site:

4.3.1 Diesel - Oil Fuel Specification

- Specific Gravity 0.8 - 0.85
- Flash Point, Max / Min 92°C / 54°C.
- Copper strip corrosion Max. 1.0
- Alternative Cetane Index 45



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- Pour Point +6°C in Summer / +3°C in Winter
- Viscosity Kinematic @ 40°C 1.5 cSt Min. / 6.5 cSt Max
- Ash Content (Max %wt) 0.01
- Water & Sediment(Max %wt) 0.05
- Sulphur Content (Max %wt) 1.0
- Carbon Residue (Max 10%wt) 0.2
- Distillation (°C 90% Max) around 350°C

5.0 **TECHNICAL**

5.1. **General Requirement**

- a) Centrifugal Pump shall be manufactured, design and tested in accordance with NFPA 20 and must be approved for UL & FM.
- b) Firewater pump unit shall be listed and approved for fire protection service.
- c) Supplier shall have responsibilities that the fire pump unit, consisting of pump, driver and controller, shall perform in compliance with this standard as an entire unit when installed or when components have been replaced.
- d) Pump selection based on the operating condition under which they are to be installed and used.
- e) Centrifugal pump and driver shall be mounted on common base plate.
- f) Main Suction and discharge nozzle shall be terminated at skid edge.
- g) All vents/drains shall be terminated at skid edge and where practical collected at common location.
- h) On skid wiring shall be terminated at junction box.

5.2. **Design**

- a) Centrifugal pumps shall be designed and constructed to meet service conditions specified on the Data.
- b) Fire Pump Unit shall be listed and approved for UL & FM.
- c) Pumps shall meet design pumping requirements with an impeller diameter not more than 95% of maximum impeller diameter available for that particular casing size.
- d) The pump performance shall meet the following standards published in NFPA20:



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- i. The pump shall furnish not less than 150 percent of rated capacity at a pressure not less than 65 percent of the rated head
- ii. The total shutoff head of the pump shall not exceed 140 percent of the total rated head.
- iii. The pump shall undergo hydrostatic testing to twice the maximum pressure developed at shutoff but not less than 250 psig.
- e) The head curve for the pump shall rise continuously from the specified capacity point to shut-off.
- f) Close coupled pumps are not acceptable.
- g) The pump sets shall be in accordance with NFPA 20 and must be approved for UL & FM. Any deviations shall be made in writing and shall require written approval from Owner.
- h) The net positive suction head required (NPSHR) shall be at least 1 meter (3.3') less than the net positive suction head available (NPSHA) throughout the entire operating range.
- i) Diesel consumption for each specified duty at the input to the pump set shall be confirmed and guaranteed by the Supplier, prior to order.
- j) The shaft system shall be designed to accommodate the highest torque that can be developed in the system, whether starting or stopping.
- k) Pump shaft sealing shall be provided by means of a packed gland. The pump design shall enable replacement of packing without need to disassemble major components.
- l) Bearings shall be designed for an L10 rating life of 20,000 hours continuous operations at rated conditions or better.
- m) All sections of the pump and all seals shall be designed for the maximum allowable working pressure given in the pump data sheet.
- n) Couplings shall be of steel of the non-lubricated spacer disc type with stainless steel disc.
- o) All couplings running at speeds greater than 1,800 rpm shall be dynamically balanced.
- p) Guards shall be provided for all exposed rotating elements.



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5.3. Material

- a) Pump Casing shall be cast iron, axially split with a 15 degree angle that will minimize NPSH requirements and dimensions.
- b) Lower half shall contain suction and discharge nozzles. Suction and discharge connections shall be on the same elevation.
- c) Top half and rotating element shall be removable without disturbing the piping.
- d) Casing shall be fitted with replaceable bronze wearing rings.
- e) Impeller shall be bronze, double suction, enclosed type fully balanced and keyed to an alloy steel shaft.
- f) Shaft shall be fitted with replaceable bronze sleeves.
- g) Shaft shall be mounted in two dust tight deep grooves, sealed and permanently greased ball bearings.
- h) Bearing shall be mounted in a cartridge type housing so that they shall be replaceable without opening the pump casing. Bearings shall be removable without the need of special tools or bearing puller, but only by rotating the bearing removal nut.
- i) Each stuffing box shall be fitted with a three piece bronze split gland. Stuffing box shall be fitted with an extension to facilitate the packing rings removal.
- j) Packing rings shall be removable without disturbing wetted parts or the pump bearings. Water seal rings made from non-corroding material shall be piped to pump volute.

5.4. Nozzles and Miscellaneous Connections

- a) All suction and discharge connections shall be R.F. flanged or with mating flanges.
- b) The pump casing shall be furnished with drilled and tapped vent and drain openings, which shall be valved unless plugs are specified.
- c) Drain and vent shall not be smaller than ½" where practical. All pipe and nipples shall be Schedule 80 pipe class.
- d) Suction nozzle flanges shall be of the same rating as the discharge nozzles flanges and shall be as per ANSI B16.5.

5.5. Minimum Fittings

The following minimum fittings shall be provided as per NFPA 20:



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- a) Suction & Discharge Pressure Gauges shall be 3 ½ - inch glycerin filled dial type, scale: 30 to 300 psi
- b) ¼-inch size Gauge Cocks and Nipples
- c) 1/2 inch Air release valve, UL/FM listed for fire pump service.

5.6. Drivers

- a) Pumps shall be driven by diesel engine/motors unless otherwise specified.
- b) Diesel Engine/motors shall be specifically listed for firewater services.

5.7. Couplings

Coupling shall be flexible, spacer type completes with easily removable guard.

5.8. Base plate

- a) The fire pump and driver shall be mounted on a common base with all necessary piping from the pump to the engine cooling mounted and fitted in accordance to the requirements of NFPA20.
- b) Base plates shall be provided with grouting holes.

5.9. Diesel Engine Accessories

The diesel engine shall be supplied with the following accessories.

- a) Cooling water shall be supplied to the heat exchanger from the discharge of the pump prior to the pump discharge valve.
- b) The pipe connection shall include four shut-off valves (including bypass lines), two strainers, two pressure regulators, and a solenoid valve and pressure gauge.
- c) Dual heavy duty-12 volt lead-acid (industry standard) batteries shall be provided and furnished in a dry charge condition (electrolyte liquid in separate containers). A suitable battery rack and 60 inches of battery cables shall be included.
- d) The diesel engine tank shall be supplied with fill pipe and cap, manual shut-off cock, flame arrester, and oil level gauge.
- e) An insulated, flexible exhaust connection shall be supplied with residential silencer. Exhaust and silencer shall be suitable for use with 15 feet of piping with one elbow.



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- f) The diesel engine shall be equipped with an independent instrument panel upon which a tachometer, oil pressure gauge, and engine temperature gauge are mounted. One manual crank per battery shall supply for emergency starting of the diesel engine.

5.10. Engine Driven Fire Pump Controller

The fire pump manufacturer shall furnish a diesel engine fire pumps controller which shall be specifically listed for Fire Pump Services.

The fire pump controller shall meet the requirements per NFPA-20 and shall incorporate the following:

- a) Two independently functional battery chargers, each having its own power transformer rated for a maximum continuous charge current of 10 amperes. The charger shall be of solid state electronic design with a semi-conductor type rectifier, and shall include the following supervisory and safety features:
- i. Current limiting in every charging mode
 - ii. Over-current shut-off
 - iii. Automatic selection of bulk or float charge by battery voltage sensing
 - iv. Lower than 0.5 ampere trickle charge
 - v. Reverse voltage shut off
 - vi. Dead cell detection
 - vii. Over an under voltage alarm
 - viii. Charger initiated battery failure alarm with signaling to prevent the use of the defective battery during the engine cranking (starting) cycle.
- b) All relays shall be equipped with manual test buttons and 'ON' – 'OFF' status indicators and terminal block to indicate the following engine conditions:
- i. Two SPDT contacts for engine running condition
 - ii. One NO/NC contact when the main switch is in the 'AUTO' position
 - iii. One NO/NC contract when the main switch is in the 'MANUAL' or 'OFF' position.



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- iv. One SPDT contact indicating engine trouble. The engine trouble condition shall be indicated on engine overspeed, engine failure to start, low oil pressure, and high coolant temperature conditions.
- c) Listed (UL/FM) Pressure Recorder for sensing and recording the pressure in each fire pump controller for Seven Days (07) without being reset.
- d) The controller shall have provision for interface with plants DCS/PLC for monitoring. Vendor shall provide monitoring signals that will be interfaced with plant DCS/PLC with bid.
- e) The pressure adjustment for High and Low pressure switches shall be in accordance with the cause & action table mentioned in P&ID 060-001-157-PID-010.
- f) The diesel engine driven pump shall start automatically by pressure switch low actuation.
- g) Provision for manual starting and operation of Diesel Engine Pump shall also be provided through push button switch. The switch shall be arranged such that the operation of engine when manually started cannot be affected by pressure switch.
- h) Provision for manual (by push button) and automatic pump shutdown (through pressure switch high actuation) shall be provided for each pump in compliance with NFPA 20.
- i) The pumps arranged for automatic shutdown after starting causes have returned to normal, a running period timer set for at least 10 minutes running time permitted to commence at initial operation in compliance with NFPA 20.
- j) A central annunciator and operator control panel shall be provided inside the controller but visible and accessible through a breakable glass panel on the enclosure door. This control panel shall incorporate all positions main switch manual start push-buttons, combination Lamp test / Charger reset push-button and the optional 'NORMAL' / 'SILENCE' selector switch for pump room alarms.
- k) Diesel engine controller and engine batteries shall be mounted and wired on a common base with fire pump by the fire pump manufacturer. The complete unit shall be ready for field piping, electrical power supply and hook up to fuel system.



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5.11. Electrical Design Requirement for Fire Water Pump Package

Below mentioned are the minimum design requirements for the electrical system of the fire water pump package. The Manufacturer / Vendor may enhance these minimum requirements for safe and reliable operation of the supplied package. The Manufacturer / Vendor shall provide the list of electrical equipment to be supplied with the package.

The electrical equipment supplied by the Supplier shall be suitable for following available power supply.

5.11.1. Power Supply

415Vac, 50 Hz, 3-phase, 4-wire

For any other voltage levels other than those mentioned above the Supplier shall be responsible to provide the voltage transformation system.

5.11.2. Electric Motor requirement

- a) The Electric motors shall be squirrel cage induction motors supplied in accordance with the latest international standards. All motors shall be supplied at 400 volts, 3-Phase, 50Hz, and shall be weather / water proof and corrosion resistant. The enclosure degree of protection shall be IP55 / NEMA 4X.
- b) Motors shall be rated for maximum design ambient temperature. Insulation to Class F shall be used with Class B temperature rise. The cooling type shall be TEFC.
- c) The offered electric motor shall be listed for fire pump service as per NFPA-20 & NFPA-70.

5.11.3. Electric Motor Driven Fire Pump Controller

- a) The fire pump controller shall be complete with motor starters, protection, indications and remote operation. The controller shall be IP-55 suitable for outdoor installation.
- b) The Controller and each pump shall be internally pre-wired by the Manufacturer. The Client shall only provide three-phase electric power to the package.



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- c) Listed (UL/FM) Pressure Recorder for sensing and recording the pressure in each fire pump controller for Seven Days (07) without being reset.
- d) The controller shall have provision for interface with plant DCS for monitoring. Vendor shall provide monitoring signals that will be interfaced with plant DCS with bid.
- e) The pressure adjustment for High and Low pressure switches shall be in accordance with the cause & action table mentioned in P&ID 060-001-157-PID-010.
- f) The electric motor driven pump shall start automatically by pressure switch low actuation.
- g) Provision for manual starting and operation of Pumps shall also be provided through push button switch. The switch shall be arranged such that the operation of engine when manually started cannot be affected by pressure switch.
- h) Provision for manual (by push button) and automatic pump shutdown shall be provided for each pump in compliance with NFPA 20.
- i) The pumps arranged for automatic shutdown after starting causes have returned to normal, a running period timer set for at least 10 minutes running time permitted to commence at initial operation in compliance with NFPA 20.
- j) The offered fire pump motor controller shall be listed for fire water pump service as per NFPA-20 & NFPA-70.

5.11.4. Jockey Pump Motor Controller Requirement

- a) The jockey pump motor controller shall be complete with motor starters, protection, indications. The controller shall be IP55 suitable for outdoor installation.
- b) The Controller and the electric motor shall be internally pre-wired by the Manufacturer. The Client shall only provide three-phase electric power to the package.
- c) Listed (UL/FM) Pressure Recorder for sensing and recording the pressure in each fire pump controller for Seven Days (07) without being reset.



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- d) The controller shall have provision for interface with plant DCS/PLC for monitoring. Vendor shall provide monitoring signals that will be interfaced with plant DCS/PLC with bid.
- e) The pressure adjustment for High and Low pressure switches shall be in accordance with the cause & action table mentioned in P& ID 018-028-107-CD-001.
- f) The electric motor driven pump shall start automatically by pressure switch low actuation.
- g) Provision for manual starting and operation of Jockey Pump shall also be provided through push button switch. The switch shall be arranged such that the operation of engine when manually started cannot be affected by pressure switch.
- h) Provision for manual (by push button) and automatic pump shutdown shall be provided for each pump in compliance with NFPA 20.
- i) The pumps arranged for automatic shutdown after starting causes have returned to normal, a running period timer set for at least 10 minutes running time permitted to commence at initial operation in compliance with NFPA 20.
- j) The offered jockey pump motor controller shall be listed for fire water pump service as per NFPA-20 & NFPA-70.

5.11.5. Documents / Drawings required

The following drawings / documents shall be submitted as a minimum.

- Listing certification
- Controller schematic diagram
- Cable Termination Drawings
- Equipment installation details

The Supplier / Vendor shall provide preliminary documents of the above mentioned deliverables to the Owner at the time of bidding.



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6.0 DELIVERY

6.1 Inspection and Testing

- a) The Owner reserves the right to inspect the equipment at any reasonable time in the Vendor's plant. Such inspection does not in any way relieve the Vendor of any responsibility for design, material or workmanship.
- b) Suction Piping shall be flushed at a flow rate not less than indicated in NFPA 20.
- c) Flushing shall occur prior to hydrostatic test.
- d) Hydrostatic test shall be carried out as per requirement of NFPA 20.
- e) Performance Test as mentioned in data sheet shall be performed at shop.
- f) The Vendor shall notify to Owner at least 10 days in advance of all shop tests to be performed on the equipment.
- g) Field Acceptance tests shall be performed in accordance with NFPA 20.
- h) Certified Pump Test characteristic shall be available for comparison of the results of the Field Acceptance Test.
- i) Field Acceptance Test shall be performed as per requirement of NFPA-20.

6.2 Preparation for Shipping

- a) The supplier shall notify the Owner two weeks prior to shipment.
- b) All openings such as nozzles, vents and field connections shall be properly sealed and protected during shipment.
- c) All fragile items shall be removed and crated in rigid packing crates with sufficient padding to prevent damage during shipment and shall be properly tagged for ease of field installation.
- d) The Vendor shall furnish shipping preparation procedures to the Owner for review with the proposal. The Vendor shall provide corrosion inhibitor protection for all internal and external machine parts for sea shipment and six months outdoor storage.

6.3 Operating and Maintenance Manuals

- a) Three (3) sets of operating and maintenance manuals shall be provided to enable Owner to install, operate and maintain the complete equipment ordered.
- b) Vendor's list shall show original manufacturer and local representative name, address and phone number for each item not manufactured by Vendor.



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- c) The information and material supplied shall pertain directly to the unit purchased. Generalized or typical material shall not be included.

6.4 Spare Parts

The Vendor shall submit a list of recommended spare parts for 2 years of operation with his proposal. This list shall include original manufacturer and local representative name, address and phone number for each item.

6.5 Guarantee and Warranty

6.5.1 General

The Vendor will warrant the equipment to be free of defects in material and workmanship, and that it is of adequate size and capability to fulfill the design and operating conditions specified herein. The Vendor shall replace and install, without cost to the Owner, any materials, supplies, or equipment which fails under design conditions due to defects in material or workmanship, if the defect is observed and/or such failure occurs within one (1) year from the date such equipment or material is put in operation. Acceptance of this order will signify acceptance of all conditions of this guarantee.

6.6 Certification

The Supplier shall provide the following certificates:

- Material certificates.
- Pressure test certificates for all pressure containing components.
- Pump performance certificates, showing head, capacity and power together with the specified operating conditions.
- Diesel engine performance certificate.