

SCOPE OF WORKS/SUPPLY **PROCESS SPECIFICATIONS** **(PLOT PLAN & WATER DEPARTMENT)** **EFFLUENT TREATMENT PLANT** **(ETP)**

PROJECT : EFFLUENT TREATMENT PLANT AT TENGAGHAT, ASSAM.

OWNER : OIL INDIA LTD. (OIL)

PMC : ENGINEERS INDIA LTD.

JOB NO. : A843

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1.0 INTRODUCTION

OIL INDIA LIMITED (OIL) is engaged in Exploration, Production and Transportation of crude oil & natural gas with its Headquarters at Duliajan, Assam. The major Oil & Gas producing assets of the Company are located in Upper Assam Basin of North East India. Produced water or the formation water from oil collection system (OCS) to be treated prior to its disposal or reinjection to ensure stipulated guidelines and maintain parameters.

The Produced fluid (a mix of oil and water in emulsion form) and associated gas is handled by about 40 production installations of various capacities and non-associated gas is produced through about 26 installations. In order to ensure stipulated guidelines and maintain parameters of produced water to be treated prior to its disposal or reinjection, an Effluent Treatment Plant (ETP) is proposed to be installed for the same.

Produced Water after oil water separation in process units will be routed to the existing Formation Water Tanks and then pumped to the new equalization tanks in the ETP. Inlet header will be provided by OIL up to ETP battery limit with flange connection.

The treated effluent from the proposed ETP will be reused in water injection wells. The sub-surface Water Disposal Wells are of 1,200 to 1,500 m deep and Water Injection Wells are of 2,500 to 3,000 m deep.

The proposed ETP shall be designed to meet all the latest and relevant standards for QHSE-ISO, applicable Environmental Protection Acts and rules and ISRS (International Safety Rating System) etc.

M/s EIL has been retained by M/s OIL for providing PMC services for the construction of new Effluent Treatment Plant to meet the stipulated guidelines.

2.0 DETAILED SCOPE OF SUPPLY/WORK

The scope of work for the effluent treatment plant shall be, but not limited to as given herein:

The scope shall include Design, Engineering, Procurement, Supply, Manufacture, Construction and Erection of Civil and Structural, Mechanical, Electrical, Piping, Acid / Caustic proofing, lining, Painting and Instrumentation works, Storage at site, Commissioning and testing of Effluent Treatment Plant, training of owners personnel, trial runs for 30 days after commissioning and performance guarantee test run for 72 hrs continuous operation, guaranteeing, and handing over of effluent treatment Plant to the Client, all on turnkey basis, as per design basis, job specifications, equipment lists, standards, P&IDs, data sheets, drawings, etc., all complete within Contractor's specified battery limits.

All equipment described in these specifications and equipment list, as shown in the P&ID, as mentioned elsewhere in the tender document or as necessary for completeness but not listed above shall also be deemed to have been included in Contractor's scope. All works required to meet requirements given in design/process/operation requirements defined elsewhere in the bid document shall also be deemed to have been included in Contractor's scope.

Contractor's scope of work also includes operation & maintenance of the Plant for a period of TEN (10) YEARS after the successful commissioning. Contractor's scope of work, during O&M contract for effluent treatment plant, shall be as per Specifications No. A843-806-17-44-O&M-01.

2.1 PROCESS

Process documents enclosed are the basic documents and are to be followed for execution of job leading to successful commissioning of the Plant. During the course of execution updating/modification to the process documents that would become necessary is to be carried out with the approval of EIL/Owner. The resultant work arising out of this will also form the part of scope from detailed engineering to handing over of the plant including O & M contract with no cost implication to the Owner.

The tender specifies the scheme consisting of the following stages/sections:

- i) Pretreatment section, using equalization tank, TPI separator, DAF system to remove suspended solids load and Oil
- ii) Polishing Section, using walnut shell filter to take care of final oil polishing & total suspended solids to desired specifications
- iii) Re-injection Water Treatment Section, including de-oxygenation system. Further using biocide dosing system, SRB & other bacterial activity is controlled in the water
- iv) Package Units (VOC system, Cooling Tower, Bio-Remediation Package, Air Compressor Package, etc.)
- v) Sludge and Chemical Handling System

(Bidder may include in his scope any additional requirements, if so warranted to meet the guarantees as per tender requirements.)

Bidder's scope shall also include the following:

- a. Internal Fire protection system of ETP area which consists of firewater network around ETP, internal fire water hydrants, monitors, landing valves for double storied buildings & staircase landings of platforms, fixed water spray system and semi-fixed foam system on hydrocarbon storage tanks (As per EIL standard specification 6-66-0072) and first aid fire protection (portable fire extinguishers) equipment as per OISD.
- b. High velocity water spray (sprinkler) system shall be provided in case oil capacity of transformer is more than 2000 liters complying with OISD / TAC.
- c. First aid fire protection (portable fire extinguishers) equipment.

2.2 ENGINEERING

The design basis, data sheets, drawings, standards, specification, codes to be followed for different types of works are brought out in the various engineering sections forming part of the tender document. Contractor shall carry out the Basic Design & Detailed engineering works for the plant and submit various Drawings and documents for approval of EIL / Owner before these are released for Construction.

2.3 CONSTRUCTION AND INSTALLATION

These activities shall be carried out by contractor as specified elsewhere in the tender document.

2.4 QUALITY ASSURANCE

These activities shall be carried out by contractor as specified elsewhere in the tender document.

2.5 STATUTORY CLEARANCES

All the applicable safety codes, national laws and local regulations shall be followed by the successful bidder for the design engineering, fabrication, erection, commissioning of the Plant/Equipment and necessary approvals shall be obtained from the concerned statutory authorities by the contractor. It is to be ensured that all activities from detailed engineering up to handing over of the Plant should accommodate statutory requirement during the execution of the contract and forms part of the scope. Documents as required for taking statutory approvals will be generated and submitted to the statutory authorities by the contractor through Owner. Follow up and obtaining clearances (**wherever applicable**), shall be the responsibility of the contractor. Statutory bodies from which approvals may have to be taken include State Pollution Control Board, Factory Inspectorate, DGMS, PESO, Labor Authorities, etc. The contractor shall ascertain requirement of approvals as applicable in such Plants and initiation of action as required shall be in contractor's scope. EIL would render technical assistance to the contractor for obtaining the above statutory clearances.

2.6 SAFETY

These activities shall be carried out by contractor as specified elsewhere in the tender document. All safety procedures for different types of work as per the safety rules from time to time by EIL/Owner shall be binding and adhered to by the contractor. Safety report generation for different situations as per the rules and required by EIL/Owner are to be adhered to.

Carrying out HAZOP study, QRA Study and SIL Study and incorporating its recommendations in the project is in ETP Contractor's scope. Third Party Chairman for HAZOP & SIL shall be arranged by the ETP Contractor at its own cost. CV of the proposed Chairman shall be submitted by ETP Contractor to OIL/EIL for approval.

2.7 VENDOR LIST

For most of the systems/equipment the approved vendor list of EIL is enclosed in the bid document which shall be adhered to, while for other items the suppliers who would be involved for supply of equipments and materials are to be proposed by the Contractor during detailed engineering with the documentary evidence of having supplied similar equipment, systems and/or materials for similar applications with proven track record in hydrocarbon processing Industry/chemical industry. Any change for new contractor/ supplier after award of contract for supply will not be permitted. It may be necessary to purchase certain items as a system and not as individual equipment. These have to be identified and furnished during detailed engineering for approval of the EIL / Owner.

2.8 WASTE DISPOSAL

All wastes generated like surplus earth after use / surplus construction materials will be disposed-off from time to time to the disposal locations as mentioned elsewhere and as directed by the Engineer-in-Charge.

2.9 DESCRIPENCIES/VARIATIONS IN SPECIFICATIONS/STANDARDS

During pre-bid stage, it is necessary for the bidders to bring out variations, deviations, if any, in related data sheets, drawings, specifications, standards, codes, scope and any other contractual clauses as per the format given in the bid document and seek pre-bid clarifications.

In case of any contradiction on specification brought out in bid or at the post award stage of job, decision of EIL/ Owner shall be binding upon the Contractor.

2.10 SUPPLY OF CONSUMABLES & CHEMICALS

Supply of all chemicals (including oxygen scavenger and biocide), spares and consumables required for the Operation and Maintenance of the plant during start-up, pre-commissioning, commissioning, trial runs, performance guarantee test runs and during O&M duration shall be in the scope of supply of the contractor. Special chemicals required, if any, shall be clearly defined by the bidders with respect to quality & quantity and the supply of the same shall be in contractor's scope. Minimum two Nos. of manufacturers shall be specified by the bidder for these special chemicals. Unloading/handling of all chemicals, spares and consumables (including provision of necessary facilities) shall be done by the contractor.

2.11 COMMISSIONING

The contractor's scope covers preparation of operating and maintenance manual and supply of all initial fill such as lubricant, chemicals, consumables, spares, required for startup, pre-commissioning and commissioning. The contractor shall also supply all chemicals as specified in above clause. The scope also includes providing manpower and organization chart. Commissioning scope shall also include onsite training of OIL Staff.

POST COMMISSIONING

The contractor's scope covers Operation, Maintenance and Running of the ETP for a period of **TEN YEARS** reckoned from the Date of Successful Commissioning. For scope of work of O&M contract refer to Specification No A843-806-17-44-OM-01 attached elsewhere in the tender.

2.12 PERFORMANCE AND GUARANTEES

Performance tests shall be started when the Plant is stabilized under design conditions. The Plant shall be operated and controlled in accordance with procedures set up beforehand. The comparison of the performance measured during performance test and performance guarantees mentioned in bid document, shall be ensured.

Performance Guarantee Test Run (PGTR) shall be carried out to determine the following guarantees:

- Hydraulic Capacity of the plant
- Treated water quality as per the parameters given in the Process Design Basis (Doc. No. - A843-806-17-44-DB-01).

The PGTR shall be conducted after successful stabilization of the Plant. Any defects found in design, workmanship or in any of the equipment shall be rectified by the contractor at his own cost within a reasonable time to be decided by the Engineer-in-Charge and the system shall be tested again for faultless running for one month to the entire satisfaction of the Engineer-in-Charge before conducting PGTR again.

2.13 PROJECT MANAGEMENT

Effective project management within time frame is also a part of the contractor's scope. The system of organization and control, feedback and corrective measures, communication and project execution scheme to be submitted.

Planning scheduling and monitoring is essential for timely completion of the project and effective project management system to be adopted is enumerated.

2.14 SPECIAL TOOLS & TACKLES

All facilities including special tools and tackles required for smooth operation and maintenance of the Plant shall be provided by the Contractor and shall form part of the scope of supply.

3.0 BATTERY LIMIT CONDITIONS

Feed effluent lines from the OCS's, and natural gas (NG) line to ETP shall be made available at the ETP battery limit. Exact locations shall be finalized by EIL during detail engineering. The combination of the feed effluent lines into a single header at ETP B/L shall be in the scope of the ETP Contractor.

Also, all out-going lines from the ETP (except for storm water drain which shall be connected to the nearest storm water drain) shall be terminated by the contractor at the ETP battery limit. Exact locations shall be finalized by EIL during detail engineering.

Hook up for meeting the fire water demand for the proposed ETP shall be taken from a pressurized fire water line of M/s OIL (ITF region, south of proposed ETP). Hooking up for the fire water network for new ETP from the existing Fire water line in ITF region shall be in ETP Contractor's scope.

Also refer to scope drawing & other tender drawings/documents for battery limit conditions.

4.0 SCOPE OF SUPPLY

The Contractor's scope of supply of equipments in general shall be as given in the Equipment List, datasheets, drawings, and in the tender document.

For all the equipments listed in tender or as required to make the plant complete in all respects to deliver the required quantity & quality of ETP treated water, the Contractor has to supply piping, valves and fittings, instruments, electrical items, filter media, etc. and all other items as indicated in the equipment list, data sheets, P&ID's, PFD's etc., or as required to make the plant complete with respect to safe & trouble free operation of the plant.

Contractor shall also provide one **Double Storied Chemical House Building** within the ETP battery limit. Chemical house Building shall house chemicals required for twenty days requirement in ground floor based on chemical solution strengths & dose rates specified in the datasheets, otherwise as per process requirements & shelf life. The chemical house shall also house a maintenance-cum-store room, check & change room, laboratory room, toilet, etc. as per details given in the datasheet for Chemical House. Area for chemical solution preparation & dosing facilities, etc. shall be provided on first floor of the chemical house. One drinking water tank (sintex or equivalent make), one overhead service water loft tank, one weighing scale of 100 kg capacity shall also be provided. Sizes of the room & chemical house shall be as reviewed & approved by EIL during detail engineering. The bidders shall go through all the requirements given in various standards/specifications attached with the tender for sizing of the Chemical House. Any increase in the size during detailed engineering review shall have no implications of time and cost to the Owner on this account. Also, required numbers of Exhaust Fans shall be provided.

One no. of Substation-cum-Control Room building shall also be provided by the Contractor within the ETP battery limit as per specifications / standards / drawings attached elsewhere in the tender document. This building shall house all the MCCs of the ETP and control room for ETP (with AC environment) apart from other requirements (battery room, pressurization room, UPS room etc.).

Contractor shall also provide one Centrifuge Building which shall be RCC frame structure - double storied - open from all sides on ground floor for truck movement, while on first floor, low height wall on all sides to prevent water collection shall be provided with RCC roof above. Chain pulley block with monorail shall be provided on first floor of the building.

The ETP battery limits area shall be paved as per the specifications given elsewhere in the tender. The air compressor and instrument air package shall be provided under a common shed as per the specifications/ standards/ drawings attached elsewhere in the tender document. The sizes of the shed shall be reviewed and approved by EIL during detailed Engineering.

The bio-remediation package supplier shall have installed similar systems for bio-remediation of oily sludge. PTR of the system supplier for bio-remediation system shall be submitted by the ETP Contractor during the detail engineering review (after award of work) for EIL/OIL approval.

All working & standby pumps (including warehouse store standby) shall also be provided with the respective motors.

Rated capacity of all the blowers shall be minimum 10% more than the normal process requirements. Also, head of all the pumps shall be minimum 10% more than the total calculated head (including static head and losses in pipes, fittings, instruments, etc.) based on normal process requirements.

Capacities, pressure requirements, etc. as given in various process datasheets for chemical dosing system shall be reviewed & approved during detail engineering based on the calculations for chemical requirements for the system. Also, sizes/specifications as given in various other process datasheets of the tender are minimum requirements, which are to be followed by the contractors as a minimum. Higher sizes, if process design demands, shall be provided by the contractors at no extra cost to the owner. These are part of the detail engineering review/approval by EIL.

Effective liquid depth (side water depth) shall be considered between Low Water Level (LWL) & Top Water Level (TWL) and shall exclude free board & dead volume depth (liquid depth below LWL). Also, for all pumps with flooded suction, LWL in the tank shall be above the top of pump casing.

Recirculation lines as per process requirements are to be provided by the vendor for the pumps even though the same might not be indicated in the tender PFDs/P&IDs.

None of the special chemicals shall be single vendor supply.

4.1 Scope of Supply (ISBL Works)

The following constitute the inside battery limit (ISBL) works, which shall be a part of the contractor's scope of work:

- All works within ETP battery limit for treatment of 210 m³/hr feed effluent on continuous basis.

The proposed plant shall be designed for the conditions as specified in the Basic Engineering Design Basis (Document No. A843-806-17-44-DB-01) and/or as described in this specification or elsewhere in the tender document.

Equipment list for inside battery limit works shall be as per “Equipment List (**EIL Document No. A843-806-17-44-EL-01**)”. Bidders may include in his scope any additional requirements, if so warranted to meet process guarantees.

4.2 Operation & Maintenance Contract

All works required for Operation and Maintenance of the plant as per bid specification no. **A843-806-17-44-OM-01** shall be included in the contractor’s scope of supply.

5.0 TREATMENT PHILOSOPHY

The treatment for meeting the specified/guarantee quality in the ETP can be broadly divided into following sections:

5.1 Pretreatment section (for bulk removal of Oil and TSS)

This includes feed water receipt with necessary facilities for effluents received, treatment for removal of oil & suspended solids with the use of equalization tank, TPI separator and DAF system.

5.2 Oil Polishing Section (for final polishing of Oil and TSS)

This includes removal of residual oil & suspended solids to desired specifications using walnut shell filters.

5.3 Re-injection water treatment

De-oxygenation system shall be provided for the elimination of DO in water. To control the SRB & other bacterial activity in the water, biocide dosing system shall be provided before the produced water is sent for re-injection/ well disposal.

5.5 Sludge Handling Section

This section comprises of handling of sludge generated through the pre-treatment stage. It involves collection, thickening and pumping of the sludge to the bio-reactor and centrifuge for final dewatering of the sludge before disposal.

5.6 Slop Oil Handling Section

This includes facilities for collection of wet slop oil from the equalization tanks & TPI, separation into dry slop oil & water and dry slop oil pumping to OSBL.

5.7 Chemicals Handling Section

Contractor shall supply all facilities for unloading and transfer of chemicals as per tender requirements. Also, handling of various other chemicals required to be dosed at various stages of the treatment is included in this section. Chemical storage, solution preparation

and dosing requirements along with safety provisions required form part of the same. Chemical handling facility shall be located in the Chemical House Building of the ETP.

5.8 VOC Handling

Handling of Volatile Organic Compounds (VOC) in terms of their collection from oil handling units, routing to central VOC handling facilities and treatment in package units to meet the VOC emission norms (90% removal of VOC) shall form a part of ETP Contractor's scope of work. During detail engineering, vendor shall submit details of VOC control system proposed by them for EIL's review & approval.

6.0 PROCESS DESCRIPTION

6.1 PRIMARY TREATMENT

6.1.1 Equalization Tanks

Equalization tanks receives effluent coming from existing Formation Water Tanks. The effluent having hydraulic and pollutant load fluctuations is equalized in these tanks. The tanks are provided with the facilities for oil skimming and desludging. The homogenous effluent from Equalization tanks is pumped out at a controlled flow rate for further treatment.

6.1.2 Tilted Plate Interceptor

Free oil (Dia.>60 μ) present in the above streams is to be removed with the help of density difference between the dispersed phase (oil) and the dispersion medium (water). In order to provide effective surface area, number of inclined oleophilic plates are provided. To achieve this Tilted Plate Interceptors (TPI) system is envisaged. Number of feeding channels, inclination and space between the plates shall be properly provided with respect to Oil and TSS loads. Standby bays shall also be provided to facilitate maintenance / repair. Due to the possibility of VOC emissions, TPI unit shall be covered and provided with suitable vents connected to VOC handling system. To skim the free oil from the surface, slotted pipe skimmer shall be provided. Sludge settled at the bottom shall be scrapped off through the sludge pit.

6.1.3 Flash Mixing Tank

The effluent is pumped to a Flash Mixing Tank where acid and PAC (Coagulant) are dosed into the Flash mixing tank for coagulation. Raw effluent is mixed with these chemicals and will then enter the mixing zone of Flash Mixing Tank.

6.1.4 Flocculation Tank

Coagulated water from Flash Mixing Tank will pass into the Flocculation tank where DOPE is added and mixed by means of a slow mixing through slow speed drive (Paddle type agitator) in the Flocculation tank so as to allow formation of flocks.

6.1.5 DAF Tank

Free & Emulsified oil (particle Dia < 60 μ) as well as TSS present will be removed by chemical flocculation followed by floatation in a Dissolved Air Floatation Unit (DAF). The DAF process relies on the release of dissolved air as a cloud of micro bubbles into the incoming effluent stream. The water saturated with Air is received from the saturation vessel. The bubbles attach themselves to the emulsified oil globules and lift them onto the surface to form a floating blanket. De-emulsifying agents are also employed in the floatation units to break the oil in water emulsion by neutralizing the charge carried by oil droplets. The oily layer (Scum) is formed at the surface and is skimmed off by skimmer mechanism.

The above process helps to bring up the floating materials to the surface of the DAF unit, where the sludge containing the TSS is scraped off at the bottom with the help of a scraper. Settled sludge is removed from the bottom with help of a screw auger.

6.2 SECONDARY TREATMENT

6.2.1 Walnut Shell Filter (WSF)

The DAF outlet water is passed through Walnut Shell Filters where the residual oil and suspended solids in the water are removed and other impurities are retained in the outlet. The filters shall be provided with suitable backwash arrangement with filtered water. The backwash effluent from the filters shall be sent to the Oily Effluent Collection Sump from where it shall be pumped back to the Equalization Tanks.

The treated water from the Walnut Shell Filter with Oil < 10 ppm and 98 % removal of suspended solids >10 μ will be sent to the Injection Water Storage Tank.

6.3 RE-INJECTION WATER TREATMENT

To achieve the desired dissolved oxygen in the treated produced water for re-injection, the DO in water shall be removed in a de-oxygenation system (1 No.). Further to control the SRB & other bacterial activity in the water, biocide dosing shall be provided before the produced water is sent for re-injection/ well disposal. The treated water shall be then sent for re-injection/ well disposal using Injection Water Booster Pumps.

The contractor can provide mechanical de-oxygenation system consisting of any one of the following four (4) options to achieve 0.2 ppm of dissolved oxygen in treated water at mechanical de-oxygenation system outlet:

Option-1: Mechanical de-oxygenation (Stripping by Steam)

Steam required for this option (or any other utility) will not be supplied by M/s OIL to the ETP contractor. Provision of a new steam generation facility (including new boiler, DM water production, etc.) and cooling facilities for de-oxygenated injection water, as required including all other associated facilities shall be in the scope of the ETP contractor. Regeneration waste water/reject from the DM water production system shall be terminated by ETP contractor at ETP B/L at pressure for further disposal by M/s OIL.

Option-2: Mechanical de-oxygenation (Stripping by Nitrogen Gas/Instrument Air and catalytic burning)

Nitrogen Gas (or Instrument Air) required for this option (or any other utility) will not be supplied by M/s OIL to the ETP contractor. Provision of a new nitrogen generation/storage facility as required including all other associated facilities shall be in the scope of the ETP contractor. Alternatively, in case instrument air is used (in place of nitrogen) for stripping after passing through catalytic bed, capacity of instrument air package (to be provided by the ETP contractor) shall be finalized accordingly to accommodate additional instrument air required for stripping. Provision of a new fuel storage facility as required (including supply of fuel during entire O&M contract duration of 10 years) shall also be in the scope of the ETP contractor.

Option-3: Mechanical de-oxygenation (Stripping by Natural Gas)

Natural gas required for this option will be supplied by M/s OIL to the ETP contractor at ETP battery limit (on chargeable basis). The oxygen containing natural gas shall be cooled, passed through a water separator for separating any water particle entrained in the gas, compressed (as per requirement) and sent back to the fuel gas header. ETP contractor's scope is limited to pipe routing up to ETP battery limit at battery limit pressure and other conditions which shall be finalized during detail engineering.

Option-4: Mechanical de-oxygenation (Vacuum De-oxygenation: single stage or multi stage)

Complete de-oxygenation package for removal of dissolved oxygen under vacuum consisting of all the facilities & equipments as required (including vacuum pumps) shall be in contractor's scope. If required, feed water to vacuum de-oxygenation system may be cooled (using a direct once through package FRP cooling tower or air cooler or by other means) before feeding to vacuum de-oxygenation unit. Complete cooling & other associated facilities as required shall also be in ETP contractor's scope. It shall be ensured that the maximum water / vapor loss through the entire mechanical de-oxygenation system shall be $\leq 5\%$.

General Requirement for selection of option:

- For the selected mechanical de-oxygenation system, bidder shall take back-up (for design, engineering, supply of critical items if applicable, commissioning assistance, O&M training of bidders personnel) from technology/know-how/design/system supplier having PTR (Proven Track Record) in designing/supplying the selected technology for similar application (similar application shall be considered as de-oxygenation of produced water, sea water or any other type of water or wastewater at any inlet temperature or dissolved oxygen to achieve reduction in dissolved oxygen to 0.2 ppm or less at the mechanical de-oxygenation outlet). The bidder/technology/know-how/design/system supplier shall submit suitable documentary evidences from purchaser of that system to establish the PTR requirement for mechanical de-oxygenation system.

- A provision shall be mandatorily kept by the contractor for dosing of oxygen scavenger at the outlet of Mechanical De-oxygenation system to meet any eventuality of non-compliance to treated water specification. The chemical dosing system shall be designed for reduction of DO from 1 ppm to 0.2 ppm. However, the EPC/LSTK contractor shall be responsible for providing guarantee of 0.2 ppm DO at mechanical de-oxygenation system outlet during PGTR and during O&M of the plant for 10 years.
- All facilities & equipment as required for the selected option for successful commissioning, compliance to performance guarantees, and successful operation of the mechanical de-oxygenation system and ETP during entire O&M duration shall be in the scope of the ETP contractor. Material of various equipment shall be suitable for the application and shall be in general compliance with material specified for other equipments in this tender (proposed material shall be reviewed by EIL/Owner during detail engineering). All rotating equipments (pumps, blowers, compressors, etc.) shall be provided with minimum one number of standby equipment of same specifications as operating equipment.
- Total bore-well water supply for consumption in entire ETP is limited to maximum of 72 m³/day. Beyond this, the excess water demand shall be met from a new bore-well system (digging of new bore-well, piping, pumps, motors, etc.), which shall be in the scope of the ETP contractor. Statutory permission for installing the new bore-well is excluded from ETP Contractor's scope.
- Utilities as required for the selected technology/system, which are not available at site at present, shall be generated/stored by the bidder and necessary facilities as required shall be included in bidder's scope.
- Electric Power (on chargeable basis): Electric power (maximum up to 1200 KW) required for ETP Operation during start-up, pre-commissioning & commissioning shall be supplied by M/s OIL free of charge. However, the cost of electric power consumed by the contractor for ETP operation during entire O&M period of 10 years shall be borne by the contractor. M/s OIL shall supply maximum 1200 KW to the contractor for ETP operation, beyond which the excess power required by the contractor shall be arranged by the contractor himself (by supplying DG set). Diesel required for DG set for the entire ETP operation during start-up, pre-commissioning, commissioning & O&M period of 10 years shall be supplied by the contractor. Also, the actual electric power supplied by M/s OIL shall be charged from the contractor at electricity cost defined in commercial part of the tender document. The contractor shall install an electricity energy meter (of M/s OIL approved make) within ETP for accounting of the actual electric energy consumed. The cost of actual electric energy supplied by M/s OIL shall be suitably adjusted from contractor's monthly O&M bills as per provisions specified in commercial part of the tender document.
- Natural Gas (on chargeable basis): Natural Gas required for ETP Operation during start-up, pre-commissioning & commissioning shall be supplied by M/s OIL free of charge. However, the cost of natural gas consumed by the contractor for ETP operation during entire O&M operation shall be borne by the contractor. M/s OIL shall supply natural gas to the contractor at ETP battery limit. The actual quantity of natural gas supplied by M/s OIL shall be charged from the contractor at cost defined in commercial part of the tender document. The contractor shall install a flow transmitter for accounting of the natural gas consumed. The

cost of natural gas supplied by M/s OIL shall be suitably adjusted from contractor's monthly O&M bills as per provisions specified in commercial part of the tender document.

6.4 SLUDGE HANDLING

Sludge generated in the pre-treatment units shall be collected in Oily and Chemical Sludge Sump and then pumped to the Oily and Chemical Sludge Thickener. The supernatant from the thickener shall be recycled back to the Oily Effluent Collection Sump.

The thickened sludge from the thickener shall be routed to the Thickened Oily and Chemical Sludge Sump and then pumped to the bio-reactor and the centrifuge. The water from the Centrifuge shall be routed to the Oily Effluent Collection Sump and the sludge shall be sent for disposal.

6.4.1 BIO-REMEDIATION

The thickened sludge from the Thickened Oily and Chemical Sludge Sump shall be pumped to the confined Reactor based Bio-remediation System for treatment of oily and chemical sludge in the proposed ETP package including O&M duration. The Bio-remediated sludge shall meet the TCLP (Toxicity Characteristics Leaching Procedure) test as per the USEPA Guidelines.

Disposal of the bio-remediated and centrifuge dewatered sludge from the ETP to the disposal location (including transportation through tractor-trolley) shall not be a part of ETP Contractor's scope and the same shall be carried out by M/s OIL.

6.5 SLOP OIL HANDLING

Wet Slop Oil from Equalization Tanks and TPI Separator is collected in Wet Slop Oil Sump and pumped to Dry Slop Oil Storage Tanks by Wet Slop Oil Transfer pumps. After providing settling time to the wet slop oil, the water shall be drained from bottom of the tank. The remaining Dry Slop Oil shall be pumped to OSBL by Dry Slop Oil Transfer Pumps.

6.6 CHEMICAL HANDLING

An integrated and centralized system shall be envisaged for chemical solutions preparation in Chemical House and dosing at various points.

Chemical dosing system shall be suitably located on first floor of the chemical house; whereas provision for chemicals storage shall be made on the ground floor. Bulk liquid chemicals such as Conc. Hydrochloric acid shall be stored outside the Chemical house in a dyked area. Loading from the supply tankers and dosing to the respective location in ETP shall be done by their respective unloading pumps and dosing pumps. These tanks shall be provided with dyke wall. HCL bulk storage tank shall be located within ETP B/L with the required facilities.

Minimum 2 Nos. of dosing tanks shall be provided for solution preparation and dosing of each chemical (except HCl, and Bio-rem Chemicals). Majority of the chemical handling

operations i.e., introduction of chemicals into solution preparation tank, addition of water for dilution, agitation and subsequent transfer by the respective dosing pumps shall be designed such that minimum manpower would be necessary. The dosing tank capacities (each tank) shall be designed for 12 hours requirement of dosing chemicals.

6.7 VOC HANDLING

As a minimum requirements, the VOC control system shall consist of vents, carrying pipes, valves, required set of ID fans (each set provided with standby unit), flame arrestors, carbon filters (activated carbon & quartz as media) and a vent (12" diameter x 12 m high) to take out the VOC stripped air from the system. Entire piping network from individual units up to the vent including slip fits, flapper valves, gate valves, butterfly valves, reducers, expanders, spring loaded air breather valve on slop oil tanks etc. shall be provided. Three (3) Nos. of carbon filters are to be considered as minimum requirement. Each filter shall be provided with all internals (distributor, collector, fixing arrangements), manholes, hand-holes (minimum 150 mm dia. for media removal), nozzles, media traps (316 stainless steel), distributors, water spray, collectors, frontal piping with valves etc., with epoxy painting inside and including full charge of filter media, as required. Each of the carbon filter bed shall be sized to handle normal flow of total VOC emissions from the ETP. However, as a safeguard to meet VOC treatment requirements, two of the filters shall operate in series as Primary & Secondary filters. The third filter shall be a standby and brought to service when one of the filters gets exhausted. Flexibility shall be provided to operate any of the filters as either Primary or Secondary filter. Flame arrestors shall be provided in the slop oil tanks header and in the main collection header to help protect the upstream equipment in case of detonation. Each of the carbon filters shall be equipped with temperature sensors (temperature transmitter and temperature gauge) with associated high and high-high alarms to sense overheating of the carbon beds and help the operator to take corrective actions. The standby ID Fan shall auto start as per safety requirements during overheating of carbon bed. Interlocks shall be provided to initiate the fire suppression system in case the bed temperature exceeds the High-High set value. On actuation of the High-High temperature alarm, the quenching valves (SOV) provided at inlet & outlet of each filter shall auto open to spray water in the carbon bed to arrest the rise in Temperature. Low point drains shall be provided to drain out water from the collection header. Differential Pressure transmitter with low and high alarms shall be provided across each flame arrestor to measure the pressure drop. If the pressure drop becomes significantly high, the flame arrestor's element shall be cleaned / replaced. A bypass across the flame arrestor shall be provided to facilitate cleaning/ replacement of the flame arrestor. Differential Pressure transmitters shall be provided in each of the carbon beds with low and high alarms. If the pressure drop in a bed becomes significantly high, the filter shall be isolated and the standby filter shall be taken in line. On-line Hydrocarbon Analyzer shall be provided in the common header upstream of the carbon beds to measure the VOC entering the beds. Also, on-line Hydrocarbon Analyser and CO analyzer shall be provided in the downstream of the ID Fan to monitor the carbon monoxide (CO) levels before the air is vented out. All signals shall be available in the control panel. Flow & pressure transmitters, pressure gauges and other instruments shall be provided as required for safe & trouble free operation of the entire VOC collection & treatment system.

7.0 FIRE PROTECTION SYSTEM

Contractor shall provide fire protection system inside the ETP area and hook up with battery limit valve considering the following and as per codes, specifications and standard. Fire protection system shall be provided as per OISD requirement and requirements of TAC and include the following fire protection systems:

- Fire water network around ETP
- Double headed hydrants & water cum foam monitors for inside ETP. Water/ Foam Monitors shall be BIS approved.
- Landing valves and hose reels for double storied buildings and at staircase landing of platforms.
- Hose cabinets with hoses and accessories. Hose reel shall be 40m long of 20mm bore size. Hose shall be reinforced rubber line (RRL) 2 nos 15m each kept in each hose cabinet. Hose cabinet shall be BIS approved installed at every alternate hydrant points and every landing valves.
- Isolation valves
 - Isolation valve shall be provided below monitor and at all hydrants.
 - Isolation valve shall be provided at all tapping points on firewater headers.
 - Isolation valves shall also be provided at junction of each segment for proper maintenance.
 - Landing valves on tech structure, platforms, columns, and buildings shall have individual 4" isolation valve at each hydrant.
 - Only carbon steel valves shall be used. No cast iron valves shall be used.
- **Restriction Orifice:** Suitable restriction orifice shall be provided in fixed medium velocity water spray systems to maintain the pressure requirements as per TAC/ OISD.
- Providing semi-fixed foam system and manual medium velocity water spray system on hydrocarbon storage tanks as per OISD. Foam connection shall be through pickup drum located near foam couplings. Foam drum shall be sized to provide tank roof protection by foam system for 65 minutes. First time filling of foam pickup drums shall be in the scope of contractor
- First Aid Fire protection (Portable Fire extinguishers) as per TAC/ OISD
- Supplying and erection of First Aid Fire protection system (portable fire extinguishers) as per OISD/ TAC rules.
- The firewater header and branch lines shall be laid above ground on independent sleepers. In the paved area, fire water header shall be laid underground.
- Automatic (deluge) high velocity water spray system shall be provided for hot oil transformer with oil capacity more than 2000 liters. Actuation of deluge valve shall be with the help of Quartzoid bulb (QB).
- The minimum header size for hydrant and monitor branches shall be as under

• Hydrant connection	-	4"
• Water Monitor/Foam Monitor connection	-	6"
• Long Range Water cum Foam Monitor	-	8"
• Minimum Size of Network	-	8"

- All the equipments connected with fire water system shall be BIS marked or from companies which carry ISO certification and FM/ UL listed.
- The contractor shall meet the requirements of TAC/ OISD recommendations, over and above the requirements which are mentioned above.

All carbon Steel underground piping shall be provided with corrosion protection as per spec. no. 6-79-0011 "Specification for Corrosion Protection Tape coating of underground steel pipelines.

8.0 COMMISSIONING SPARES

For successful pre-commissioning, commissioning and performance testing, requirements of spares are to be included by the contractor within quoted lump sum price.

9.0 PROCESS DESIGN BASIS

The general process design requirements (including Feed and Re-injection water qualities) of the Plant are described in the Process Design Basis (**Document No. A843-806-17-44-DB-01**).

10.0 INSTRUMENTATION AND CONTROL PHILOSOPHY

The plant shall be PLC based system as given in job specifications for instrumentation works. The control system should have provision for connection to the SCADA system of OIL for seamless data transfer. The PLC shall be located in the control room housed in the Substation-cum-Control Room Building. All works for instrumentation and control shall be as per Instrumentation Job Specifications. Instrumentation works specified in this section are minimum requirements and shall be considered by the contractor in his scope of work. All other instrumentation works requirements as per tender drawings (PFDs, P&IDs, etc.) and as specified elsewhere in the tender or as required for safe and trouble free operation of the plant shall also be included in the Contractor's scope of work.

For tanks/sumps/pits, only Non-Contact SMART Radar type Level Transmitter (including the interface level) shall be used as primary level measurement device and for secondary level measurement, servo type shall be provided. No level switch shall be used unless specified otherwise. Switching action shall be in PLC. No displacer type level measurement shall be considered. Level transmitter shall be used for local & control room level indication and for tripping purposes (including low & high levels alarms in the control room).

10.1 Incoming and Outgoing Lines

Suitable type flow measurement systems (orifice type for fluids without solid particles and magnetic type for fluid with solid particles) with local and control room indication along with recording and totalizing facilities (in Control Room) shall be provided on all incoming lines and outgoing lines.

10.2 Walnut Shell Filter

Each Filter shall be provided with PG at the inlet and Outlet. Outlet line to the filters shall be provided with flow element with transmitter, indicator, integrator / totalizer for flow indication. The Filter shall be provided with local & panel differential pressure indicator, differential pressure transmitter high and corresponding alarm across the inlet and outlet. In case the DP transmitter reaches high alarm the inlet valve of the filter shall be closed and the filter taken off line and the standby filter shall be taken in line. On activation of high Differential Pressure alarm, the filter shall be taken under backwash automatically. Backwashing of the filters shall be done by using filtered water from Injection Water Storage Tank. Air scouring facility shall also be provided for the Filters if recommended by the System Supplier.

10.3 Sumps / Tanks and Transfer Pumps

Each of the sumps shall be provided with a level transmitter (LT) and a Level Indicator (LI). All of the tanks shall be provided with 2 level transmitter (LT) and a Level Indicator (LI). The operating pump shall auto start at high (set) level in the tank as per process/ operating philosophy. All the operating pumps shall auto trip at level low. The level transmitters shall also have corresponding alarms. This logic shall be generally applicable to all tanks / sumps, unless otherwise specified.

10.4 All Solution preparation/dosing Tanks and Pumps

Each of the tanks shall be provided with local level indication/gauge and level transmitter with high/low alarm and auto tripping of the corresponding dosing pumps and agitators at low level. All tripping and alarms shall be configured on the PLC for the ETP. All the dosing pumps (Diaphragm type) shall have pressure safety relief valves at their respective discharge lines (if not provided internally). Local flow indicators shall be provided on the discharge line on the dosing pumps. If the same pumps are dosing a chemical at more than one place then those line shall be provided with individual local flow indicators.

10.5 General

- All pumps shall have Pressure Gauge (PG) on their discharge lines. The PG on all sludge and chemical services shall be of diaphragm type.
- All motors shall have their running indication in the Control Room
- All motors shall have local start / stop facility. The motors having interlock facility shall have local / remote selector switch (local), auto / manual switch, start / stop push buttons and main / standby switch in Control Room to facilitate remote operation.
- All required start/stop push buttons, selectors, etc. for operation of various equipments shall be through soft keys in the PLC Console.
- In case a motor is already running, there should not be a stoppage due to mode change over from local to remote and vice-versa. This is equally applicable for mode change over from auto to manual and vice-versa.
- For all pumps/blowers acting on interlocks/program, if the running pump/blower fails, the standby pump/blower shall start automatically provided it is in Auto mode. However, manual override arrangement for the same shall also be available. All pumps/blowers are interchangeable.

- Under no point of time both the operating and standby pumps/blowers shall run together in auto mode. However the same is not applicable for manual mode.
- In case of more than two pumps, provision of alarm shall be made only for the highest cut-in level and not for intermediate cut-in levels, unless otherwise specified. In auto mode removal of high level signal should not cause stoppage of the running pump. All pumps are interchangeable and start to depend on the liquid level in the sump, i.e. as the level in the sump rises, pumps to correspondingly get activated.
- Effective Liquid Depth of units shall be considered between levels corresponding to Lowest Water Level and Highest Water Level. Flooded suction requires that lowest switch level shall not be lower than the elevation of discharge flange of pump.
- All sumps and pumps shall be provided with appropriate instrumentation for alarms and auto operation (start/stop) of pumps with respect to preset levels.
- No direct level switches shall be used in the ETP. Instead level transmitters shall be used for all sumps and tanks. These transmitters shall be connected to PLC system and software switches shall be generated for interlock/alarm.
- No direct process switches shall be used in the ETP. For Pressure, Diff. pressure, Flow, Temperature, Level, etc., transmitters shall be used and switching action shall be carried out in PLC.
- All instrumentation as required for monitoring and control of process and operating parameters in the ETP system to be provided. Also to be provided are suitable instruments to measure the consumption of various chemicals and utilities for establishing the system performance during performance guarantee test run.
- Type of all instruments shall be as per Instrumentation Specifications. For all the instruments, standard EIL specifications shall be followed.
- On line analyzers and other instruments with corresponding panel display in control room for the plant shall be as per P&IDs and tender specification.
- For detailed instrumentation, tender P&IDs shall be referred. However, necessary instrumentation shall be provided in addition to that indicated in P&IDs and as deemed necessary during detailed engineering.

10.6 On-line analysers

On line analysers with corresponding panel display in control room on different lines as per the P&IDs shall be provided as minimum requirements.

Equipment for measuring Oil and TSS particle size distribution in feed/treated water shall also be provided by the contractor.

All other analyzers as indicated elsewhere in the tender, P&IDs, drawings, document or as required for smooth & trouble free operation & control of the plant shall also be included in the Contractor's scope of work.

11 GENERAL DESIGN REQUIREMENTS

- It may be noted that all the pumps which are to be located below FGL shall have a suitable pump house building having RCC construction below FGL and RCC lintel and brick masonry work above FGL. For pumps/blowers to be located on grade level, the motors shall be protected by canopies. The pavement and pedestal minimum levels shall be as per relevant

clauses under engineering specifications/standards. The interspacing/ clearances between wet sump and pump pedestal pump pedestal to side/ back walls shall be same as applicable for pumps to be located in a pump house/ dry well below FGL.

- The specifications / requirements specified are bare minimum only; the vendor shall follow Good engineering practices and incorporate maximum operational flexibility in the system.
- Chain pulley blocks with monorail shall be provided for maintenance of pumps, blowers, chemicals, etc.
- Draining arrangement shall be provided for all units, as necessary.
- All effluent holdup tanks shall be provided with overflow lines, Sampling and gauging hatches etc.
- Sampling points shall be provided for each treatment sections.
- Dewatering systems shall be provided with approach roads and adequate space for movement of vehicles to facilitate easy disposal of sludge cake collected.
- Piping class shall be as given below for the indicated services. Corresponding material shall be as per EIL Piping Specifications.

Service	Piping Class
Effluent lines from Battery Limit to Equalization Tank Inlet	A21V
Equalization Tank outlet to DAF system inlet	A21V
DAF Outlet to WSF Inlet	A21V
WSF Outlet to De-oxygenation System Inlet	A21V
De-oxygenation System Outlet to Injection Water Booster Pump Inlet	A1A
Injection Water Booster Pump Outlet to Battery Limit	B1A
Chemical Sludge	A21V
Wet Slop Oil	A1A
Hydrochloric Acid Solution	A91S
PAC Solution	A91S
Dewatering Polyelectrolyte (DWPE)	A91S
Demulsifier	A91S
Polymer (DOPE)	A91S
Biocide	A6K
Oxygen Scavenger	A6K
Service Water/ Bore Well Water/ Fire Water	A3A

Service	Piping Class
Plant Air	A3A
Instrument Air	A1K \leq 1" Line Size A3A >1" Line Size
Drinking water	J2A
For all incoming lines, same class of piping, as available at the Plant battery limit, shall be used up to their respective first unit. Material, for services not listed here, shall be subject to EIL's review and approval during engineering. <u>In case, different material & line size is specified in the tender drawings (Schematic Flow Diagram, PFDs, P&IDs, etc.), the material & line size specified in the drawings shall be governing.</u>	

➤ Following type of valves shall be used for the indicated services.

Service	Valve Type
Effluent / Water /Slop Oil Lines	Gate, Globe Valves & Butterfly Valves
Sludge Lines	Diaphragm Valves (PTFE) / Gate Valves
Conc. Hydrochloric Acid	Ball Valve
Caustic Lines	Plug Valve
Chemical Solution Lines	Ball Valves
Sampling Lines	Gate followed by Globe Valve
Other type of valves such as Check Valve (NRV), Control Valve etc. shall be provided, wherever required. Isolation valves shall be provided in each unit as per the valve specs. MOC of the valves shall be compatible with MOC of the pipe.	
Spectacle blinds shall be provided downstream of all tank drain lines as well as at other main isolation places, wherever required.	
Piping components and its type shall be provided, as appropriate, which shall be subject to EIL's review and approval during Detailed Engineering.	

12.0 GENERAL ENGINEERING SPECIFICATIONS

NOTE: Bidders to refer clauses relevant to respective units/equipment in the Bidding document

- 12.1 All pumps shall be flooded suction type, unless otherwise specified, fully primed under Low Liquid Level in the suction sump/ tank. Low Liquid Level shall be above the top of pump casing. The sump floor shall slope towards suction pit/channel.
- 12.2 Flushing connections shall be provided in all sludge handling units and sludge lines.
- 12.3 Motors of all pumps and blowers shall be covered with canopy.

- 12.4 Layout of filters and piping shall be such planned that loading and unloading of media can be facilitated by operator with vehicular approach.
- 12.5 All drains from chemical house to be routed to the local neutralization pit of appropriate capacity and neutralization arrangement before connecting the outlet to drain.
- 12.6 All dosing pumps shall have external pressure safety valves (if not provided internally).
- 12.7 Splitter Box, if provided, shall be provided with scale for flow measurement.
- 12.8 HCl storage tank(s) shall be provided with Fume absorber system.
- 12.9 Agitator in chemical solution tanks shall be located off-center to avoid vortex. Otherwise tanks to be provided with baffles.
- 12.10 Air scour blowers shall be provided with pulsation dampener at their discharge lines. Check valves and pneumatic operated butterfly valves shall be provided at air scouring inlet line to individual filters.
- 12.11 Inverted U type seal shall be provided with a height of seal height that top level of various filters.
- 12.12 Filters shall be provided with adequate expansion space (during backwash).

13 FORMAT FOR CHEMICAL & UTILITY CONSUMPTION FIGURES

13.1 Maximum Consumption Figures for Utilities

Description of Utility	Unit	Hourly Rate (Max.)	Maximum Consumption Figure/day (1 Day = 24 Hours)
Power	kW		
Service Water	m ³ /hr		
Drinking Water	m ³ /hr		
Plant Air	Nm ³ /hr		
Instrument Air	Nm ³ /hr		
Natural Gas	Nm ³ /hr		
DM Water	m ³ /hr		
Cooling Water Make-up	m ³ /hr		
Any Other			

13.2 Maximum Consumption Figures for Chemicals

Description of Chemical	Dosing Rate in ppm (Nor. / Design)	Consumption in kg/d at Design Flow	Purity of Chemical	Solution Strength
HCl				
Demulsifier				
DOPE				

DWPE				
PAC				
Oxygen Scavenger				
Biocide				
Any Other				

All utilities & chemicals shall be listed which are envisaged to be used in the ETP, for regular consumption as well as for start-up/shutdown requirements.

14 LIST OF ENCLOSURES

S. No.	Document/ Drawing No.	Document Title
1.	A843-806-17-44-EL-01	Equipment List (ISBL Works)
2.	A843-806-17-44-DB-01	Design Basis
3.	A843-806-17-44-DS-001 TO A843-806-17-44-DS-064	Process Datasheets
4.	A843-806-17-44-1001 & A843-806-17-44-1002	Process Flow Diagram
5.	A843-806-17-44-1003	Scope Drawing
6.	A843-806-17-44-1004	Indicative Equipment Layout
7.	A843-806-17-44-1111 to A843-806-17-44-1122	P&IDs
8.	A843-806-17-44-OM-01	O&M Specifications
9.	A843-806-17-44-VD-01	Vendor Data Requirements
10.	A843-806-17-44-TC-01	Technical Compliance
11.	A843-806-17-44-COM-01	Pre-commissioning, Commissioning and PGTR Guidelines

STANDARD SPECIFICATIONS

Specification No.	Title	Rev.	Pages
6-66-0004	Standard specification for portable fire extinguisher	0	5
6-66-0011	Standard specification for rubber lined or rubberized fabric lined woven jacketed hose	3	4
6-66-0012	Standard specification for stand post type fire hydrant (with or without pumper connection)	3	5
6-66-0016	Standard specification for foam branch pipe.	3	5
6-66-0018	Standard specification for first aid hose reel	3	4
6-66-0021	Standard specification for stand post type water monitor	3	5

6-66-0027	Standard specification for water cum foam monitor single barrel type.	4	6
6-66-0029	Standard specification for foam chamber equipment for cone roof tanks.	3	5
6-66-0035	Standard specification for landing valve.	3	4
6-66-0046	Standard specification for water spray nozzle for cooling.	3	6
6-66-0047	Standard specification for hose cabinet.	3	5
6-66-0048	Standard specification for deluge valve (with hydraulic detection system)	2	7
6-66-0061	Standard specification for 50 kg. & 75 kg. capacity dry chemical powder extinguisher.	3	5
6-66-0072	Standard specification for fire protection system package for storage tanks.	2	14

INSTALLATION STANDARD

Standard No.	Title	Rev.	Pages
7-65-0420	Installation details of fire water hydrant.	3	1
7-65-0421	Installation details of water or water cum foam monitor, long range foam / water monitor.	2	1

DATA SHEETS

Data sheet No.	Title	Rev.	Pages
A843-806-17-44-DS-0101	Data sheet for Hydrant	0	1
A843-806-17-44-DS-0102	Data sheet for Water cum foam Monitor	0	1
A843-806-17-44-DS-0103	Data sheet for Hose reel	0	1
A843-806-17-44-DS-0104	Data sheet for Hose Cabinet	0	1
A843-806-17-44-DS-0105	Data sheet for Landing Valves	0	1
A843-806-17-44-DS-0106	Data sheet for Deluge valve	0	1
A843-806-17-44-DS-0107	Data sheet for MV Spray Nozzle	0	1
A843-806-17-44-DS-0108	Data sheet for HV Spray Nozzle	0	1
A843-806-17-44-DS-0109	Data sheet for Quartzoid Bulb Detectors	0	1