



**CREATION OF SURFACE PRODUCTION FACILITIES
(OCS & GGS) AT NADUA & EAST KHAGORIJA**

**MPC3 – WATER PACKAGE ENGINEERING
FABRICATION AND SUPPLY**



**VOLUME-II TECHNICAL
FOR EAST KHAGORIJA & NADUA**

 ऑयल इंडिया लिमिटेड Oil India Limited	MODULAR PACKAGE CONTRACT (MPC-3) Engineering, Procurement, Fabrication and Supply of Modular Water Package for OCS, Nadua and GGS, East Khagorijan	

INDEX SHEET - Volume – II (Technical)

SL No.	DESCRIPTION
	Section – I: General
1.0	Introduction
2.0	Scope of Supply
3.0	Site conditions and Utilities
	Section – II: Specifications
4.0	Specification for API 610 Centrifugal Pump
5.0	Specification for Gas Engine Driven Reciprocating Pump
6.0	Specification for Unfired Pressure Vessel
7.0	Specification for Surface Preparation and Painting
8.0	Specification for Insulation
9.0	Functional Specification for Package Instruments
10.0	Specification for Electrical requirements
11.0	Package specification for Civil & Structural works
12.0	Piping design basis
	Section – III: Annexure
13.0	PFD - Effluent Water Treatment System
14.0	PFD - Oily Water Collection System
15.0	PFD - Raw Water System
16.0	PFD - Sewage Treatment Package
17.0	P&ID - Effluent Water Treatment Package
18.0	P&ID - Clarified Water Storage Tank & Clarified Water Booster Pump
19.0	P&ID - Clarified Water Disposal Pump
20.0	P&ID - Skim Oil Tank
21.0	P&ID - Skim Oil Transfer Pump
22.0	P&ID - Off-spec Effluent Water Storage Tank & Pumps
23.0	P&ID - Oily Water Collection System
24.0	P&ID - Industrial Water System
25.0	P&ID - Potable Water Filters
26.0	P&ID - RO Water Makers
27.0	P&ID - Potable Water Storage Tank
28.0	P&ID - Sewage Treatment Package
29.0	Process Design Basis
30.0	Fire Fighting Design Basis
31.0	Isolation Philosophy
32.0	Vent and Drain Philosophy
33.0	Overall Plot plan – East Khagorijan
34.0	Overall Plot plan – Nadua

SL No.	DESCRIPTION
35.0	Piping Material Specification
36.0	Valve Material Specification
37.0	Pipe Stress Philosophy
38.0	Structural Steel Standard Details for Ladder
39.0	Structural Steel Standard Details for Handrail
40.0	Structural Steel Standard Details for Grating

 ऑयल इंडिया लिमिटेड Oil India Limited	MODULAR PACKAGE CONTRACT (MPC-3) Engineering, Procurement, Fabrication and Supply of Modular Water Package for OCS, Nadua and GGS, East Khagorijan	

Section-I

VOLUME-II

1.0 INTRODUCTION:

OIL INDIA LIMITED (OIL) a Government of India Enterprise, proposes to construct two number of Surface Production facilities primarily for separation of Oil, Gas & Water and processing of non-associated & associated gas in its producing field at Nadua and East Khagorijan. The installation will be constructed on Modular design concept with emphasis on skid mounted prefabricated facilities minimizing civil construction work at site to the extent possible as per functional specifications of various process/utility packages. Instead of permanent civil buildings, containerized offices/structures will be preferred.

The NADUA (OCS) oil field is located near Dibrugarh town in Assam. The field is presently producing from 04 Nos. of wells through a QPS (Quick Production Setup). Considering the potential of the field, it is envisaged that Oil production is expected to rise to a level of 1200 KLPD from 15 HP wells and 15 LP wells. Associated Gas is expected to be around 0.2 MMSCMD. Oil India Limited proposes to construct an Oil Collecting Station (OCS) at NADUA to cater to the production in that area. It is also expected that the field will produce about 800 KLPD of water along with the 1200 KLPD of crude, so the plant will be designed for handling 2000KLPD of total well fluid.

The East Khagorijan (GGS) field is located near Dibrugarh town in Assam at a location approximately 200m south (aerial distance) of Loc# TAI at 27°32'N 95°09'E approx. Elevation 121mMSL. The field is presently producing from 02 Nos. of wells through a QPS (Quick Production Setup). Considering the potential of the field it is envisaged that Oil production is expected to rise to a level of 1000 KLPD from 06 HP wells, 06 LP wells and 06 Non Associated Gas wells. Associated Gas is expected to be around 0.1 MMSCMD. The East Khagorijan gas field is expected to produce about 1 MMSCMD of non-associated natural gas from this area. It is also expected that the field will produce about 800 KLPD of water along with the 1000 KLPD of crude, so the plant design will be for handling 1800KLPD of total well fluid. Oil India Limited proposes to construct a Group Gathering Station (OCS + FGS) at East Khagorijan to cater to the production in that area.

Pipelines carrying well fluids to the proposed surface production facilities and pipelines transporting dry crude, separated gas, treated water from the facilities are not in the project scope.

1.1. SUBJECT:

As a part of this development scheme, OIL desires to procure **Modular Water Package** for providing Potable water / Industrial water, Clarified water, Sewage treated water etc. for Oil Collection Station(OCS) at Nadua and Group Gathering Station (GGS) at East Khagorijan in Upper Assam, India.

1.2. SITE DATA

Site information shall specify the environmental condition of the Project site. All information specified herein shall be used for reference for the MPC Contractor's sound Engineering and Design.

All equipment shall be suitable for mounting and operation in the ambient conditions specified below.

Ambient Temperature: 41°C (Max) and 2°C (Min)

Relative Humidity: 98% (Max) and 36% (Min)

Maximum Rainfall for 24 hr. period: 1600mm

For detailed information, please refer to the document "Site conditions & Available utilities".

1.3. SITE LOCATION: Nadua& East Khagorijan

Nadua is a village in Panitola Tehsil in Dibrugarh District of Assam State, India. It is located 20 KM towards East from District headquarters Dibrugarh and 426 KM from State capital Dispur. East Khagorijan is close to Chauba town, located 11km from Chabua Railway station.

Dibrugarh Town Rail Way Station is major railway station 23 KM near to Nadua

Airport: Nearest airport Dibrugarh

1.4. ABBREVIATION

ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
CPCB	Central Pollution Control Board
EK	East Khagorijan
EPCM	Engineering Procurement Construction Management
GGs	Group Gathering Station
MPC	Modular Package Construction
NB	Nominal Bore
ND	Nadua
NFPA	National Fire Protection Association
OCS	Oil Collecting Station
OISD	Oil Industry Safety Directorate
OMR	Oil Mines Regulations

 ऑयल इंडिया लिमिटेड Oil India Limited	MODULAR PACKAGE CONTRACT (MPC-3) Engineering, Procurement, Fabrication and Supply of Modular Water Package for OCS, Nadua and GGS, East Khagorijan	

1.5. DEFINITIONS

COMPANY / OWNER	Oil India Limited
EPCM	Kavin Engineering and Services Private Limited
MPC CONTRACTOR	MPC Contractor executing the package

1.6. DESIGN LIFE

The design life of complete package shall be 20 years.

1.7. CODES AND STANDARDS

CODES / STANDARDS	DESCRIPTION
API 674	Positive Displacement Pumps – Reciprocating
DIN: 24255 / IS 6595	Specifications for Horizontal centrifugal pumps for clear, cold water pumps
IS 8034	Specifications for Submersible Pump
API 610	Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries (Latest Edition)
API STD 674	Positive Displacement Pumps – Reciprocating
API 682	Pumps - Shaft Sealing Systems for Centrifugal and Rotary Pumps (Latest Edition)
API Std. 614	Lubrication, Shaft Sealing and Control Oil Systems for Special Purpose Applications
API 671	Special purpose coupling for refinery purpose
HIS	Acceptance Test for Centrifugal, Mixed Flow and Axial Pumps
IS 2800	Code of practice for construction and testing of tube / bore wells
IS: 10500	Drinking Water Quality standards
ISO 281	Roller Bearing– Dynamic load ratings and rating life
ISO 1940	Balance quality of Rotating Rigid Bodies
ISO 5198	Centrifugal, mixed flow and axial pumps – Code for hydraulic performance tests

 ऑयल इंडिया लिमिटेड Oil India Limited	MODULAR PACKAGE CONTRACT (MPC-3) Engineering, Procurement, Fabrication and Supply of Modular Water Package for OCS, Nadua and GGS, East Khagorijan	

CODES / STANDARDS	DESCRIPTION
ISO:3046-1	Reciprocating Internal Combustion Engine – Performance Part-1: Standard ref. conditions & declaration of power, fuel & lubricating oil consumptions and test methods.
ISO:3046-3	Reciprocating Internal Combustion Engine – Performance Part-3 : Test measurements
ISO:3046-4	Reciprocating Internal Combustion Engine – Performance Part-IV : Speed governing
ISO:3046-5	Reciprocating Internal Combustion Engine – Performance Part-V : Torsional vibrations
ISO:3046-6	Reciprocating Internal Combustion Engine – Performance Part-6 : Over-speed protection
ISO:3046-7	Reciprocating Internal Combustion Engine – Performance Part-7 : Codes for engine power
BS: 5514-1	Reciprocating internal combustion engines- standard reference conditions, declarations of power, fuel and Lubricating oil consumptions and test methods.
ASME Sec. V	Non-Destructive Testing
IS: 5571	Guide for Selection of Electrical Equipment for Hazardous
IS 6533	Code of practice for design and construction of steel chimney
IS 800	Code of Practice for general construction in Steel
IS 12065	Permissible limits of Noise levels for Rotating Electrical Machines
API RP 500	Recommended practice for classification of locations for electrical installations at petroleum facilities classified as Class I, Division I and Division II
API STD 670	Machinery Protection Systems
ASME Sec. VIII Div. 1	ASME Boiler and Pressure Vessel Code – Rules for Construction of Pressure Vessels.
IS 2825	Code for Unfired Pressure Vessels
ASME Sec. II	ASME Boiler and Pressure Vessel Code – Materials
ASME Sec. IX	ASME Boiler and Pressure Vessel Code – Welding, Brazing and Fusing Qualifications

 ऑयल इंडिया लिमिटेड Oil India Limited	MODULAR PACKAGE CONTRACT (MPC-3) Engineering, Procurement, Fabrication and Supply of Modular Water Package for OCS, Nadua and GGS, East Khagorijan	

CODES / STANDARDS	DESCRIPTION
ISO 1940	Mechanical Vibrations - Balance Quality
IS - 875 (Part - 3)	Codes of practice for design loads (other than earthquake) for buildings and structures
IS – 1893	Criteria for earthquake resistance design of structures
CPHEEO	Manuals Guidelines (WTP) for WTP Equipment design

1.8. UNITS OF MEASUREMENT

Dimension	Units	Symbol
Area	Square Metre	m ²
Concentration	Mole	%
Density	Kilogram per cubic metre	kg/m ³
Energy	Kilowatt	kW
Flow rate (Liquid)	Kilo Litres Per Day	KLPD
Flow rate (gas)	Million Metric Standard Cubic Metre per day / Million Metric Standard Cubic feet per day	MMSCMD/MMSCFD
Flow rate (Air/Nitrogen)	Normal Cubic metre per hour	Nm ³ /hr
Length	Meter	m
Mass	Kilogram	kg
Momentum	Kilogram per metre square second	kg/ms ²
Power	Kilowatt	kW
Pressure	Kilogram per square centimetre	kg/cm ²
Specific Heat Capacity	Kilo joule per kilogram Celsius	kJ/kg °C
Thermal Conductivity	Watt per metre Kelvin	W/ m K
Temperature	Celsius	° C
Time	Second	sec
Velocity	Metre per second	m/s

 ऑयल इंडिया लिमिटेड Oil India Limited	MODULAR PACKAGE CONTRACT (MPC-3) Engineering, Procurement, Fabrication and Supply of Modular Water Package for OCS, Nadua and GGS, East Khagorijan	

Dimension	Units	Symbol
Viscosity	Centipoise	cP
Volume	Cubic Metre	m ³

2.0 SCOPE OF SUPPLY

The Scope of supply together with the attachments defines and covers the guidelines for design, engineering, selection of equipment, procurement, fabrication of Water package required for East Khagorijan & Nadua including transportation and delivery of complete package at site.

The Scope of supply is not limited to the below mentioned items, MPC Contractor shall supply all required items for the satisfactory operation of the unit.

The scope of work described below is for one facility, the second facility follows the typical arrangement.

The Water package consists of following systems,

- a. Raw water treatment system.
- b. Effluent treatment system (along with Sludge treatment).
- c. Sewage treatment system.

2.1. RAW WATER SYSTEM

The raw water system scope of supply shall include the following equipment as minimum, however not limited to the same. MPC Contractor shall design and supply all required items for the satisfactory operation of the unit.

Raw water system receives water inlet from the deep tube wells of capacity 35 m³/hr.

- a) Three (3) nos. of Bore well pumps of capacity 18 m³/hr each for feeding Raw water to Iron removal filter shall be loose supplied by MPC contractor.
- b) Raw water inlet specification,

SI. No	Specification	Value
1	pH	7.1
2	Colour	5.6 Hazen
3	Odour	Unobjectionable
4	Turbidity	20 NTU
5	Total Hardness as CaCO ₃	91.52 mg/l
6	Calcium as Ca	14.64 mg/l
7	Magnesium as Mg	15.59 mg/l

 ऑयल इंडिया लिमिटेड Oil India Limited	MODULAR PACKAGE CONTRACT (MPC-3) Engineering, Procurement, Fabrication and Supply of Modular Water Package for OCS, Nadua and GGS, East Khagorijan	

SI. No	Specification	Value
8	Alkalinity	95.76 mg/l
9	Chlorides as Cl	28.5 mg/l
10	Sulphate as SO ₄	8.1 mg/l
11	Nitrate as NO ₃	24.34 mg/l
12	Copper as Cu	<0.02 mg/l
13	Iron as Fe	1.32 mg/l
14	Fluorides as F	<0.1 mg/l
15	Zinc as Zn	0.03 mg/l
16	Phenolic	<0.001 mg/l
17	Mercury as Hg	<0.001 mg/l
18	Cadmium as Cd	<0.002 mg/l
19	Arsenic as As	<0.01 mg/l
20	Lead as Pb	0.014 mg/l
21	Hexavalent Chromium as Cr+6	<0.05 mg/l
22	Total dissolved solids	119.89 mg/l
23	Total Coliform organism	130 (MPN/100ml)
24	Faecal organism	Absent

The Raw water quality mentioned here is based on the ground water available in the plant area.

- c) Iron removal filter (2 x 100%) suitable for inlet water capacity of 35 m³/hr.
- d) RO maker (2 x 100%) of capacity 35 m³/hr at RO system inlet; Potable water quality shall meet the requirements of standard IS 10500 Latest edition. RO system recovery shall be minimum 70%. Necessary chemical dosing system for RO system shall be supplied by MPC contractor.
- e) Chemical dosing system as required for the treatment consisting of dosing tank (HDPE), dosing pump (2x100%) diaphragm type with piping, valves, instruments etc.
- f) Potable water pump shall be redundant (2 x 100%); pump discharge head shall be selected suitable for pumping the water to potable water storage tank where the inlet nozzle is at an elevation of 20m (approx) from ground level.
- g) UV Stabilizer unit shall be of Membrane Type for disinfection of harmful microorganism which shall be installed at the outlet of Potable water pump.
- h) Interconnecting piping with valves, fittings, specialty items, instruments etc. from skid edge to Iron removal filter inlet, between filter to RO Maker, up to potable water pump discharge to skid edge.

- i) All drain piping to skid edge shall be in MPC contractor scope.
- j) Industrial water piping from Iron removal filter outlet shall be provided up to skid edge.
- k) Fire fighting system including fire extinguisher as per OISD–STD–189 requirements and shall be of standard capacity as per IS 15683, IS 2878 & IS 10658.

The complete system including equipment's, piping, instruments etc. shall be pre-fabricated and assembled at shop as a single skid and transported in container. If skid size exceeds the transport regulations, then the same shall be split suitable for road conditions of Assam. The skid fabrication at the site shall be avoided.

2.2. EFFLUENT WATER TREATMENT SYSTEM

Effluent water treatment system package shall be designed for the capacity of 1108 KLPD. The scope of supply shall include the following equipments as minimum, however not limited to the same. MPC Contractor shall supply all required items for the satisfactory operation of the unit.

- a) Effluent transfer pump (2x100%) of capacity 46 m³/hr and Vertical centrifugal type as per API 610. The pump is located over the Effluent water storage tank (underground) of tentative dimension 20m (L) x 18m (W) x 4m (H) and the tank construction is not in MPC contractor scope. Pump with driver and accessories mounted on base plate arrangement shall be loose supplied by MPC contractor and installation by others.
- b) Effluent water inlet specification:

SI. No	Specification	Parameters
1	Oil in Water	10000 ppm
2	Inlet Temperature	51 °C
3	pH	7 - 9
4	TSS	Up to 100 ppm
5	Dissolved O ₂ Content	Up to 7 ppm
6	SRB	10 ³ to 10 ⁶ CFU/ml
7	Any other bacteria activity like GAB, IRB & APB	Not Measured

- c) The Effluent treatment system shall consist of the following equipments as minimum; MPC contractor shall carry out the design and propose any additional equipment required for meeting the design conditions.

- API Separator

 ऑयल इंडिया लिमिटेड Oil India Limited	MODULAR PACKAGE CONTRACT (MPC-3) Engineering, Procurement, Fabrication and Supply of Modular Water Package for OCS, Nadua and GGS, East Khagorijan	

- Tilted plate interceptor
- Flash Mixer
- Flocculation tank
- Dissolved Air Flootation (DAF) Unit
- Filter feed tank and Filter pumps (2 x 100%)
- Multi grade filter and Oil removal filter to reduce the suspended solids and oil content
- Air blower for cleaning the filter during backwash
- Treated water storage tank to store clarified water from filter outlet.
- Treated water transfer pump (2x100%) to transfer the treated water to Clarified water storage tank. Oil in water analyzer with solenoid operated on-off valves shall be provided at the pump discharge and the water shall be transferred to Clarified water storage if the water quality as specified is met else the same shall be routed to off-spec effluent tank for further treatment. MPC contractor shall terminate the Clarified water line and Off-spec water line from pump discharge near the skid edge and further piping shall be in Others scope.
- Off-spec effluent transfer pump with suction and discharge piping, valves, instruments etc. shall be supplied in a separate skid for transferring the off-spec effluent water back to Effluent water storage tank. The pump capacity shall be 46 m³/hr and as per API 610. Requirement of the pump shall be decided based on the location of the tanks in the Final plot plan drawing.
- Recovery crude storage (steel) tank of with transfer pump for transferring Recovered oil to Skim oil tank in dyke area. The pump discharge shall be routed up to the skid edge.
- Effluent water drain collection sump. RCC pit design and detail drawings shall be provided by MPC contractor and construction by Others.
- Effluent water drain transfer pump (Submersible pump) with discharge piping shall be routed to Effluent storage tank by MPC contractor up to skid edge.
- Chemical dosing system with dosing pumps (2x100%) for the ETP system. Chemical dosing system shall consists of dosing tank (HDPE), dosing pump (2x100%) diaphragm type with piping, valves, instruments etc.

d) MPC Contractor shall meet the Effluent water outlet specification mentioned in the below table:

 ऑयल इंडिया लिमिटेड Oil India Limited	MODULAR PACKAGE CONTRACT (MPC-3) Engineering, Procurement, Fabrication and Supply of Modular Water Package for OCS, Nadua and GGS, East Khagorijan	

SI. No	Specification	Value
1	Oil in Water	<10 ppm
2	Temperature	51 °C
3	Sludge content	NIL
4	Ph	6.5 – 8.5
5	TSS	98% Removal of suspended Solids >10 microns
6	Dissolved O ₂ Content	<0.2 ppm
7	SRB	Nil
8	Any other bacteria activity like GAB, IRB & APB	Nil

- e) Sludge treatment system of efficient technology shall be supplied by the MPC contractor. Drain water from sludge shall be routed to Effluent drain water sump and Sludge disposal by others.
- f) It is preferable to provide Steel construction for the tanks / equipments inside the package; wherever the same is not possible RCC tanks shall be provided with EPCM approval. The detail design & drawing of the RCC tanks shall be in the scope of MPC contractor. Procurement & construction of the same shall be by others.
- g) A separate skid for clarified water system shall be provided consisting of following equipment's,
- Clarified water booster pump (3 x 50%) of capacity 46 m³/hr and head 10kg/sq.cm (g) as per API 610.
 - Clarified water disposal pump, reciprocating type as per API 674 and shall be driven by Gas engine. Pump capacity shall be 46 m³/hr and differential pressure of 60.3 kg/sq.cm (g).
 - Gas engine shall be designed as per ISO 3046. Acoustic enclosure shall be provided to meet the noise level of 75 dBA @ 1m distance from the periphery of equipment/enclosure.
 - CEMS panel shall be provided to monitor the emission at the Gas engine exhaust.
 - Clarified water booster pump suction piping header from skid edge, individual suction piping with valves, strainer, instruments etc. and individual discharge piping with NRV, valves, instruments, with header routed to clarified water disposal pump.

 ऑयल इंडिया लिमिटेड Oil India Limited	MODULAR PACKAGE CONTRACT (MPC-3) Engineering, Procurement, Fabrication and Supply of Modular Water Package for OCS, Nadua and GGS, East Khagorijan	

- Clarified water disposal pump with individual discharge piping with valves, instruments etc. and header up to skid edge.
- h) Complete interconnecting pipes, valves, instruments within the skid / package shall in MPC contractor scope.
- i) Pumps used in Oily water service shall as per API standards.
- j) Fire fighting system including fire extinguisher as per OISD-STD-189 requirements and shall be of standard capacity as per IS 15683, IS 2878 & IS 10658. Spray nozzles (MVWS) & Quartzoid bulb (QB) detectors with automatic deluge valve in ETP area. Nozzles shall be ISI marked/UL Listed. Fire fighting design basis attached in Volume-II shall be referred for further details. F&G detectors in clarified water pump house shall be supplied by MPC contractor. Spray nozzle, Quartzoid bulb, F&G detector make and model shall be confirmed by EPCM consultant during detail engineering in order to ensure the same type is used throughout the plant.

The complete ETP system including equipment's, piping, instruments etc. shall be pre-fabricated and assembled at shop and transported as skids. The no. of skids shall be kept minimum and decided based on size recommended by transport regulations & suitable for road conditions of Assam. The skid fabrication at the site shall be avoided. The overall skid dimension shall be restricted to the dimension specified in Overall plot plan attached in Volume-II.

2.3. SEWAGE TREATMENT PACKAGE

The Sewage treatment package shall be designed for 50 persons as per applicable rules & regulations.

- a) Sewage treatment system shall consist of the following equipment's as minimum.
 - Sewage transfer pump (2x100%) for transfer of Raw sewage from storage sump to treatment plant. Pump shall be loose supplied.
 - Bar screen chamber and Oil / Grease chamber
 - Equalization tank
 - Sewage lift pump (2 x 100%)
 - Aeration tank (Steel tank with Epoxy coating)
 - Tube settler (Steel tank with Epoxy coating)
 - Sludge pump (2x100%)
 - Intermittent storage tank (Steel tank with Epoxy coating)
 - Filter feed pump (2 x 100%)

- Chemical dosing system as required for the treatment consisting of dosing tank (HDPE), dosing pump (2x100%) diaphragm type with piping, valves, instruments etc.
 - Multi-grade filter and Activated carbon filter
 - Treated water tank
 - Treated water transfer pump with piping up to skid edge.
- b) The water outlet specification shall meet the requirement as per PCB/CPCB norms and the same shall be routed to clarified water storage tanks.
- c) Complete interconnecting pipes, valves, instruments within the skid / package shall in MPC contractor scope.
- d) MPC Contractor shall meet the following water outlet specification mentioned in the below table:

SI. No	Specification	Value
1	Oil in Water	<10 ppm
2	Temperature	51 °C
3	Sludge content	NIL
4	Ph	6.5 – 8.5
5	TSS	98% Removal of suspended Solids >10 microns
6	Dissolved O ₂ Content	<0.2 ppm
7	SRB	Nil
8	Any other bacteria activity like GAB, IRB & APB	Nil

- e) Fire fighting system including fire extinguisher as per OISD–STD–189 requirements and shall be of standard capacity as per IS 15683, IS 2878 & IS 10658.
- f) It is preferable to provide Steel construction for the tanks / equipments inside the package; wherever the same is not possible RCC tanks shall be provided with EPCM approval. The detail design & drawing of the RCC tanks shall be in the scope of MPC contractor. Procurement & construction of the same shall be by others.

2.4. GENERAL FOR RAW WATER SYSTEM, ETP SYSTEM AND SEWAGE TREATMENT SYSTEM

- a) Complete equipment, piping, fittings, valves, instrument and controls, supports, structures etc. within the skid

 ऑयल इंडिया लिमिटेड Oil India Limited	MODULAR PACKAGE CONTRACT (MPC-3) Engineering, Procurement, Fabrication and Supply of Modular Water Package for OCS, Nadua and GGS, East Khagorijan	

- b) Complete electrical system required for satisfactory operation of the unit including earthing design, preparation of detailed drawings, manufacture, testing.
- Power and control cabling, cable trays and tray supports
 - Local control station (As applicable)
 - Lighting & small power sockets and distribution boards
 - Earthing protection system
 - Junction boxes (As required)
 - Cable glands
 - Fire proof sealing system(As required)
 - Local AC UPS distribution
 - Local DC UPS distribution
- c) Surface preparation and painting
- d) Shop inspection and testing, Factory Acceptance Tests (FAT), Site acceptance test
- e) Packing, marking and forwarding
- f) Spares and Special tools
- Supply of Start-up spares as required during start-up and commissioning
 - Supply of Maintenance tools and tackles including special tools
- g) Price list of recommended spares for smooth operation of the system / equipment for a minimum period of 2 years.
- h) Noise level of the equipments shall be 75 dBA @ 1m distance from periphery of the equipment. If required Acoustic enclosure shall be provided to meet the same.
- i) Thermal insulation for the package as required
- j) Mechanical / Performance Guarantee
- k) Access platforms, ladders, stairways, handrails etc as required
- l) List of consumables & first fill of Lubricants including lube oil, grease, jacket water, anti-freeze / inhibitor, anti-corrosive agent, battery acid, spare CO2 cylinders etc. as applicable for gas engine. Additional top up quantity of First fill lubricants required during commissioning and PGTR operation for one (1) month.
- m) Warranty

 ऑयल इंडिया लिमिटेड Oil India Limited	MODULAR PACKAGE CONTRACT (MPC-3) Engineering, Procurement, Fabrication and Supply of Modular Water Package for OCS, Nadua and GGS, East Khagorijan	

n) Guarantee to Meet all HAZOP, SIL and Safety Operational Requirements

MPC Contractor shall carry out the design and engineering of the Water package in accordance with International codes & standards, local legislation, Specification & Design basis attached in the subsequent sections.

3.0 SITE CONDITIONS & AVAILABLE UTILITIES

SITE CONDITIONS

Site Location:	East Khagorijan & Nadua		Elevation above MSL:	Note-4	m	Barometer:	1.0335	kg/cm ²
Air Temperature:	Design:	80 °C	Maximum:	41 °C	Normal:	* °C	Minimum:	2 °C
Atmosphere:	☐ Noncorrosive	☐ Corrosive	☒ Dust	☐ Fumes				
Wind Speed:	Avg:	14.4 m/s	Max:	* m/s				
	Prevailing Direction:	North East						
Relative Humidity:	Mean:	* %	High:	98 %	Low:	36 %		
Precipitation:	Annual Max:	19450 mm	Monthly Max:	* mm	Monthly Min:	* mm	24 Hour Max:	1600 mm
(Rain fall)	Ice/Snow Burden:	* mm						
Installation:	☐ Offshore	☐ Coastal	☒ Inland	☐ Enclosure by Supplier				
	☐ Indoor	☒ Outdoor	☐ Winterization	☐ Tropicalization				
Seismic Loads:	☐ None	☒ Seismic Zone:	V	Load:	*			
Water Properties:	☐ Fresh	☐ Salt	Temp: Max Surface:	N/A °C	Max Seabed:	N/A °C		
			Min Surface:	N/A °C	Min Seabed:	N/A °C		

UTILITIES

Area Classification:	Zone:	T Class:	Group:	NOTE-3	☐ Nonclassified	
Available Power:	☒ 415V AC, 3 Ph, 50 Hz	☐ 120 V, 1 Ph, 50 Hz	☐ 120 V, 1 Ph, 60 Hz			
	☐ 110V AC, 1Ph, 50Hz	☐ 11 kV, 3 Ph, 50 Hz	☐ 6.6 KV AC, 3 Ph, 50 Hz			
	☒ 240V AC, 1 Ph, 50 Hz	☐ 24V DC	☒ 110V DC			
NITROGEN	☒	☒ Design	☐ Press:	12.5 kg/cm ² g	☒ Temp:	85.0 °C
		☒ Operating	☒ Press:	6.3-8.3 kg/cm ² g	☒ Temp:	51.0 °C
INSTRUMENT AIR	☒	☒ Design	☒ Press:	12.5 kg/cm ² g	☒ Temp:	85.0 °C
		☒ Operating	☒ Press:	6.5-8.5 kg/cm ² g	☒ Temp:	51.0 °C
HP FUEL GAS	☐ None	☐ Design	☐ Press:	- kg/cm ² g	☐ Temp:	- °C
		☐ Operating	☐ Press:	- kg/cm ² g	☐ Temp:	- °C
FUEL GAS:	☒	☒ Design	☒ Press:	11.0 kg/cm ² g	☒ Temp:	85.0 °C
		☒ Operating	☒ Press:	6.0 kg/cm ² g	☒ Temp:	46-52 °C
COOLING MEDIUM	☐ None	☐ Design	☐ Press:	- kg/cm ² g	☐ Temp:	- °C
		☐ Operating	☐ Press:	- kg/cm ² g	☐ Temp:	- °C
HEATING MEDIUM	☒ (NOTE-1)	☒ Design	☒ Press:	12.0 kg/cm ² g	☒ Temp:	250.0 °C
		☒ Operating	☒ Press:	5.0 kg/cm ² g	☒ Supply Temp:	200.0 °C
					☒ Return Temp:	100.0 °C
UTILITY AIR	☒	☒ Design	☒ Press:	12.5 kg/cm ² g	☒ Temp:	85.0 °C
		☒ Operating	☒ Press:	6.8-8.8 kg/cm ² g	☒ Temp:	51.0 °C
SEA WATER	☐ None	☐ Design	☐ Press:	- kg/cm ² g	☐ Temp:	- °C
		☐ Operating	☐ Press:	- kg/cm ² g	☐ Temp:	- °C
FIRE WATER	☒	☒ Design	☒ Press:	15.0 kg/cm ² g	☒ Temp:	80.0 °C
		☒ Operating	☒ Press:	10.0 kg/cm ² g	☒ Temp:	AMB °C
SERVICE WATER	☒	☒ Design	☒ Press:	5.0 kg/cm ² g	☒ Temp:	80.0 °C
		☒ Operating	☒ Press:	ATM kg/cm ² g	☒ Temp:	AMB °C
FOAM	☒	☒ Design	☒ Press:	15.0 kg/cm ² g	☒ Temp:	80.0 °C
		☒ Operating	☒ Press:	12.0 kg/cm ² g	☒ Temp:	AMB °C
POTABLE WATER	☒	☒ Design	☒ Press:	5.0 kg/cm ² g	☒ Temp:	80.0 °C
		☒ Operating	☒ Press:	ATM kg/cm ² g	☒ Temp:	AMB °C
GROUND FLARE	☒	☒ Design	☒ Press:	3.5/FV kg/cm ² g	☒ Temp:	200.0 °C
		☒ Operating	☒ Press:	0.2-0.7 kg/cm ² g	☒ Temp:	AMB °C
CLOSED DRAIN	☒	☒ Design	☒ Press:	3.5/FV kg/cm ² g	☒ Temp:	80.0 °C
		☒ Operating	☒ Press:	0.7 kg/cm ² g	☒ Temp:	AMB °C

SKID CONSTRUCTION

Skid Type	Onshore-Grouted
Lifting Devices	Lugs
Main Beams	TBA
Other Beams	TBA
Skid Level Screws	TBA
Equipment Mounting	TBA

NOTE:

- Hot oil (Therminol-55) is used as a heating medium.
- FOW - Full of water
- Area Classification as per OISD Guidelines.
- Site elevation above MSL shall be 121m for East Khagorijan and 116m for Nadua.
- * OIL to provide information.

Section-II

**Specification for API 610 Centrifugal
Pump**

1 SCOPE

This specification defines the minimum requirements for the design, material procurement, manufacturing & assembly, inspection, testing, painting and shipment of Centrifugal pump.

2 TECHNICAL SPECIFICATION

2.1 General

- a) The Centrifugal pump package shall include pump, drive system, coupling with non-sparking guard, mechanical seal with cooling and flushing plan, base frame, instrumentation & controls (if required) and other equipment necessary to make the unit safe & operational.
- b) Pumps shall be designed for continuous operation at rated duty, unless otherwise stated.
- c) The NPSH requirements shall not exceed the specified NPSH available for the complete operating range of pump from minimum continuous flow to pump run-out flow.
- d) The suction specific speed for pumps shall not exceed 11,000 in U.S. units. Pumps with Suction Specific Speeds exceeding 11000 U.S. units calculated as per Hydraulic Institute Standard, requires specific approval by EPCM.
- e) Material selection and construction shall be in accordance with the requirements of API 610.
- f) Equipment (pump, electric motor) shall be provided with adequate lifting points to enable single point lifts.
- g) Any non-rotating maintenance part weighing more than 25 kg shall be fitted with permanent lifting lugs or equipped for removable lifting eyes.
- h) The pump types listed in Table - 3 of API 610 are not acceptable and shall not be proposed.
- i) All interface piping and connections shall be in accordance with ASME B31.3 and ASME B16.5.
- j) Suction and discharge nozzles shall be flanged and shall both have the same pressure rating. Irrespective of service conditions, offered pumps shall be

SPECIFICATION FOR API 610 CENTRIFUGAL PUMP

provided with minimum 300 # flange rating as per ASME B16.5. Flange details shall be as specified on the MPC's data sheets.

- k) Casing and bearing bracket castings shall be free of defects of any kind, and dressed free of burrs.
- l) Pump(s) shall be designed with robust and stiff solid shaft.
- m) The design shall be such as to facilitate maintenance and in particular the shaft gland or mechanical seal shall be readily accessible for replacement without having to disturb pipe work/insulation.
- n) All gaskets shall be non-asbestos and shall be selected for complete safety for the pumped fluid. Gaskets, O rings shall be compatible with fluid being handled.
- o) The difference between "NPSH available" and "NPSH required" shall be at least one (1) meter throughout the entire operating range.
- p) All pump skids shall have 2 earthing bosses located diametrically opposite 150 mm above the base. Each SS316 boss shall be supplied complete with SS316 bolts and washers.
- q) Motor shall be selected considering the margin values specified in Table-12 of API 610 and power consumption at run-out / maximum flow condition of the pump, whichever is higher.

2.2 Pump Casing

- a) Pump casing shall be designed for MAWP and Maximum operating temperature and shall be tested to hydro test pressure of 1.5 times MAWP.
- b) The minimum corrosion allowance for casing shall be 3mm.
- c) Pump casing shall be provided with vent (except self venting) and drain connection. All drain and vents shall be provided with Gate valve.
- d) Pump casing drain after the gate valve, shall run to a manifold and terminated at base plate edge with flanged connection. This connection along with base plate drip pan shall be routed to the Closed drain system.
- e) For pumps specified for flammable or have a pumping temperature greater than 60°C, each vent connection after the gate valve shall be routed to a Closed drain system or flare system.

- f) Direction of rotation shall be clearly indicated on each pump casing. Rotation arrows may be cast in. Direction arrows (if attached) shall be AISI Standard Type 316 stainless steel or nickel- copper alloy (Monel or equivalent). Attachment pins shall be of the same material. Welding is not permitted.
- g) All auxiliary connections to the pressure casing shall be fitted with flanged stubs, full penetration welded to the casing. Pump casing drains shall be furnished for all low points to enable total draining of the pump casing.

2.3 Impeller

- a) Impeller shall be of single piece construction if cast and of semi-open type design.
- b) The proposed rated impeller diameter for pumps with constant speed drivers shall not be greater than 95% or less than 80% of the maximum impeller diameter that can be installed in the pump casing.
- c) Impellers shall be provided with renewable wear rings.

2.4 Mechanical Shaft Seals

- a) Mechanical seals shall be selected to suit the process conditions. Seal packing is not acceptable.
- b) Cartridge type mechanical seals are preferred. Mechanical seals shall be designed to API 682 latest edition.
- c) The pump manufacturer shall be responsible for the adequate engineering and installation of the mechanical seal and associated auxiliaries, such as circulation, quenching and cooling facilities, as applicable. When double or tandem seals are specified, seal housing shall be designed to allow for effective circulation of the barrier / buffer fluid.
- d) Unless otherwise specified, all non-sealing metallic parts of the seal shall be of material with corrosion resistance equal to or better than that of the pump impeller.
- e) OISD-STD-125 shall be considered for Mechanical seal selection.

2.5 Bearings

- a) Bearings shall have a minimum “L-10” life of 40,000 hrs for continuous duty at maximum load as per ISO 281. (Maximum load is the maximum radial load

on the impeller to be supplied at any point on its curve based on data sheet specific gravity).

- b) Bearing selection shall be based on guidelines provided in API 610 (table 10).
- c) Bearing housing serving as Oil reservoir shall be provided with Constant level oiler.

2.6 Base plates / Mounting plates

- a) All skids shall be designed to be self supporting. Pumps and drivers shall be provided with anti vibration mounts, where required. The skid base shall have sufficient mass and structural rigidity to avoid natural frequencies resulting in resonance, and to ensure that only residual vibration levels occur under normal operation conditions. Base Plate Rigidity Design calculations shall be submitted for EPCM review.
- b) Base plate shall be of fabricated steel, suitable for mounting the pump, driver and all associated auxiliaries. Base plates shall be sized so that no part of the pump, driver, piping or accessories overhangs the outer edge. The drain connection to the base plate shall terminate with a flanged connection.
- c) Base plates shall have sufficient strength for transportation and lifting without any permanent deformation and to transit equipment generated forces and moments to the structures. Base plate shall be of fabricated steel construction.
- d) Provisions for shims shall be made where alignments are critical. Shims shall be made of a non-corrosive material such as stainless steel (SS316). Provisions shall be made for sufficient field vertical alignment.
- e) Each base plate support shall be supplied with the necessary sub plates, shims and levelling jackscrews to allow satisfactory levelling.

2.7 Coupling

- a) Coupling design shall permit removal of bearing frame without disturbing the pump case, driver or piping.
- b) Coupling service factor shall be 1.5 based on nameplate rating of driver.
- c) Coupling guards shall be non-sparking type (Aluminium, if provided shall be low copper) and suitable for onshore environment. The offered guard shall be robust and capable of withstanding 100 kg weight of a person.

2.8 Auxiliary piping

- a) The temperature and pressure rating of the auxiliary piping handling pumped fluid shall be not less than pump case maximum allowable working pressure at design temperature.
- b) Mechanical seal flush and auxiliary piping shall be minimum 316L SS or of same material as that of pump casing, whichever is superior

3 INSPECTION AND TESTING

3.1 General

- a) Inspection, testing and material certification shall be in accordance with the requirements of API 610 and also the requirements of the Certification / Approval Authority. Inspection and testing shall be followed as per OIL / EPCM approved ITP.
- b) OIL / EPCM consultant shall be informed fifteen (15) working days prior to the shop testing of the components.
- c) After inspection, Procedures and records of factory test shall be available for review by EPCM.
- d) The acceptable Test Tolerances shall be as per API 610.
- e) While establishing the actual pump performance curves on test, the pump suction conditions shall be controlled to give the minimum site NPSHA conditions stated on the data sheets.
- f) Pump and Pump base plate alignment shall be carried out prior to dispatch and the records shall be properly documented.
- g) The right to witness all inspection and Non-Destructive Test from raw material certification till final stage of inspection is reserved by EPCM consultant /OIL and their TPI agency.
- h) All testing shall be done using certified test equipment, which have been calibrated / checked prior to the test. The calibration records shall be furnished for EPCM consultant review.

3.2 Pump Test

- a) The EPCM / COMPANY shall witness the following tests per pump,
 - Hydrostatic test

SPECIFICATION FOR API 610 CENTRIFUGAL PUMP

- Performance test
 - NPSH test
 - Complete unit test
 - Sound level test.
- b) Hydrostatic testing shall be carried out as per the requirements of the API 610. For Vertical pump, bowls and column pipe shall be hydrostatically tested with liquid at a minimum of 1.5 times the maximum differential pressure developed by the bowl assembly.
- c) Hydrostatic tests shall be carried out before any painting or preparation for painting is carried out.
- d) Where gaskets are used, they shall be identical during hydrostatic tests as those supplied with the pump. Leaks past any gasket or joint connections are not acceptable. The pump will be supplied with unused gaskets.
- e) Site Acceptance Testing shall be carried out at site after installation and commissioning of the package to demonstrate the guaranteed performance of the package and its interface with other Onshore Systems.

4 SURFACE TREATMENT, PAINTING AND MARKING

All external surfaces of the Pump/Motor Package except machined surfaces shall be cleaned, primed and finish painted in accordance with the “Specification for Surface Preparation & Painting”.

5 SPARE PARTS AND SPECIAL TOOLS

- a) MPC Contractor shall include and supply the spare parts for start-up and commissioning as part of supply scope.
- b) Priced two (2) year spare parts list shall be provided.
- c) Special tools and tackles, which are necessary to dismantle, service and assemble the unit shall be supplied, if required.

6 NAME PLATE

The Pump and Motor shall be equipped with a permanently attached nameplate in SS 316. Text and numbering shall be clearly engraved, paint filled and a minimum of 5 mm high.

SPECIFICATION FOR API 610 CENTRIFUGAL PUMP

Unless otherwise specified, the thickness of name plate and bracket shall be 3 mm and 6 mm respectively.

The nameplate shall be mounted in a prominent location secured by stainless steel screws or rivets.

The name plate shall be in English language.

The nameplate shall contain the following information:

- a) Owner name
- b) Manufacturer Name
- c) Equipment name
- d) Equipment tag number
- e) Purchase order number
- f) Serial number
- g) Design code
- h) HP / RPM / Motor Duty , kW
- i) Capacity
- j) NPSHr
- k) Efficiency %
- l) Casing Hydro test Pressure
- m) MAWP
- n) Rated Head
- o) Rated Flow
- p) Certified Weight
- q) Date of Manufacture

**SPECIFICATION FOR GAS ENGINE DRIVEN
RECIPROCATING PUMP**

Specification for Gas Engine driven
Reciprocating pump

**SPECIFICATION FOR GAS ENGINE DRIVEN
RECIPROCATING PUMP**
1 SCOPE

This specification defines the minimum requirements for the design, material procurement, manufacturing & assembly, inspection, testing of Gas engine driven reciprocating pump.

2 BASIC DESIGN
2.1 General

- a) Gas engine driven Reciprocating Pump with Gear box, pulsation suppression device and other accessories required for complete package shall be supplied.
- b) The engine exhaust emission and Chimney height shall meet the CPCB & local pollution control board norms.
- c) Vendor shall consider the Gas engine deration due to altitude, ambient temperature, inlet and exhaust losses, relative humidity etc. Deration factor shall be worked out as per ISO 3046.
- d) The continuous net engine brake horse power rating of Gas engine (after accounting for all auxiliary power consumption) at the site condition shall be at least 20% greater than brake horse power required to drive the pump at its duty point at the rated rpm.

3 SCOPE OF SUPPLY FOR GAS ENGINE DRIVEN RECIPROCATING PUMP

- a) Reciprocating Pump package shall minimum include Pump, Gas engine drive system, Gearbox, coupling with non-sparking guard, safety valve, pulsation suppression device, instrumentation, control panel and other items necessary to make the unit operational mounted on a common Base plate.
- b) Reciprocating pump shall be designed as per API 674_Latest edition.
- c) Pulsation suppressor shall be designed as per ASME SEC VIII DIV 1 and in accordance with "Specification for Unfired Pressure vessel". The Bladder type dampeners shall be provided with suitable charging kit as spare.
- d) Pulsation simulation study shall be carried out as per recommendations given by API 674 and Vendor shall review and comment on the pipe routings and foundation drawings to ensure the performance after installation at site.
- e) Vibration isolators, if required.
- f) Gas engine design shall be in accordance with ISO 3046.

**SPECIFICATION FOR GAS ENGINE DRIVEN
RECIPROCATING PUMP**

- g) Gas engine and pump shall be suitable for installation at outdoor site conditions and Acoustic enclosure shall be provided to meet the noise level as per CPCB norms or 75 dBA (whichever is applicable), at 1m distance from the surface of the enclosure / equipment.
- h) Common Inlet gas conditioning skid for the gas engines, shall be supplied (If required)
- i) Exhaust duct height and Emission level for gas engine shall be as per CPCB / local state pollution board norms. Emission control equipment shall be an integral part of the engine package.
- j) Engine starting system shall be provided.
- k) Continuous online emission monitoring system (CEMS) including sensors, cabling, control panel etc. for monitoring NO_x, CO as required from local PCB with provision for online data transfer to state PCB server as per the state PCB reporting format.
- l) PLC based control panel shall be provided for each gas engine.
- m) Complete earthing system inside the battery limit with two earthing bosses in SS316 construction located diagonally opposite.
- n) Name plate shall be SS316.
- o) All required lifting attachments and supports for transportation, erection and maintenance.
- p) Assembling and testing in accordance with approved Inspection & Test Plan, quality assurance/quality control as detailed on the referenced specifications, datasheets, applicable codes / standards and local regulations.
- q) First fill of lubricants including lube oil, grease, jacket water, anti-freeze / inhibitor, anti-corrosive agent, battery acid etc. as applicable for gas engine.
- r) Spares and special tools shall be provided.

4 EQUIPMENT DESIGN

4.1 General

- a) Pumps and Gas engine shall be designed for continuous operation at rated duty, unless otherwise stated.
- b) Vendor shall be responsible for the detail design of the complete equipment assembly including all the auxiliaries / accessories.

**SPECIFICATION FOR GAS ENGINE DRIVEN
RECIPROCATING PUMP**

- c) Material selection and construction for pump shall be in accordance with the requirements of API 674.
- d) All interface piping and connections shall be in accordance with ASME B31.3 and ASME B16.5.
- e) If Gas engine is installed in Hazardous area,
 - Pump is handling hazardous liquid, brick wall shall be constructed between engine and pump in order to make Gas engine area safe. MPC contractor shall supply pump shaft with adequate additional length as required for brick wall arrangement if pump is handling hazardous liquid.
 - In Gas engine the instruments, electrical items, ignition system etc. shall be supplied suitable for Zone-2 application and the Exhaust system shall be provided with suitable insulation / protective shielding for the Exhaust duct including expansion joint, turbocharger etc. wherever the surface temperature is higher than 200 Deg C.

4.2 Reciprocating pump

- a) Maximum allowable pump speed shall be limited as per Table 3 of API 674 and necessary viscosity correction factor as per clause 6.3.2 of API 674 shall be followed.
- b) The pump nozzles shall be designed for 2 times the forces and moments value specified in Table 6a of API 674.
- c) Pump inlet and outlet nozzle connection shall have the same flange rating as per ASME B16.5.
- d) Pumps where difference between NPSHA (including estimated system acceleration head) and NPSHR is less than 1 meter not acceptable.
- e) Crankcase inspection covers shall be provided to enable visual inspection of the oil sump and critical areas.
- f) When geared drive is required, the gear shall be separate from the pump and shall conform to the requirements of API 677.
- g) Coupling guards shall be manufactured from non sparking brass or bronze and able to support a live load of 100 kg without permanent deformation or deflection at the point of contact with the rotating coupling and shafts.

**SPECIFICATION FOR GAS ENGINE DRIVEN
RECIPROCATING PUMP**

- h) Flexible couplings shall be of the non-lubricated non-sparking type.
- i) Vent and drain connections shall be routed to base plate edge and provided with isolation valve and flanged terminal connections. Drains handling the same type of fluid shall be combined and brought to the base plate edge to terminate in flanged connection.

4.3 Gas Engine

- a) Gas Engine shall be of heavy duty, latest state of art machine with higher efficiency and lower NOx emission of proven design conforming to ISO 3046.
- b) The engine shall be suitable for continuous, 24 hours unattended operation for both maximum and minimum ambient conditions.
- c) The engine vibration limits shall be as per ISO 3046.
- d) Ignition system related parts and installation shall be certified for use in Zone 2 hazardous area classification.
- e) Online emission monitoring system (CEMS) for monitoring of NOx and CO shall be provided.

4.4 Lube Oil System

Lube oil system shall comprise of following items as minimum:

- a) Engine Mounted Lube oil sump.
- b) Engine operated Main lube oil pump and AC driven priming pump for Pre/post lubrication of engine as recommended by Manufacturer.
- c) Lube oil cooler and oil filters. Oil Cooler shall be designed for 110% of the heat rejection at the engine service power at the maximum site ambient temperature.
- d) Fresh lube oil tank and waste lube oil collection tank with transfer pumps.
- e) All necessary piping, valves, specialities, instrumentation and supports etc. Lube oil system complete piping, fittings etc. downstream of filters shall be of Stainless steel material.

4.5 Fuel System

- a) The fuel system shall comprise of Gas pressure regulator, gas shut off valve, common gas conditioning system, filters, inlet fuel governor, associated instrumentation and control system.
- b) Gas supply pressure after regulator at full rated flow conditions shall be as recommended by the Gas engine vendor.

**SPECIFICATION FOR GAS ENGINE DRIVEN
RECIPROCATING PUMP**

- c) Gas shut off valve for engine fuel gas line should close automatically when the engine is stopped.

4.6 Combustion Air Intake System

The combustion air intake system shall consists of air inlet filters, silencer, all necessary piping including specialities like bends, flanges, expansion joints, supports etc. The filter shall be fitted with a differential pressure switch to show when the filter requires attention.

In case the filter is located outside the gas engine container, vendor shall provide Rain hood and suitable access for filter cleaning and maintenance.

4.7 Engine exhaust system

Exhaust System shall consists of following items as minimum,

- a) Exhaust gas Silencer with spark arrestor.
- b) Exhaust piping from Gas Engine up to Exhaust stack including specialities like bends, flanges, expansion joints and insulation. The Exhaust pipe material selected shall be suitable for engine outlet flue gas temperature.
- c) Individual exhaust stack shall be considered for each Gas engine.
- d) Exhaust stack shall be designed as per IS 6533. The stack shall be complete with all accessories and insulated up to a height of two (2) meters from ground level.
- e) The outer surface of the stack shall be protected from the atmospheric corrosion by applying heat resistant aluminum coating. The nominal thickness of the coating shall be 0.18 mm (Minimum)
- f) Stack shall have openings for sampling flue gas, access door, access ladders, platform, and drain connections. Necessary lightning arrestors & aviation lamps with copper conductors shall be provided as per the requirement.
- g) Cage ladder shall be provided for exhaust stack with intermediate landings at every 6m and access platform as required.
- h) Exhaust stack shall be supported using Common support structure.

4.8 Engine Cooling System

- a) Gas engine cooling system shall be closed circuit liquid cooled type including water circulating pumps, Air cooled Radiator, temperature regulating device, thermostatic switch, expansion tank, makeup tank with transfer pump,

**SPECIFICATION FOR GAS ENGINE DRIVEN
RECIPROCATING PUMP**

protection & shutdown switches, level indicator for tanks and interconnecting piping.

- b) Air cooled radiator shall be sized for the maximum ambient temperature condition.
- c) Engines in Cold climates shall be supplied with integral heater.
- d) The fan, fan drive, and fan belts shall be covered with steel mesh guarding for personnel protection.
- e) The fan blades shall be made of aluminum alloy and shall be capable of withstanding the operating temperature of 120 Deg C.
- f) All low points shall be fitted with drains and high points shall be fitted with vents.

4.9 Gas Engine Starting System

The type of starting arrangement shall be either Electric started or Air started.

- a) For Electric starting system, following items shall be provided as minimum,
 - Starter motor
 - Maintenance free batteries, with capacity suitable for minimum six (6) starts
 - Battery charger drawing power from AC mains.
- b) For Air starting system, following items shall be provided as minimum,
 - Air receiver sized for minimum six (6) starts of Gas engine.
 - Dedicated Air compressor shall be provided or Instrument air header with minimum available pressure of around 6.5 kg/sq.cm (g) shall be utilized for engine starting.

4.10 Engine Safety Controls

The following minimum Engine mounted safety shut off/trip system shall be provided for tripping the engine in the event of

- a) Low lubricating oil pressure
- b) High lubricating oil temperature
- c) High cooling water temperature
- d) Engine over speed
- e) Over crank
- f) Engine temperature monitoring system.

**SPECIFICATION FOR GAS ENGINE DRIVEN
RECIPROCATING PUMP**

4.11 Instrumentation and Control

- a) PLC based control panel shall be provided for Gas Engine.
- b) MPC contractor shall provide all the instruments required for the complete operation of the system.
- c) PLC based control panel shall have protection, meters and alarm annunciation windows
- d) The following parameters of Gas engine– RPM, Voltage, Frequency, water temperature, Lube oil pressure etc. shall be monitored from the Central Control room.
- e) Continuous online emission monitoring system (CEMS) for monitoring of NO_x and CO.
- f) The locally mounted instruments shall include the following:
 - Pressure gauge for lube oil and fuel
 - Dial type thermometer for jacket water, lube oil etc.
 - Temperature regulator for jacket water temperature.
 - Pressure regulation system for air receiver.

Other items, as required

4.12 Base plate

- a) The base plate shall be designed for single point lifting of the complete equipment without causing deflections.
- b) Lifting lugs shall be attached to the base plate frame and it shall be designed for a load equal to twice the estimated static sling load connected to the lug together with a simultaneous transverse load equal to 3% of the static sling load.
- c) The base plate shall have sloped drip pan / rim type arrangement with drain connections at strategic locations.

4.13 Painting

All external surfaces of the Pump/Engine Package except machined surfaces shall be cleaned, primed and finish painted in accordance with the “Specification for Surface Preparation & Painting”.

**SPECIFICATION FOR GAS ENGINE DRIVEN
RECIPROCATING PUMP****5 INSPECTION AND TESTING**

- a) Inspection and testing shall be in accordance with the requirements of API 674 for pump and ISO 3046 for Gas engine
- b) Inspection and testing shall be followed as per OIL / EPCM consultant approved ITP.
- c) OIL / EPCM consultant shall be informed fifteen (15) working days prior to the shop testing of the components.
- d) After inspection, Procedures and records of factory test shall be available for review by EPCM.
- e) The acceptable Test Tolerances for pump shall be as per API 674, Table-13.
- f) While establishing the actual pump performance curves on test, the pump suction conditions shall be controlled to give the minimum site NPSHA conditions stated on the data sheets.
- g) Pump and Pump base plate alignment shall be carried out prior to dispatch and the records shall be properly documented.
- h) The right to witness all inspection and Non-Destructive Test from raw material certification till final stage of inspection is reserved by EPCM consultant / OIL and their TPI agency.
- i) All testing shall be done using certified test equipment, which have been calibrated / checked prior to the test. The calibration records shall be furnished for EPCM review.

5.1 Pump test

- a) The EPCM consultant / OIL shall witness the following tests per pump,
 - Hydrostatic test
 - Performance test
 - NPSH test
 - Complete unit test
 - Sound level test.
- b) Hydrostatic testing shall be carried out as per the requirements of the API 674.

**SPECIFICATION FOR GAS ENGINE DRIVEN
RECIPROCATING PUMP**

- c) Hydrostatic tests shall be carried out before any painting or preparation for painting is carried out.
- d) Where gaskets are used, they shall be identical during hydrostatic tests as those supplied with the pump. Leaks past any gasket or joint connections are not acceptable. The pump will be supplied with unused gaskets.

5.2 Gas Engine test

- a) Performance testing for power, efficiency, speed, fuel consumption and lubricating oil consumption etc for the gas engine shall be carried out as per ISO-3046 or IS: 10000 or any internationally accepted code & standard.
- b) The gas engine control panel after assembly and wiring shall be functionally tested at sub-vendor's works in the presence of EPCM /OIL and their TPI agency.
- c) The routine load test and fuel consumption test for Gas engine shall be done at 50%, 75% & 100% of Engine load at site rating.

Site Acceptance Testing for the complete Engine with pump package shall be carried out at site after installation and commissioning of the package to demonstrate the guaranteed performance of the package and its interface with other Onshore Systems.

6 SPARE PARTS AND SPECIAL TOOLS

- a) MPC Contractor shall include and supply the spare parts for start-up and commissioning as part of supply scope.
- b) Priced two (2) year spare parts list shall be provided.
- c) Special tools and tackles, which are necessary to dismantle, service and assemble the unit shall be supplied, if required

7 FUEL GAS COMPOSITION

MPC Contractor shall refer the below appendix for Fuel gas composition available in East Khagorijan and Nadua plant.

FUEL GAS COMPOSITION - EAST KHAGORIJAN

Material Streams	Unit	Fuel Gas Composition to Gas Engines
Total Stream		
Vapour Fraction		1.000000
Temperature	C	42.68-51.81
Pressure	kg/cm2_g	6.00
Mass Flow	kg/h	3087.10
Std Gas Flow	MMSCFD	3.30
Cp/Cv		1.280
Mass Density	kg/m3	4.8-5.01
Z Factor		0.984
Thermal Conductivity	W/m-K	0.035
Mass Heat Capacity	kJ/kg-C	2.18-2.21
Viscosity	cP	0.012
Molecular Weight		18.71-18.75
Component		
Methane	Mole Fraction	0.85-0.94
Ethane	Mole Fraction	0.0394-0.0436
Propane	Mole Fraction	0.0221-0.0244
i-Butane	Mole Fraction	0.0046-0.0052
n-Butane	Mole Fraction	0.0069-0.0077
i-Pentane	Mole Fraction	0.0023-0.0026
n-Pentane	Mole Fraction	0.0016-0.0018
n-Hexane	Mole Fraction	0.006326-0.00717
Nitrogen	Mole Fraction	0.0108-0.0119
CO2	Mole Fraction	0.0046-0.0051
H2O	Mole Fraction	0.001424-0.002074
The provided Fuel gas temperature is based on 28 C superheat above HC Dew point temperature.		
LHV (Net Calorific value)	36-40 MJ/m3	
HHV (Gross Calorific value)	40-44 MJ/m3	

FUEL GAS COMPOSITION - NADUA

Material Streams	Unit	Fuel Gas Composition to Gas Engines
Total Stream		
Vapour Fraction		1.000000
Temperature	C	66.49-66.98
Pressure	kg/cm2_g	6.00
Mass Flow	kg/h	2265.60
Std Gas Flow	MMSCFD	2.4
Cp/Cv		1.27
Mass Density	kg/m3	4.68
Z Factor		0.99
Thermal Conductivity	W/m-K	0.04
Mass Heat Capacity	kJ/kg-C	2.24
Viscosity	cP	0.01
Molecular Weight		18.81-18.92
Component		
Methane	Mole Fraction	0.85-0.94
Ethane	Mole Fraction	0.0394-0.0436
Propane	Mole Fraction	0.0221-0.0244
i-Butane	Mole Fraction	0.0046-0.0052
n-Butane	Mole Fraction	0.0069-0.0077
i-Pentane	Mole Fraction	0.0023-0.0026
n-Pentane	Mole Fraction	0.0016-0.0018
n-Hexane	Mole Fraction	0.012419-0.013214
Nitrogen	Mole Fraction	0.0108-0.0119
CO2	Mole Fraction	0.0046-0.0051
H2O	Mole Fraction	0.006850-0.007025
The provided Fuel gas temperature is based on 28 C superheat above HC Dew point temperature.		
LHV (Net Calorific value)	36-40 MJ/m3	
HHV (Gross Calorific value)	40-44 MJ/m3	

Specification for Unfired Pressure Vessel

1 SCOPE

The objective of this document is to present the construction details & specification for Pressure Vessels. All engineering, design, manufacturing, procurement, fabrication, testing, supply of pressure vessels are to be carried out as per Code & Standards as listed in this document.

2 DESIGN CONSIDERATIONS

2.1 Codes and Standards

Pressurized vessels must be complied with ASME code, section VIII Div.1 latest edition. All fabricated materials must comply with ASME section II, Part – A & B and components in contact with process fluids.

All welding shall be in accordance with ASME IX.

Pressurized vessels must be equipped with pressure release and safety valves, designed to release the produced volume due to different applicable over pressure scenarios.

Vessels shall be equipped with all attachments such as nozzles, manways, tray support rings, Insulation clips, as well as any platform clips, platforms or ladders as required.

Suitable supports shall be provided for internal parts to avoid damage during shipment.

2.2 Load Combinations

Loadings to be considered in designing a vessel shall be as per the ASME Code Section VIII, Div 1 and shall include cyclic conditions and erection loadings.

Vessels shall be designed to withstand the total loads resulting from the weight of all attachments plus the greater of operating weight or its original test weight.

All applicable loads shall be considered as acting simultaneously, including wind, during erection, start-up or operation.

Free-standing vertical vessels shall be designed to withstand overturning forces such as wind, plus thrust from connecting pipe work.

The following load combinations shall be considered:

- Operating, including operating dead weight, plus wind load (or earthquake).
- Hydro test, including hydro test dead weight plus pressure, plus 25% wind load.

Allowable tensile and compressive stress basis for vessels shall also apply to vessel Supporting skirts.

2.3 Material of Construction

Material of Construction of all parts of the equipment shall be compatible with the fluid in contact with that part and as per relevant Codes, Standards, Project Specifications.

The certification of material compliance shall be in accordance with EN 10204, Type 3.1 for all materials used in pressure parts and EN 10204, Type 2.2 for non-pressure parts.

2.4 Corrosion Allowance

If not specified, the corrosion allowance for each vessel shall be determined by its intended service, and shall be based on a service life of twenty (20) years or minimum 3mm corrosion allowance (whichever higher) to be considered.

Corrosion allowance shall be added to all pressure parts and non-removable internal parts and on all exposed surfaces.

Parts or surfaces that are fabricated of or protected with EPCM approved corrosion-resistant internal material may not require an added corrosion allowance.

Internally coated components shall include the corrosion allowance as indicated on the MPC's data sheet.

Corrosion allowance similar to the vessel shall be considered for the design of internals.

Unless otherwise stated, minimum corrosion allowance for carbon steel wetted parts shall be 3mm.

2.5 Minimum Thickness

The minimum thickness of pressure containing components shall be 6mm (¼-inch) excluding corrosion allowance unless otherwise noted.

Vertical vessel skirts shall be 6mm (¼-Inch) minimum wall thickness excluding external corrosion allowance, unless otherwise noted.

Internal rings, supports, baffles, vortex breakers, miscellaneous plates and structural shapes, Piping supports, etc., shall have a minimum thickness of 6mm (¼- inch) exclusive of corrosion Allowance unless otherwise noted.

Horizontal drums on saddle supports shall be investigated for buckling, local circumferential bending and shear stresses. The method of L. P. Zick may be used for this investigation.

2.6 Dimensions

All vessel connections, internals, etc, shall be located from datum or references line (bottom/left tan line). SI units shall be used.

2.7 Nozzles

All nozzles shall be welded and flanged. Threaded connections shall not be permitted on vessels.

The minimum connection size welded into a vessel shall be DN50 (2"NB) with a flanged connection.

Vessel nozzles of non-standard sizes DN65 (2 ½"), DN90 (3 ½"), DN125 (5") and DN180 (7") shall not be used.

Nozzles necks made of pipe shall be of seamless material. All Nozzles shall be set into the vessel. Full penetration welds shall be used for all body flange, nozzle and Manhole attachments.

Set on type nozzle shall only be used with prior agreement from the EPCM & provided that 100% ultrasonic examination of shell plate is carried out adjacent to opening.

Weld neck flanges shall be used on all nozzles with the hub bore to match that of the nozzle neck. Long welding neck flanges may be provided as an alternative. Flanges shall be in accordance with ASME B16.5 with bolt holes straddling main vessel centerlines unless otherwise noted. Slips on flanges are not acceptable, with the exception that flanges for internal non-pressure piping may be slip on.

Nozzle projection shall be minimum of 200 mm for sizes less than or equal to 12" and 250 mm for sizes greater than 12", from outer most layer of shell or insulation whichever is applicable. Nozzle projection should have enough clearance for bolt removal without damaging the shell / insulation.

Nozzle for drains, vents and relief valve shall be flush with inside surface of the vessel.

For sizes 300mm and larger fabricated nozzles neck shall be acceptable with full radiography of longitudinal weld.

The mill tolerance on pipe thickness shall be deducted while calculating the required nozzle neck thickness or opening reinforcement.

Flanges for external nozzles and manholes shall be in accordance with ASME B 16.5 for DN50 (2") to DN600 (24") except for DN 550 (22"), ASME B16.47 Series A standard for flange size between DN650 (26") to DN900 (36") and with ASME B16.47 Series B for flanges DN 950 (38") and larger and they shall be raised face (upto 600#) unless otherwise shown on the MPC's individual vessel data sheet and/or drawings. Non-standard size flanges shall be designed in accordance with ASME Code Rules. Liquid outlet nozzles shall be fitted with vortex breaker. All internals not welded to the shell shall be removable and designed to pass through the vessel manways.

Nozzle load calculation according to WRC 107 & WRC 297 shall be submitted along with design calculation for EPCM's approval during detailed engineering. Alternative calculation methods are subjected to EPCM approval. Nozzles excluded from these requirements are Manways, Instrument nozzles & drain nozzles.

2.8 Manholes

Manholes shall have at least DN600(24") nozzles with 475mm clear inside diameters unless otherwise specified in EPCM approved Data Sheets and are to be complete with blind flanges, bolting, gaskets, and davits or hinges. Bolting as per ASME B 16.5 shall be used.

The material used for any manhole shall be the same material as the shell or head in which the manhole is installed.

Davits and hinges shall be provided for each manhole or inspection opening where the blind flange, bolting and gasket weight more than 25 kg.

All manholes and inspection holes shall be flush with inside vessel wall. Inside edges of manholes shall be rounded off smooth with a minimum radius of curvature of 3mm.

2.9 Reinforcement of nozzles

Reinforcement of nozzles and manholes shall be designed to provide 100% compensation for the as built thickness of the shell or head in accordance with the specified design code. The reinforcement for openings shall be provided by either

self reinforcing nozzles or built up seamless pipe and WN flange with pad reinforcement as necessary.

Reinforcing pads shall have a minimum width of 50mm or three times the pad thickness, whichever is greater. Reinforcing pads shall be made in one piece if possible. Large reinforcing pads may be made from two pieces provided that written approval is obtained from the EPCM.

All rectangular reinforcing pads when used for external or internal attachments shall have 25mm minimum radius of curvature at corners.

Each pad shall contain at least one 1/4" NPT tapped tell tale hole.

2.10 Head/Dished Ends

Dished ends shall preferably be of seamless construction.

Heads shall be one-piece semi ellipsoidal (ratio 2:1) unless otherwise stated.

Heads produced from more than one plate shall have the welds 100% radiography after forming.

In the case of vessels having removable internals such as filtering elements, demisters, etc, vessel shall be designed with a body flange along with the davit arm to permit a full access.

2.11 Supports and Brackets

Ladders, access platforms, etc., shall be supplied such that all instruments, valves, etc., are readily accessible.

Where ladders, access platforms, etc., are supported by the vessel, the brackets and supports for these attachments shall be included in the original design of the vessel and detailed clearly on the vessel drawings.

Ladder clips, platform supports, and piping supports shall be furnished and installed by the MPC Contractor prior to pressure testing and certification.

Vessel supports shall be adequate for wind load in accordance with the latest edition of ASCE-7, unless specified otherwise on MPC Contractor equipment data sheets.

Vessels & other mechanical equipments shall be designed for the loads induced during shipment.

The vessel shall be self-supporting and designed to withstand wind loading based on the projected area of curved surfaces. The area of ladders, platforms and pipe work shall be assumed as equivalent to one and one half times the wind loading of the insulated vessel.

2.12 Horizontal vessel support

No more than two steel saddles shall be used for horizontal vessels. They shall be clear of vessel seams. Saddle pads shall have rounded corners. Saddles shall provide support at least 120 degree arc at the circumference of the vessel shell. Each saddle shall be attached to the shell with a wrapper plate. The wrapper plate shall have two 1/4" NPT tapped telltale holes at outer extremities. The saddle base plate shall be a minimum of 10mm thick.

An earthing boss shall be fitted to each saddle.

Calculations shall be provided for the effect of support saddles on the vessel shell and heads.

Vessel supports shall accommodate thermal expansion by preferably using a non-corroding “slotted hole” sliding arrangement.

Vessel supports shall incorporate pads for hold down bolts. The pads shall be designed to facilitate welding directly to the deck or structure.

2.13 Vertical vessel support

Vertical vessels shall be supported on steel skirts. Small vertical vessels less than 1200mm inside diameter may be supported on structural legs or lugs whichever is advantageous to plant layout or as specified. Lugs or legs, whichever applicable, must be designed to accommodate lateral loads resulting from wind, seismic and sea (or) road transportation forces.

Vessel skirts shall be of the height required to provide a clearance not less than 480mm between the bottom of the head and the deck. The mean diameter of the skirts shall be the same as the mean diameter of the bottom shell course.

All vessels provided with skirts shall have reinforced access openings of at least 400mm diameter, with the exception that skirts for vessels smaller than 920mm diameter shall be provided with at least one 200mm diameter access opening.

Vessel skirts shall be provided with 80mm diameter reinforced vent holes at approximately 920mm intervals on the circumference, located as near the vessel head as permitted by insulation or other attachments. No skirts shall have less than two such vent holes.

The following joints factors should be applied to vessel skirts

- Circumferential seams - 0.7
- Skirt to shell joint - 0.55
- Skirt to base ring joint - 1.0

2.14 Internal Attachments

All removable internals shall be fabricated so as to pass through the vessel manholes, major internal piping shall be flanged for ease of removal through the vessel manholes. All bolted internals shall be capable of being installed or removed through the vessel manways; all internal bolting shall be secured with lock nuts.

Internals shall be retained and supported by 316 SS bolts and double 316 SS nuts with Teflon inserts.

All attachment welds for vessel internal to pressure retaining parts shall be continuous. Multi pass welds shall be used and single pass welding is not acceptable. Seal welds shall have a throat thickness greater than the vessel shell corrosion allowance.

Mist eliminator elements shall be installed in gas scrubbers, separators, absorbers and any other vessels where off gas is produced. Unless otherwise stated elements shall be manufactured of 316L stainless steel or Monel wire mesh elements. Elements shall be supported above and below by carbon steel grids, except where corrosion allowance exceeds 3mm the grid shall be stainless steel wire.

The internal structure will be free of moving parts to avoid detachment and affect efficiency, operation and equipment integrity.

All vessel liquid outlets shall be equipped with vortex breakers. MPC Contractor shall design and supply vortex breakers to not restrict the flow capacity of the liquid outlets.

2.15 Sacrificial Anodes

Internally glass flake lined vessel and other vessel where indicated, should be provided with fitting for installation of sacrificial anodes.

The Supply of cathodic protection for the vessel wherever it is appropriate to meet the vessel design life. Anode material and calculation report should be submitted to EPCM for approval.

2.16 External Attachments

The vessel fabricator shall furnish and attach all insulation support rings, external pressure Stiffeners, lifting lugs, ladder, platform lugs, and pipe supports unless otherwise specified. Reinforcing pads shall be continuously welded to the vessel beneath all attachments where the welding of such attachments would cause excessive concentration of stress of vessel at those points. Each pad shall contain at least one ¼" NPT tapped tell-tale hole.

All attachments shall be continuously welded.

Piping within skirts on vertical vessels shall be fully butt welded. The first flanged joint on any such pipe shall be just outside the skirt.

Platforms & ladders for maintenance shall be provided as necessary for safe access to manholes, relief valves, control valves, controller's etc. Sample Connections, thermometers, thermo wells, gauges & control instruments shall be accessible from the platform or a ladder.

Insulation supports on vessels operating above 80°C may be stitch welded.

2.17 Earthing

The vessel shall be provided with Two SS 316L Earthing Bosses (30 mm dia, 50 mm long with 25 mm tapped hole and complete with SS 316 M10 Stud and two nuts, lock and spring washers) located diametrically opposite each other on the vessel support.

2.18 Lifting lugs / trunnions

All vessels, vertical or horizontal, shall be furnished with a minimum of two lifting lugs/trunnions, which shall be designed for a load equal to two times the shipping weight, where specified, vessels shall be provided with temporary fasteners.

2.19 Bolting

Bolts and nuts shall be furnished for all cover plates, manways, handholes, blind flanges and bolted attachment supplied with vessel.

External bolting shall be suitably treated for atmospheric corrosion protection as specified.

All stud bolts shall be threaded full length to UNC series upto 1" (M24) diameter and 8 UN series for bolts greater than 1" (M24). Nuts shall be of heavy series.

Bolts shall extend at least two clear threads from the nut.

The use of austenitic stainless steel bolting for external flanges should be avoided due to the risk of stress corrosion cracking.

Internal bolting shall be compatible with the contacting fluid and the materials being bolted.

Materials shall be as stated on the respective MPC Contractor data sheets. Internal bolting used for attachment of internals shall be fitted with double nuts or an equivalent form of locking device.

2.20 Gaskets

Gaskets shall be furnished for all cover plates, manways, handholes, blind flanges and bolted attachment supplied with vessel.

Gasket Material shall be as specified on the respective MPC Contractor data sheets.

Spiral wound and Ring joint gaskets for ASME B16.5 and ASME B16.47 Series A/ Series B flanges shall comply with the requirements and dimensions of ASME B16.20 unless specified otherwise. Colour coding of spiral wound gaskets shall be in accordance with ASME B16.20 unless otherwise specified.

The use of CAF type gasket is prohibited.

Gasket manufactured by welding shall not be used.

2.21 Welding

All pressure bearing butt welds shall be full penetration, double welded joints. For all Single side weld joints, root weld deposit shall be welded by GTAW process to ensure complete penetration.

Nozzles and manways and their reinforcement pads shall be attached to vessel with full penetration weld.

All main weld seams shall be clear of nozzles, reinforcement pads, internals, trays support rings, cleats and stiffening ring by 50 mm minimum (Weld to weld Edge). In case of unavoidable MPC Contractor shall propose suitable testing to ensure the joint strength and get approval to the EPCM before proceeding.

MPC Contractor shall submit Welding procedure Specification and qualification records for approval as per ASME Section IX.

Welding consumables shall be as per ASME Sec. II part C and shall be indicated in drawing.

Qualified welders as per the accepted procedure shall be employed for welding.

Temporary attachment welds on pressure parts shall be removed. The surface under such welds which have been removed shall be properly conditioned to eliminate surface stress raisers. Such surfaces shall be examined by either magnetic particle or liquid penetrant method of examination.

All welding slag shall be removed from weld deposits by appropriate means.

No welding or weld repair is permitted on pressure parts after Post Weld Heat Treatment (PWHT).

Weld overlay shall be applied circumferentially and it shall be relatively smooth with no notches, flaws, or undercuts that would act as stress raisers. Elbows, tees

and small bore nozzles may be overlay welded longitudinally followed by grinding or machining to a smooth surface.

2.22 Heat Treatment

For carbon steel formed components, including dished ends, stress relieving shall be performed as per applicable paragraphs of ASME Section VIII Div.1.

In addition, cold formed carbon steel heads shall be stress relieved when their thickness is 16mm or greater. Hot formed heads shall also be normalized after forming in case they are formed at temperatures below the normalizing range. Hot formed dished ends or similar parts, which have not been uniformly heated in the normalizing range in the final stages of manufacture, shall be normalized.

Flange facings shall be protected against oxidation during heat treatment. Where applicable the MPC Contractor shall submit a post weld heat treatment procedure for EPCM approval.

Local PWHT may be permitted only with prior written approval by the EPCM. Any required PWHT for welds between dissimilar metals shall conform to the requirements of the material having the more stringent requirements and shall be verified by the procedure qualification tests.

Vessels shall be post weld heat treated as a complete unit including skirt/support, wherever practicable.

2.23 Tolerances

Tolerances for vessels shall be as stated in ASME Sec VIII-Div.1.

All paired instrument nozzles shall be jig set and shall have a minimum tolerance of +/- 1mm on centers.

If vessels are to be fitted with special screens or filters which require a more precise fitting, the tolerances shall be in accordance with the screen/filter manufacturer's recommendation and shall be specified on the data/requisition sheets.

Tangent lines shall be punch-marked on the dished heads, both externally and internally at the intersection of knuckle with the cylindrical section.

2.24 Impact Test Requirements

MPC Contractor shall ensure that Code mandatory requirements of impact testing are met in accordance with minimum design metal temperature specified in the datasheets.

2.25 Material and welding inspection

Non-destructive material tests and pressure testing shall be in accordance with applicable codes, standard and specification. The tests shall be witnessed and approved by an inspector representing the EPCM.

All non-destructive testing shall be performed by a third party approved and accredited Non-Destructive Testing (NDT) inspection organization.

Full traceability of all material components (to material certificates) is required.

2.26 Hydrostatic Test

Hydrostatic test shall be conducted at a minimum of code requirement after complete fabrication and post weld heat treatment.

After testing, vessels shall be thoroughly dried by blowing dry air.

Clean potable water shall be used for hydrotest. Sea water shall not be used.

2.27 Internal and External coating

Internal and External Coating shall be in accordance with the requirements specified in "Specification for Surface Preparation and Painting.

2.28 Quality assurance and certification

The EPCM will ensure all purchased products conform to specified purchase order requirements by establishing and implementing any necessary source inspections or other activities. When source inspections are required, the EPCM inspector will conduct activities based on the approved MPC Contractor's Inspection and Test Plan (ITP). The MPC Contractor shall incorporate the inspection activities identified in the MPC Contractor Inspection and test Plan. The equipment will not be allowed to ship until the EPCM inspector issues an Inspection Release Certificate.

2.29 SPARE PARTS AND SPECIAL TOOLS

- a) MPC Contractor shall include and supply the spare parts for start-up and commissioning as part of supply scope.
- b) Priced two (2) year spare parts list shall be provided.
- c) Special tools and tackles, which are necessary to dismantle, service and assemble the unit shall be supplied, if required.

2.30 Name plate

Each complete vessel shall be provided with a type 316 stainless steel nameplate in accordance with ASME section VIII securely attached to the vessel shell and located so that it is clearly visible after installation, preferably near a manhole or inspection opening. Insulated vessels shall have nameplate brackets with enough projection to clear insulation by at least 25mm.

Name plate shall be SS316 and be permanently attached in the bracket by SS 316 rivets or screw. Name plate bracket welded to the vessel with a full penetration weld.

The nameplate shall be stamped with the following:

- Owner Name
- Equipment Name
- Equipment Tag no.
- Manufacturer's name
- Year of Fabrication
- Maximum Allowable Working Pressure, kg/cm²g at temperature ° C

SPECIFICATION FOR UNFIRED PRESSURE VESSEL

- Hydro-test pressure, kg/cm²g
- Date tested
- Capacity
- Design code
- Design pressure, kg/cm²g
- Design temperature ° C
- Minimum Design Metal Temperature
- Heat treatment
- Empty weight, kg
- Purchase Order No.
- Corrosion Allowance
- Radiography

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJAN, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

Specification for Surface preparation and Painting

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJAN, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

1 INTRODUCTION

1.1 SCOPE

This specification defines the requirements for surface preparation, selection and application of primers and paints on external surfaces of equipment, vessels, machinery, piping, ducts, steel structures, etc. The items listed in the heading of tables of paint systems is indicative only, however, the contractor is fully responsible for carrying out all the necessary painting, coating and lining on external and internal surfaces as per the requirement.

2 REFERENCE CODES & STANDARDS

IS-5	: Colour coding.
RAL DUTCH Standard)	: International Standard for colour shade (Dutch Standard)
IS-101 enamels.	: Methods of test for ready mixed paints and enamels.
IS-2379	: Indian Standard for Pipe line identification colour code.
ASTM-Vol 6.01 & 6.03	: American standard test methods for Paints and Coatings.
ANSIA 13.1	: Scheme for identification of piping systems: American National Standards Institution

3 SURFACE PREPARATION STANDARDS

SSPC-PA1	: Shop, Field and Maintenance Painting of Steel.
SSPC-PA2	: Measurement of Dry Coating Thickness with Magnetic Gauges
SSPC-SP1	: Solvent Cleaning
SSPC-SP2	: Hand Tool Cleaning
SSPC-SP3	: Power Tool Cleaning
SSPC-SP5	: White Metal Blast Cleaning
SSPC-SP6	: Commercial Blast Cleaning
SSPC-SP7	: Brush –Off Blast Cleaning
SSPC-SP10	: Near White Blast Cleaning
SSPC-SP11	: Power Tool Cleaning to bare metal
SSPC-SP12	: Surface Preparation & cleaning of Steel and Other Hard material by High and Ultra High Pressure Water Jetting prior to recoating

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJAN, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

4 EQUIPMENT

All tools, brushes, rollers, spray guns, abrasive material, hand / power tools for cleaning and all equipment's, scaffolding materials, shot / grit blasting equipment's & air compressors etc. required to be used shall be suitable for the work and all in good order and shall be arranged in sufficient quantity.

Mechanical mixing shall be used for paint mixing operations in case of two pack systems except that the Engineer-In-charge may allow the hand mixing of small quantities at his discretion in case of specific requirement for touchup work only.

5 SURFACE PREPARATION, SHOP PRIMER COATING APPLICATION & REPAIR AND DOCUMENTATION

5.1 GENERAL

In order to achieve the maximum durability, one or more of following methods of surface preparation shall be followed, depending on condition of surface to be painted and as instructed by Engineer-In-Charge. Adhesion of the paint film to surface depends largely on the degree of cleanliness of the metal surface. Proper surface preparation contributes more to the success of the paint protective system.

- a. Manual or hand tool cleaning.
- b. Mechanical or power tool cleaning.
- c. Blast cleaning.

Mill scale, rust, rust scale and foreign matter shall be removed fully to ensure that a clean and dry surface is obtained. Unless otherwise specified, surface preparation shall be done as per provisions of relevant tables given elsewhere in this specification. The minimum acceptable standard in case of manual or hand tool cleaning shall be St.2 or equivalent, in case of mechanical or power tool cleaning it shall be St. 3 or equivalent, in case of blast cleaning it shall be SSPC-SP or ISO8501-01.

Remove all other contaminants, oil, grease etc. by use of an aromatic solvent prior to surface cleaning.

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Blast cleaning shall not be performed where dust can contaminate surfaces undergoing such cleaning or during humid weather conditions having humidity exceed 85%. In case of internal coating of storage tanks, De-humidifiers shall be used to control the humidity levels during rainy season, if painting is to be carried out during the no rain days in case of exigency of project schedule with prior permission of EPCM Consultant.

Irrespective of the method of surface preparation, the first coat of primer must be applied by airless spray/ air assisted conventional spray if recommended by the paint manufacturer on dry surface. This should be done immediately and in any case within 4 hours of cleaning of surface. However, at times of unfavorable weather conditions, the Engineer-In-Charge shall have the liberty to control the time period, at his sole discretion and/or to insist on re-cleaning, as may be required, before primer application is taken up. In general, during unfavorable weather conditions, blasting and painting shall be avoided as far as practicable.

The external surface of R.C.C. chimney to be painted shall be dry and clean. Any loose particle of sand, cement, aggregate etc. shall be removed by scrubbing with soft wire brush. Acid etching with 10-15% HCL solution for about 15 minutes shall be carried and surface must be thoroughly washed with water to remove acid & loose particles and then dried completely before application of paint.

5.2 PROCEDURE OF SURFACE PREPARATION

Air blast cleaning with abrasives

The surfaces shall be blast cleaned using one of the abrasives like copper slag, Al₂O₃ particles, chilled cast iron or malleable iron and steel at pressure of 7kg/cm² at an appropriate distance and angle depending of nozzle size maintaining constant velocity and pressure. Chilled cast iron, malleable iron and steel shall be in the form of shot or grit of size with appropriate size of G42 grade (maximum) and S250 grade size of steel shots (maximum) to obtain a desired surface profile of 35-50 microns trough to peak or specified profile in case of steel and malleable iron. The combination of steel grits and shots shall be normally in the ratio of 3:1. The quality of abrasives shall be free from contaminants and impurities and shall meet the requirements of SSPC AB 1.

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJAN, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

Compressed air shall be free from moisture and oil. The blasting nozzles should be venturi style with tungsten carbide or boron carbide as the materials for liners. Nozzles orifice may vary from 3/16" to 1/2". On completion of blasting operation, the blasted surface shall be clean and free from any scale or rust and must show a grey white metallic luster. Primer/first coat of paint shall be applied within 4 hours of surface preparation. Blast cleaning shall not be done outdoors in bad weather without adequate protection or when there is dew on the metal, which is to be cleaned. Surface profile shall be uniform to provide good key to the paint adhesion (i.e. 35 to 50 microns). If possible vacuum collector shall be installed for collecting the abrasives and recycling.

Mechanical or Power Tool Cleaning

Power tool cleaning shall be done by mechanical striking tools, chipping hammers, grinding wheels or rotating steel wire- brushes. Excessive burnish of surface shall be avoided as it can reduce paint adhesion. On completion of cleaning, the detached rust mill scale etc. shall be removed by clean rags and /or washed by water or steam and thoroughly dried with compressed air jet before application of paint.

Manual or hand tool cleaning

Manual or hand tool cleaning is used only where safety problems limit the application of other surface preparation procedure and hence does not appear in the tables of paint systems.

Hand tool cleaning normally consists of the following:

- Hand de-scaling and/or Hammering
- Hand scraping
- Hand wire brushing

Rust, mill scale spatters, old coatings and other foreign matter, shall be removed by hammering, scrapping tools, emery paper cleaning, wire brushing or combination of the above methods. On completion of cleaning, loose material shall be removed from the surface by clean rags and the surface shall be brushed, swept, dusted and blow off with compressed air/steam to remove all

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJAN, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

loose matter. Finally the surface may be washed with water and dried for effective cleaning.

5.3 NON-COMPATIBLE SHOP COAT PRIMER

The paint system followed for Shop coating of structures/equipment's etc., shall be mentioned in IRN. The compatibility of finishing coat should be confirmed from the paint manufacturer. In the event of use of primer such as zinc Rich epoxy, inorganic zinc silicate etc. as shop coat, the paint system shall depend on condition of shop coat. If the shop coat is in satisfactory condition showing no major defect, the shop coat shall not be removed. The touch up primer and finishing coat(s) shall be identified for application by Engineer-in-Charge.

Shop coated (coated with Primer & finishing coat) equipment should not be repainted unless paint is damaged. Repair shall be carried out as per Table 7.2 of paint systems depending upon compatibility of paint.

Shop primed equipment and surfaces will only be 'spot cleaned' in damaged areas by means of power tool brush cleaning or hand tool cleaning and then spot primed before applying one coat of field primer unless otherwise specified. If shop primer is not compatible with field primer then shop coated primer should be completely removed before application of selected paint system for particular environment.

For Package units/equipment, shop primer should be as per the paint system given in this specification. However, manufacturer's standard can be followed after review.

5.4 COATING PROCEDURE AND APPLICATION

Surface shall not be coated in rain, wind or in environment where injurious airborne elements exists, when the steel surface temperature is less than -15°C above dew point when the relative humidity is greater than 85% or when the temperature is below 4.4°C and when the ambient/substrate temp is below the paint manufacturer's recommended temperature of application and curing. Desiccant type De-humidifier equipment shall be used to control RH and Dew point. The paint application shall not be done when the wind speed exceeds 20 KM per hour.

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJAN, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

Blast cleaned surface shall be coated with one complete application of primer as soon as practicable but in no case later than 4 hrs the same day.

To the maximum extent practicable, each coat of material shall be applied as a continuous film uniform thickness free of probes. Any spots or areas missed in application shall be recoated and permitted to dry before the next coat is applied. Applied paint should have the desired wet film thickness.

Each coat shall be in proper state of cure or dryness before the application of succeeding coat. Material shall be considered dry for recoating when an additional coat can be applied without the development of any detrimental film irregularities, such as lifting or loss of adhesion of the under coat. Manufacturer instruction shall be followed for inter coat interval.

When the successive coat of the same colour has been specified, alternate coat shall be tinted, when practical, sufficiently to produce enough contrast to indicate complete coverage of the surface. The tinting material shall be compatible with the material and not detrimental to its service life and shall be recommended by the original paint manufacturer.

Air spray application shall be in accordance with the following:

- The equipment used shall be suitable for the intended purpose, shall be capable of properly atomizing the paint to be applied, and shall be equipped with suitable pressure regulators and gauges. The air caps, nozzles, and needles shall be those recommended by the manufacturer of the equipment for the material being sprayed. The equipment shall be kept in satisfactory condition to permit proper paint application.
- Traps or separators shall be provided to remove oil and condensed water from the air. These traps or separators must be of adequate size and must be drained periodically during operations. The air from the spray gun impinging against the surface shall show no condensed water or oil.
- Ingredients shall be kept properly mixed in the spraypots or containers during application by continuous mechanical agitation.

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJAN, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

- The pressure on the material in the pot and of the air at the gun shall be adjusted for optimum spraying effectiveness. The pressure on the material in the pot shall be adjusted when necessary for changes in elevation of the gun above the pot. The atomizing air pressure at the gun shall be high enough to properly atomize the paint but not so high as to cause excessive fogging of paint, excessive evaporation of solvent, or less by over spray.
- Spray equipment shall be kept sufficiently clean so that dirt, dried paint, and other foreign materials are not deposited in the paint film.
- Any solvents left in the equipment shall be completely removed before applying paint to the surface being painted.
- Paint shall be applied in a uniform layer, with over lapping at the edge of the spray pattern. The spray patterns shall be adjusted so that the paint is deposited uniformly. During application, the gun shall be held perpendicular to the surface and at a distance which will ensure that a wet layer of paint is deposited on the surface. The trigger of the gun should be released at the end of each stroke.
- All runs and sags shall be brushed out immediately or the paint shall be removed and the surface repainted.
- Areas inaccessible to the spray gun shall be painted by brush; if not accessible by brush, daubers or sheepskins shall be used.
- All nameplates, manufacturer's identification tags, machined surfaces, instrument glass, finished flange faces, control valve items and similar items shall be masked to prohibit coating deposition. If these surfaces are coated, the component shall be cleaned and resorted to its original condition.
- Edges of structural shapes and irregular coated surfaces shall be coated first and an extra pass made later.
- If spray gun shows choking, immediately de-choking procedure shall be followed.

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJAN, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

Airless spray application shall be in accordance with the following procedure: as per steel structure paint Manual Vol.1 & Vol.2 by SSPC, USA, Airless spray relies on hydraulic pressure rather than air atomization to produce the desired spray. An air compressor or electric motor is used to operate a pump to produce pressures of 1000 to 6000 psi. Paint is delivered to the spray gun at this pressure through a single hose within the gun, a single paint stream is divided into separate streams, which are forced through a small orifice resulting in atomization of paint without the use of air. This results in more rapid coverage with less over spray. Airless spray usually is faster, cleaner, more economical and easier to use than conventional air spray.

Airless spray equipment is mounted on wheels, and paint is aspirated in a hose that sucks paint from any container, including drums. The unit shall have in built agitator that keep the paint uniformly mixed during the spraying. The unit shall consist of in built strainer. Usually very small quantity of thinning is required before spray. In case of high build epoxy coating (two pack). 30: 1 pump ratio and 0.020-0.023" tip size will provide a good spray pattern. Ideally fluid hoses should not be less than 3/8" ID and not longer than 50ft to obtain optimum results.

In case of gun choking, de-choking steps shall be followed immediately.

Brush application of paint shall be in accordance with the following:

- Brushes shall be of a style and quality that will enable proper application of paint.
- Round or oval brushes are most suitable for rivets, bolts, irregular surface, and rough or pitted steel. Wide flat brushes are suitable for large flat areas, but they shall not have width over five inches.
- Paint shall be applied into all corners.
- Any runs or sags shall be brushed out.
- There shall be a minimum of brush marks left in the applied paint.
- Surfaces not accessible to brushes shall be painted by spray, daubers, or sheepskin.

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJAN, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

Manual application by sling (where 6 O'clock position of pipe is not approachable)

A canvas strip (alternatively a tinplate strip) about 450 mm wide and 1.5m long is held under the pipe by two men holding this sling move it up and down and walk slowly forward while fresh coating is poured on the pipe and they manipulate the sling so that an even coating is obtained all round the bottom. This work shall be done very carefully and by experienced personnel. There shall not be any formation of "Whiskers" and holes in the coating. The coating film shall be inspected by mirror for each coat the painter should know the WFT corresponding to the specified OFT and standardize the paint application technique to achieve the desired WFT. This has to be ensured in the qualification trial.

5.5 DRYING OF COATED SURFACES

No coat shall be applied until the preceding coat has dried. The material shall be considered dry for re-coating when another coat can be applied without the development of any film irregularities such as lifting or loss of adhesion of under coats. Drying time of the applied coat should not exceed maximum specified for it as a first coat; if it exceeds the paint material has possibly deteriorated or maxing is faulty.

No paint shall be force dried under conditions which will cause checking, wrinkling, blistering formation of pores, or detrimentally affect the conditions of the paint.

No drier shall be added to paint on the job unless specifically called for in the manufacturer's specification for the paint.

Paint shall be protected from rain, condensation, contamination, snow and freezing until dry to the fullest extent practicable.

5.6 REPAIR OF DAMAGED PAINT SURFACE.

Where paint has been damaged in handling and in transportation, there pair of damaged coating of pre-erection / fabrication and Shop primer shall be done as given below and as per the Table 7.2 of this specification.

Repair of damaged in organic zinc silicate primer after erection / welding in the design temperature of -90°C to 550°C.

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJAN, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

Surface Preparation: Quickly remove the primer from damaged area by mechanical scraping and emery paper conforming to SSPC-SP-3 to expose the white metal. Blast clean the surface, if possible. Feather the primed surface over the intact adjacent surface surrounding the damaged area by emery paper.

Primer Coating: One coat of F-9 shall be applied wherever damaged was observed on pre-erection, pre-fabrication / shop primer of inorganic zinc silicate coating (F-9). F-9 shall not be applied if damaged area is not more than 5x5 cm.

5.7 PAINT APPLICATION

Shop priming / pre-erection priming with F9 or F12 shall be done only on blasted surface (SSPC-SP-10)

Shop priming / pre-erection priming with F9 or F12 shall be done only with airless spray.

For large flat surface field painting shall be done by airless spray otherwise brush can be used.

5.8 ASSESSMENT OF PAINTING REQUIREMENT

The paint system to be applied for a specific job shall be arrived at sequentially as given below:

- Identify the environment from area classification details and chose the appropriate table.
- Identify the design temperature from the technical documents
- Identify the specific field paint system and surface preparation requirement from the above identified table and temperature range.
- Identify the shop priming requirement from Table 7.1 based on compatibility of the above paint system.
- Identify the need of repair of shop primer and execute as per Table 7.2.

5.9 DOCUMENTATION

Detailed QAP.

Painting schedule.

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJA, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

Daily progress report with details of weather condition, particular of applications, no of coats and type of materials applied, defects, progress of work etc.

Results of measurement of temperatures relative humidity, surface profile, film thickness, holiday detection, adhesion tests with signature of appropriate authority.

Particulars of surface preparation and paint application during trials and during the work.

Details of non-compliance reject and repair.

Type of testing equipment and calibration.

Code and batch numbers of paint materials used.

TABLE-1 (for clause 5.0) SURFACE PREPARATION STANDARDS

SI NO	DESCRIPTION	VARIOUS INTERNATIONAL STANDARDS (EQUIVALENT)			REMARKS
		IS 8501-1/SIS-05 59 00	SSPC-SP, USA	NACE, USA	
1	Manual or hand tool cleaning: Removal of loose rust, loose mill scale and loose paint. Chipping, scrapping and wire brushing. surface should have a faint metallic sheen	ST.2	SSPC-SP-2	--	This method is applied when the surface is exposed to normal atmospheric conditions when other methods cannot be adopted and also for spot cleaning during maintenance painting.
2	Mechanical or power tool cleaning: Removal of loose rust, loose mill scale and loose paint to degree specified by power tool chipping, De-scaling, sanding, wire brushing and grinding, after removal of dust, surface should have a pronounced metallic sheen.	ST.3	SSPC-SP-3	--	

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJAN, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

3	Dry abrasive blast cleaning: There are four common grades of blast cleaning				
3.1	White metal: Blast cleaning to white metal cleanliness. Removal of all visible rust. Mill scale, paint & foreign matter 100% cleanliness with desired surface profile.	SA 3	SSPC-SP-5	NACE # 1	Where extremely clean surface can be expected for prolong life of paint system.
3.2	Near white metal: Blast cleaning to near white metal cleanliness, until at least 95% of each element of surface area is free of all visible residues with desired surface profile.	SA 2 ½	SSPC-SP-10	NACE # 2	The minimum requirement for chemically resistant paint systems such as epoxy, vinyl, polyurethane based and inorganic zinc silicate paints, also for conventional paint systems used under fairly corrosive conditions to obtain design life of paint.
3.3	Commercial Blast: Blast cleaning until at least two-third of each element of surface area is free of all visible residues with desired surface profile.	SA 2	SSPC-SP-6	NO.3	For steel required to be painted with conventional paints for exposure to mildly corrosive atmosphere for longer life of the paint systems.
3.4	Brush-off Blast: Blast cleaning to white metal cleanliness, removal of all visible rust, mill scale, paint & foreign matter. Surface profile is not so important	SA 1	SSPC-SP-7	NO.4	

6 PAINT MATERIALS

Paint manufacturers shall furnish the characteristics of all paint materials on printed literature, along with the test certificate for all the specified characteristics given in this specification. All the paint materials shall be of first quality and conform to the following general characteristics as per the tables 6.1, 6.2 and 6.3.

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJAN, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

PAINT MATERIALS

TABLE No. 6.1 PRIMERS

Sl. No.	DESCRIPTION	P-2	P-4	P-6	P-7
1	Technical name	Chlorinated rubber Zinc Phosphate primer.	Etch primer/wash primer	Epoxy zinc phosphate primer	ZINGA synthetic zinc primer
2	Type and composition	Single pack, air drying chlorinated rubber based medium plasticized with unsaponifiable plasticizer, pigmented with Zinc phosphate	Two pack polyvinyl butyral resin medium cured with phosphoric acid solution pigmented with zinc tetroxychromate	Two component polyamine cured epoxy resin medium, pigmented with zinc phosphate.	One pack Synthetic Resin based zinc primer containing 96% of electrolytic zinc dust of 99.995% purity.
3	Volume Solids (minimum)	40%.	7-8%	40%	37%
4	DFT (Dry Film thickness) per coat (minimum)	30-40 μ	8-10 μ	40-50 μ	40-50 μ
5	Theoretical covering capacity in m ² /coat/litre (minimum)	8-10	8-10	8-10	4 m ² /kg
6	Weight per litre in kgs/litre (minimum)	1.3	1.2	1.4	2.67kg at 15°C
7	Touch dry at 30°C (minimum)	30 minutes	2 hrs	After 30 min.	10 minutes
8	Hard dry at 30°C (maximum.)	24 hrs	24 hrs	24 hrs	24 hrs

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJAN, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

9	Over coating interval	Min.: 8 hrs	Min: 4-6 hrs	Min.:8hrs	Min.:4 hrs
10	Pot life at 30°C for two component paints (minimum)	Not Applicable	Not applicable	6 - 8 hrs	Unlimited
11	Temperature (Resistance (minimum)	60°C	NA	80°C	100°C

PAINT MATERIALS

TABLE No. 6.2 FINISH PAINTS

Sl. No	DESCRIPTION	F-2	F-3	F-6 A/B	F-7
1	Technical name	Acrylic polyurethane finish paint	Chlorinated rubber based finish paint	Epoxy-High build finish paint	High build coaltar epoxy coating
2	Type & composition	Two-pack aliphatic isocyanate cured acrylic finish paint	Single pack plasticized chlorinated rubber based medium with chemical and weather resistant pigments	F6A: Two-pack polyamine cured epoxy resin medium suitably pigmented. F6B: Polyamide cured epoxy resin medium suitable pigmented.	Two-pack polyamide cured epoxy resin blended with coaltar medium, suitably pigmented
3	Volume Solids (minimum)	40%	40%	62%	65%
4	DFT (Dry Film thickness) per	30-40μ	30-40μ	100-125μ	100-125μ

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJAN, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

	coat (minimum)				
5	Theoretical covering capacity in m ² /coat/ litre (minimum)	10-13	8-10	5-6	5.2-6.5
6	Weight per liter in kgs/litre (minimum)	1.3	1.2	1.4	1.5
7	Touch dry at 30°C (maximum)	1 hr	30 minutes	3 hrs	4 hrs
8	Hard dry at 30°C (maximum) Full cure 30°C (for immersion / high temperature service)	16 hrs 5 days	8hrs NA	16 hrs 5 days	48 hrs 5 days
9	Over-coating interval at 30°C	Min: 12 hrs	Min: Overnight	Min: Overnight Max : 5 days	Min: 24 hrs Max: 5 days
10	Pot life (approx.) at 30°C for two component paints (minimum)	6-8 hrs	Not applicable	4-6 hrs	4-6 hrs
11	Temperature Resistance (minimum)	80°C	60°C	80°C	125°C

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJA, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

PAINT MATERIALS

TABLE No. 6.3 FINISH PAINTS

Sl. No	DESCRIPTION	F-8	F-9	F-11	F-12
1	Technical name	Self priming type surface tolerant high build epoxy coating (complete rust control coating)	Inorganic zinc silicate coating	Heat resistant synthetic medium based two packs Aluminium paint suitable up to 250°C dry temp.	Heat resistant silicone Aluminium paint suitable up to 500°C dry temp.
2	Type & composition	Two pack epoxy resin based suitable pigmented and capable of adhering to manually prepared surface and old coating.	A two pack air drying self curing solvent based inorganic zinc silicate coating with minimum 80% zinc content on dry film. The final cure of the dry film shall pass the MEK rub test.	Heat resistant synthetic medium based two pack Aluminium paint suitable upto 250°C.	Single pack silicone resin based medium with Aluminium flakes.
3	Volume Solids (minimum)	72%	60%	25%	20%
4	DFT (Dry Film thickness) per coat (minimum)	100-125μ	65-75μ	20-25μ	20-25μ
5	Theoretical covering capacity in m ² /coat/	6.0-7.2	8-9	10-12	8-10

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJAN, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

	litre (minimum)				
6	Weight per liter in kgs/litre (minimum)	1.4	2.3	1.2	1.1
7	Touch dry at 30°C (maximum)	3 hrs	30 minutes	3 hrs	30 minutes
8	Hard dry at 30°C (maximum) Full cure 30°C (for immersion/high temperature service)	24 hrs 5days	24 hrs NA	24 hrs NA	24 hrs NA
9	Over-coating Interval	Min.:10 hrs	Min.: 12 hrs at 20°C & 50%RH	Min: 24 hrs	Min.: 24 hrs
10	Pot life at 30°C for two component paints (minimum)	90 minutes	4-6 hrs	Not applicable	Not applicable
11	Temperature Resistance (minimum)	80°C	400°C	250°C	500°C

PAINT MATERIALS

TABLE No. 6.4 FINISH PAINTS

Sl No	DESCRIPTION	F-14	F-15	F-16	F-17
1	Technical name	Polyamine cured coal tar epoxy	Two-component Epoxy phenolic coating cured with Polyamine adduct hardner system (primer + intermediate coat + finish paint)	Ambient temperature curing Poly Siloxane coating/High build cold applied inorganic copolymer based aluminium coating suitable for under insulation coating of CS and SS piping for high temperature service.	Two component solvent free type high build epoxy phenolic/ novalac epoxy phenolic coating cured with Polyamine adduct hardner system

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJAN, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

2	Type & Composition	Specially formulated polyamine cured coal tar epoxy suitable for application under insulation	Two pack ambient temperature curing epoxy phenolic coating system suitable for application under insulation of CS/SS piping	Amercoat 738, / Berger 938 or Intertherm 751 CSA	Two component solvent free type high build epoxy phenolic/ novalac epoxy phenolic coating cured with Polyamine adduct hardner system
3	Volume Solids (minimum)	70%	65%	60%	98-100 %
4	DFT(Dry Film thickness) per coat (minimum)	125 µm	75-100 µm	75-100µm	125-150µm
5	Theoretical covering capacity in m ² /coat/litre (minimum)	5.5	6.5- 8.5	6.0- 8.0	6.5 - 8
6	Weightperliterinkgs/litre (mix paint) (minimum)	1.5	1.7	1.3	1.7
7	Touch dry at 30°C (maximum)	4 hrs	2 hrs	1 hr	2 hrs
8	Hard dry at 30°C (maximum) Full cure 30°C (for immersion /high temp. service)	24 hrs 168 hrs (7 days)	24 hrs 168 hrs (7 days)	16 hrs -	24 hrs 168 hrs (7 days)
9	Over-coating interval	Min.6hrs Max.5 days	Min.36hrs Max.21 days	Min. 16hrs Max. NA	Min. 16hrs Max. 21 days
10	Pot life at 30°C for two component paints (minimum)	4 hrs	1.5 hrs	1 hr	1 hr
11	Temperature Resistance (minimum)	-45°C to 125°C under	-45°C to 150°C under insulation	Up to 400 deg. C for CS & SS surfaces	-45°C to 150°C for immersion service

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJAN, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

		insulation	(Note: 5)	under insulation	

NOTES: (For tables 6.1 to 6.4)

1. Covering capacity and DFT depends on method of application. Covering capacity specified above is theoretical. Allowing the losses during application, min specified DFT should be maintained.
2. All primers and finish coats should be cold cured and air drying unless otherwise specified.
3. All paints shall be applied in accordance with manufacturer's instructions for surface preparation, intervals, curing and application. The surface preparation, quality and workmanship should be ensured. In case of conflict between this specification and manufacturer's recommendation, the same shall be clarified.
4. Technical data sheets for all paints shall be supplied at the time of submission of quotations.
5. F-15: Two-component Epoxy phenolic coating cured with Polyamine adducts hardner system (primer + intermediate coat + finish paint) suitable upto 225°C (Intertherm 228).
6. F-16: Ambient temperature curing epoxy poly siloxane Coating or high build cold applied inorganic co-polymer based aluminium coating.

6.5 STORAGE

All paints and painting materials shall be stored only in rooms to be arranged by contractor and approved by Engineer-in-charge for the purpose. All necessary pre cautions shall be taken to prevent fire. The storage building shall preferably be separate from adjacent building. A signboard bearing the word "PAINTSTORAGE- NO NAKEDLIGHT- HIGHLY INFLAMMABLE" shall be clearly displayed outside. Manufacturer's recommendation shall be followed for storage of paint materials.

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJAN, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

7 PAINT SYSTEMS

The paint system should be selected based on the areas classified inside the plant as given below. The Geographical corrosive and highly corrosive conditions of a plant located in Coastal and Marine area, Highly Corrosive conditions inside a plant and Industrial Corrosive Environment are taken care in the specifications in total.

ENVIRONMENT/AREA CLASSIFICATION

- Corrosive Environment-Offsite areas (excluding Cooling Tower area, DM-plant)
- Corrosive Environment-Unit areas
- Highly Corrosive Environment-Unit & Offsite areas of a plant with corrosive fumes like HCL, H₂SO₄, Water impingement, Salty water, Chloride and water mist, Cooling Tower areas, DM Plant area.

Notes :

1. Painting systems (Primers, Finish Paints etc) based upon Area classification/ Environments (Corrosive / Highly Corrosive) / Applications are tabulated in Tables 8.0 to 17.0.
2. Primers & Finish paints covered in Tables 8.0 to 17.0 are listed in Table 7.1.
3. Repair of Pre-Erection/Pre-Fabrication & Shop priming after erection/welding shall be done as per Table 7.2.

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJAN, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

TABLE 7.1: LIST OF PRIMERS & FINISH COATS COVERED IN TABLE NOS. 8.0-14.0

PRIMERS	
P-2	Chlorinated rubber zinc Phosphate Primer
P-4	Etch Primer/Wash Primer
P-6	Two component Epoxy Zinc Phosphate Primer cured with polyamine hardner
P-7	Single pack, synthetic resin based 'ZINGA' zinc primer containing 96% of electrolytic zinc dust in dry film

FINISH COATS/PAINTS	
F-2	Two component Acrylic — Polyurethane finish paint
F-3	Chlorinated Rubber finish paint
F-6A	High Build Epoxy finish coating cured with polyamine hardner
F-6B	High Build Epoxy finish coating cured with polyamide hardner
F-7	High build coal tar epoxy coating cured with polyamine hardner
F-8	Self priming surface Tolerant High Build epoxy coating cured with polyamine hardner
F-9	Two component Inorganic Zinc Silicate coating
F-11	Heat resistant synthetic medium based Aluminium paint
F-12	Two component Heat resistant Silicone Aluminium paint
F-14	Specially formulated coal tar epoxy coating cured with polyamine hardner
F-15	Two component Epoxy phenolic coating cured with Polyamine adduct hardner system
F-16	Engineered Epoxy poly Siloxane Coating or high build cold applied inorganic co-polymer based aluminium coating
F-17	Two component solvent free type high build epoxy phenolic/novalac epoxy phenolic coating cured with Polyamine adduct hardner system

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJAN, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

TABLE 7.2 REPAIR OF PRE-ERECTION/PRE-FABRICATION & SHOP PRIMING AFTER ERECTION/WELDING for all insulated and un-insulated CS, LTCS& low allow steel items in all environments. (Refer clauses 5.4, 5.5& 5.9)

SI No.	Design Temp. in °C	Surface Preparation	Paint System	Total DFT in Microns (min.)	Remarks
7.2.1	-40 to 150 for structures, hand rails and Gratings only	SSPC-SP-3	1 coat of F-9 or 2 coats of P-7 @ 40μDFT/coat	65-75 (F-9) or 80 (P-7)	For few isolated damaged areas of more than 5x5 CM
7.2.2	-90 to 400	SSPC-SP-3	1 coat of F-9	65-75	-DO-
7.2.3	401 to 550	SSPC-SP-3	1 coat of F- 12	20	-DO-

NOTES :

- 1) The application and repair of pre-erection/pre-fabrication & Shop Priming given in above tables shall be done for all the items to be painted. In case the damages of primer are severe and spread on large areas, the Engineer-in-Charge may decide to advice re-blasting and priming again if required.
- 2) The pre-fabrication primer P-7, 'ZINGA' primer is recommended as alternative repair primer to F-9 for Structures, Hand Rails and Gratings only. F-9 shall be used for all other areas.

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJA, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	 KAVIN™

TABLE 8.0 PAINT SYSTEM FOR CORROSIVE ENVIRONMENT-OFF SITE ARE AS (excluding Cooling Tower area & DM Plant area) for external surfaces of Un-insulated Structures, Piping, Equipments, Pumps, Vessels etc (Note- 1); (For Carbon Steel, LTCS& Low Alloy Steel)

Sl. NO	Design Temperature in °C	Surface Preparation & Pre-erection / shop primer	Paint system (Field)		Total final DFT in Microns (min)	Remarks
			Primer	Finish Paint		
8.1	-90 to -15	SSPC-SP-10; 1 coat of F-9 @ 65-75 μ DFT/coat	None	None	65-75	No over-coating to be done on F-9 as it will lead to mud cracking F-3 paint shall contain pure chlorinated rubber, not modified. F-12 shall be ambient temperature curing type. Flare lines shall be painted as per Table 9.0.
8.2	-14 to 60	SSPC-SP-10; 1 coat of F-9 @ 65-75 μ DFT/coat	1 coat of P-2 @ 40 μ DFT/coat	2 coats of F-3 @ 40 μ DFT/; (2x40=80)	185	
8.3	61 to 80	SSPC-SP-10; 1 coat of F-9 @ 65-75 μ DFT/coat	1 coat of P-6 @ 40 μ DFT/coat	1 coat of F-6B @ 100 μ DFT/coat + 1 coat of F-2 @ 40 μ DFT/coat; (100+40=140)	245	
8.4	81 to 250	SSPC-SP-10; 1 coat of F-9 @ 65-75 μ DFT/coat	None	3 coats of F11 @ 20 μ DFT/coat; (3x20=60)	125	
8.5	251 to 400	SSPC-SP-10; 1 coat of F9@ 65-75 μ DFT/coat	None	2 coats of F-12 @ 20 μ DFT/coat (2x20=40) or 1 coat of F-16 @ 50 μ DFT/coat.	105-115 or 115-125	

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORI JAN, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

8.6	401 to 550	SSPC-SP-10; 1 coats of F-12 @ 20 μDFT/coat	None	2 coats of F-12 @ 20 μDFT/coat (2x20=40)	60	

NOTES:

- 1) The list of items given in the heading of the above table is not exhaustive. The Contractor is fully responsible for completing painting including pre fabrication primer for all the items supplied and fabricated through his scope of work.
- 2) For external surfaces of MS chimney with/without refractory lining and for internal surfaces of MS chimney without refractory lining 8.3, 8.4 & 8.5 shall be followed.
- 3) For external surfaces of RCC chimney: 2 coats of F-6 @ 100μ OFT/coat to obtain 2x100=200μ DFT shall be applied after making surface preparation as per guidelines in 5.1.5.
- 4) If the Pre-erection/Pre-fabrication & Shop Primer has already been completed, the same shall not be repeated again in the field. In case the damages of primer are severe and spread over large areas, the engineer-in-charge may decide & advise re-blasting and priming again. Repair of pre-fabrication/pre-erection primer, if required, shall be done as per Table 7.2.
- 5) In case of Paint systems as per SI Nos 8.5 and 8.6, the colour band shall be applied over the Aluminum paint as per the Colour coding requirement for specific service of piping given in Clause 15.0.

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJA, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

TABLE 9.0 PAINT SYSTEM FOR CORROSIVE ENVIRONMENT-UNIT AREAS for external surfaces of Un-insulated Structures, Piping, Equipments, Columns, Towers, Vessels, Pumps, Compressors, Blowers etc(Note-1);(For Carbon Steel, LTCS& Low Alloy Steel)

SI.NO	Design Temperature in °C	Surface Preparation & Pre-erection /shop primer	Paint system (Field)		Total final DFT in Microns (min)	Remarks
			Primer	Finish Paint		
9.1	-90 to -15	SSPC-SP-10; 1 coat of F-9 @65-75 μDFT/coat	None	None	65-75	
9.2	-14 to 80	SSPC-SP-10; 1coat of F-9 @ 65-75μDFT/coat	1 coat of P-6 @40 μDFT/coat	1 coat of F-6A @ 100 μDFT/coat + 1 coat of F-2 @ 40μDFT/coat; (100+40=140)	245-255	No over-coating to be done on F-9 as it will lead to mud cracking.
9.3	81 to 400	SSPC-SP-10; 1 coat of F-9@ 65-75μ DFT/coat	None	2 coats of F-12@ 20 μDFT/coat (2x20=40) or 1 coat of F-16 @50 μDFT/coat	105-115 or 115-125	F-12 shall be ambient temperature curing type
9.4	401 to 550	SSPC-SP-10; 1coat of F-12 @ DFT/coat 20 μDFT/coat	None	2 coats of F-12 @ 20 μ DFT/coat (2 x 20=40)	60	

Notes:

- 1) The list of items given in the heading of the above table is not exhaustive. The Contractor is fully responsible for completing painting including prefabrication primer for all the items supplied and fabricated through his scope of work.

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORI JAN, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

2) If the Pre-erection/Pre-fabrication & Shop Primer has already been completed, the same shall not be repeated again in the field. In case the damages of primer are severe and spread over large areas, the engineer-in-charge may decide & advise re-blasting and priming again. Repair of pre-fabrication/pre-erection primer, if required, shall be done as per Table 7.2.

3) In case of paint systems as per SI Nos 9.3 and 9.4, the colour band shall be applied over the Aluminum paint as per the Colour coding requirement for specific service of piping given in clause 15.0.

TABLE 10.0 PAINT SYSTEM FOR HIGHLY CORROSIVE ENVIRONMENT- UNIT & OFFSITE AREAS OF THE PLANT with corrosive fumes like HCL, H₂SO₄, Water Impingement, Salty Water, Chloride & Water Mist, DM Plant Area, Cooling Tower Area for external surfaces of Un-insulated Structures, Piping, Equipment's, Towers, Columns, Vessels, Pumps, Compressors, Blowers etc (Note-1); (For Carbon Steel, LTCS & Low Alloy Steel)

Sl. No	Design Temperature in °C	Surface Preparation & Pre-erection /shop primer	Paint system (Field)		Total final DFT in Microns (min)	Remarks
			Primer	Finish Paint		
10.1	-90 to -15	SSPC-SP- 10; 1 coat of F-9 @ 65-75 μDFT/coat	None	None	65-75	No over coating to be done on F-9 as it will lead to mud cracking F-12 shall be ambient temperature curing type.
10.2	-14 to 80	SSPC-SP- 10; 1 coat of F-9 @ 65-75 μDFT/coat	1 coat of P6 @ 40 μ DFT/coat	2 coat of F-6A @ 100 μDFT/coat + 1 coat of F-2 @ 40 μDFT/coat; (2x 100+40=240)	345-355	
10.3	81 to 400	SSPC-SP- 10; 1 coat of F-9 @ 65-75	None	2 coats of F-12 @ 20 μDFT/coat 2x20=40 or 1 coat of F-16	105-115 or 115-125	

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORI JAN, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

		μ DFT/coat		@ 50 μ DFT/coat.		
10.4	401 to 550	SSPC-SP- 10; 1coat of F-12 @ 20 μ DFT/coat	None	2 coats of F- 12@ 20 μ DFT/coat 2x20=40	60	

Notes :

- 1) The list of items given in the heading of the above table is not exhaustive. The Contractor is fully responsible for completing painting including prefabrication primer for all the items supplied and fabricated through his scope of work.
- 2) If the Pre-erection/Pre-fabrication & Shop Primer has already been completed, the same shall not be repeated again in the field. In case the damages of primer are severe and spread over large areas, the engineer-in-charge may decide & advise re-blasting and priming again. Repair of pre-fabrication/pre-erection primer, if required, shall be done as per Table 7 .2
- 3) In case of paint systems as per SI Nos 10.3 and 10.4, the colour bands shall be applied over the Aluminum paint as per the Colour coding requirement for specific service of piping given in clause 15.0.

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJA, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

TABLE 11.0 COATING SYSTEM FOR EXTERNAL SIDE OF UNDERGROUND CARBON STEEL PLANT PIPING AND UNDER GROUND TANKS IN ALL AREAS

SI.NO	Design Temperature in °C	Surface Preparation	Paint system (field)		Total final DFT in Micro ns (min)	Remarks
			Primer	Finish Paint		
11.1	Underground carbon steel plant piping (Yard/Over the Ditch corrosion protection coating)					
11.1.1	25 to 65	SSPC-SP-10	1 coat of synthetic fast drying primer 25μ@DFT/ T/ coat	1 layer of coaltar tape coating @ 2mm +1 coat of synthetic fast drying primer 25 μ@ DFT/ coat +1 layer of coal tar tape coating @ 2mm /layer	4 mm	The primer DFT is not measurable . Reconciliation primer shall be done by coverage of maximum 10 sq. m / litre
11.2	Carbon steel plant piping (underground).					
11.2.1	66 to 150	SSPC-SP-10	1 coat of F-17 primer@ 125μ DFT/coat	1 coat of F-17 intermediate coat @125μ DFT/coat + 1 coat of F-17 finish coat @ 125μ DFT/coat; (125+125=250)	375	
11.2.2	151 to 400	SSPC-SP-10	1 coat of F-16 primer@ 125μ DFT/coat	1 coat of F-16 finish coat@125μ DFT/coat	250	
11.3	External side of un-insulated underground storage tanks					

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORI JAN, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

11.3.1	-40 to 80	SSPC-SP-10	1 coat of F-9 @65-75μ DFT/coat	3 coats of F-7@100μ DFT/coat (3x100=300)	365-375	
11.3.2	81 to 150	SSPC-SP-10	1 coat of F-17 primer@125μ DFT/coat	1 coat of F-17 intermediate coat @125μ DFT/coat + 1 coat of F-17 finish coat @ 125μ DFT/coat; (125+125=250)	375	
11.3.2	151 to 400	SSPC-SP-10	1 coat of F-16 primer @ 125 μ DFT/coat	1 coat of F-16 finish coat@125μ DFT/coat	250	

TABLE 12.0 PAINTING UNDER INSULATION (ALL ENVIRONMENT)

All areas (Units & Off-sites) for insulated Piping, Storage Tanks, Equipment's etc (Note-1); (For Carbon Steel, LTCS, Low Alloy Steel & Stainless Steel)

SI.No	Design Temperature in °C	Surface Preparation& Pre-erection / shop primer	Paint system (field)		Total final DFT in Microns (min)	Remarks
			Primer	Finish Paint		
12.1	Insulated carbon steel, LTCS, and low alloy steel piping, storage tank, Equipments etc.					
12.1.1	-45 to 125	SSPC-SP- 10; 1coat of F-9 @ 65-75µDFT/coat	None	2 coats of F-14 @125µDFT/coat; (2x125=250) or 3 coats ofF-15 @ 80µDFT/coat; (3x80=240)	315-325 or 305-315	No over-coating to be done on F-9 as it will lead to mud cracking.
12.1.2	126-400	SSPC-SP- 10; 1coat of F-9 @ 65-75µ DFT/coat	None	3 coats of F-12 20µDFT/coat; (3x20=60) or 1 coats ofF-16 @ 60µDFT/coat;	125-135	F-12 shall be ambient temperature curing type

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJA, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

12.2	Insulated stainless steel including alloy -20 piping (Note:2)					
12.2.1	Below 0°C to all minus temperature	Aluminium sheeting with aluminium foil and “Chloride free mineral sealant coating barium chromate” shall be applied.				If the piping & equipments are already erected then surfaces shall be prepared by cleaning with emery paper and wash/flush with chloride free DM water followed by wiping with organic solvent
12.2.2	0 to 125	SSPC-SP-10 (15-25µ surface profile) 1 coat of F-14 @ 125µ DFT/coat	None	1 Coat of F-14 @ 125µ DFT/coat	250	
	0 to 125 (alternative)	SSPC-SP-10 (15-25µ surface profile) 1 coat of F-15 @ 80µ DFT/coat	None	1 Coat of F-15 intermediate coat @ 80µ DFT/coat + 1 coat of F-15 finish coat @ 80µ DFT/coat; (80+80=160)	240	
12.2.3	121 to 400	SSPC-SP-10; 1 coat of F-16 @ 125µ DFT/coat	None	1 Coat of F-16 @ 125µ DFT/coat	250	
12.2.4	401 to 600	SSPC-SP-10; 1 coat of Amercoat 738 @ 125µ DFT/coat	None	1 Coat of Amercoat 738 @ 125µ DFT/coat	250	Only Amercoat 738 is suitable for the temperature of 600 deg.C and cyclic temperature.
12.2.5	Cyclic service (-)196 to 480 excepting (-)45 to 120	SSPC-SP- 10 1 coat of Amercoat 738 @ 125µ DFT/coat	None	1 coat of Amercoat 738 @ 125µ DFT/coat	250	
12.3	No painting is required for insulated monel, incoloy and nickel lines.					

Notes :

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORI JAN, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

1. Refer Notes 1&4 of Table 8.0.
2. The blast cleaning abrasives for SS and Alloy steel surfaces shall be SS grits/shots or Aluminium oxide grits/shots.
3. For SS surfaces with cyclic temperature of -45 to 125 deg.C, both 12.2.1 & 12.2.2 are applicable.

**TABLE 13.0 INTERNAL PROTECTION OF CARBON STEEL COOLERS /
CONDENSERS**
**Water boxes, channels, partition plates, end covers and tube sheets
etc.**

Sl.No	Design Temperature in °C	Surface Preparation & pre-erection / shop primer	Paint system (field)		Total final DFT in Microns (min)	Remarks
			Primer	Finish Paint		
13.1	Upto 65	SSPC-SP- 10; 1coat of P-6 @ 40µDFT/coat	None	2 coats of F-7@125µ DFT/coat; (2x125=250)	290	For CS Surfaces
13.2	Upto 65	SSPC-SP- 3; 1coat of P-4 @ 8- 10µDFT/coat + 1 coat of P-6@ 40µ DFT/coat	None	2 coats of F-7@125µ DFT/coat; (2x125=250)	300	(Non ferrous and brass tube sheets)

TABLE 14.0 PAINTING SYSTEM FOR EFFLUENT TREATMENT PLANT

Sl.NO	Design Temperature in °C	Surface Preparation	Paint system (field)		Total final DFT in Micro ns (min)	Remarks
			Primer	Finish Paint		
14.1	For external surfaces of CS/MS items: Screens, Walk way bridges, Baffles, Dual media filters, Vertical pumps, piping in treated effluent sump, bio-sludge pump, Screw pump and pump house, CS tanks, sumps and vessels					

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJAN, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

14.1.1	-14 to 80	SSPC-SP-10	1 coat of F-9@ 65-75μ DFT/coat	2 coats of F-6A @ 100μDFT/coat + 1 coat of F-2@ 40 Microns DFT/coat; (2x100+40=240)	305-315	
14.2	For internal surfaces of CS/MS Items: Bio-sludge sump, Filter feed sump, Process sump, Sanitary sump, Transfer sump, Sludge, Slop oil tank, and scrapping mechanism in Clarifier.					
14.2.1	-14 to 80	SSPC-SP-10	1 coat of F-9@65-75μDFT/Coat	3 coats of F-6A@100μDFT/Coat (3X100=300)	365-375	Note-1
14.3	All R.C.C/ concrete surfaces exposed to effluent water /liquid such as tanks, structures, drains etc in Process sump, TPI separator (Process and Oil), Aeration Tank and Transfer sump etc.					
14.3.1	-14 to 80	Blast cleaning to SSPC-SP guide lines and Acid etching with 10-15% HCL acid followed by thorough water washing.	Epoxy screed lining	Epoxy screed lining	3 mm	
14.4	C.S / M.S Dual media filters (Internal), Chemical dosing tanks(internal) such as Di-ammonium Phosphate and Urea					
14.4.1	Upto 60	SSPC-SP-10	-	Rubber Lining	4.5mm	

Notes:

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJAN, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

1. The paint/coating manufacturers shall provide their Quality control test certificate of coating materials (F-6A) for immersion service of the exposed effluent given in 14.2

15 PIPING COLOUR CODE

The following colour coding system has been made based on international standards like ASME/ ANSI, BS and Indian Standard.

15.1 IDENTIFICATION

The system of colour coding consists of a ground colour and secondary colour bands super imposed over the ground colour. The ground colour identifies the basic nature of the service and secondary colour band over the ground colour distinguishes the particular service. The ground colour shall be applied over the entire length of the un-insulated pipes. For insulated lines ground colour shall be provided as per specified length and interval to identify the basic nature of service and secondary colour bands to be painted on these specified length to identify the particular service. Above colour code is applicable for both unit and offsite pipelines.

The following ground colour designation for identification of basic classification of various important services shall be followed:

Post office red	-	Fire protection materials
Dark admiralty grey	-	crude oil, lube oil
Sky blue	-	Water (all purities and temperatures)
Sea green	-	Air and its components

Secondary colours:

The narrow bands presenting the secondary colour which identifies the specific service, may be applied by painting or preferably by use of adhesive plastic tapes of the specific colour.

15.2 COLOUR BANDS AND IDENTIFICATION LETTERING

The following specifications of colour bands shall be followed for identifying the piping contents, size and location of bands & letters. The band width and size of

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORI JAN, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

letters in legends will depend to some extent upon the pipe diameter. Either white or black letters are selected to provide maximum contrast to the band colour. Bands usually are 50 mm wide and regardless of band width, are spaced 25 mm apart when two bands are employed.

Table 1.0: Colour bands and size of lettering for piping:

Outside diameter of pipe or covering in mm	Width of colour bands in mm	Size of legend letters in mm
19to32	200	13
38to51	200	19
64 to 150	300	32
200to 250	600	64
Over 250	800	89

In addition, ground colour as per specified length should be provided on insulated piping for easy identification of nature of fluid, on which the colour bands should be painted for identification of each service. The length of the ground colour should be 3 times the width of normal band or 2 meters, whichever is suitable depending on the length of the pipe.

Size of letters stenciled/ written for equipment shall be as given below:

Column and vessel : 150 mm (Height)

Pump, compressor and other machinery :50 mm (Height)

In addition, the contents of the pipe and/or direction of flow may be further indicated by arrows and legend. If a hazard is involved it must be identified clearly by legend.

Colour bands: The location and size of bands, as recommended, when used, shall be applied to the pipe:

- On both sides of the valves, tees and other fittings of importance.

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJAN, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

- Where the pipe enters and emerges from walls and where it emerges from road & walkway overpasses, unit battery limits.
- At uniform intervals along long sections of the pipe.
- Adjacent to tanks, vessels, and pumps.

For piping, writing of name of service and direction of flow for all the lines shall be done at following locations:

The letters will be in black on pipes painted with light shade colours and white on pipes painted with dark shade colours to give good contrast.

Only writing of service name shall be done on stainless steel lines. Pre cautions should be taken while painting by using low chloride content painting to avoid any damage to the stainless steel pipes. It is preferable to use adhesive plastic tapes to protect stainless steel pipes.

Colour band specification:

- a) Unit Area: Bands at intervals of 6.0 meters.
- Offsite Area: Bands at intervals of 10.0 meters.

- b) Each pipe segment will have minimum one band indication, irrespective of length.

- c) The bands shall also be displayed near walkways, both sides of culverts, tanks, dykes, tanks, vessels, suction and discharge of pumps / compressors, unit battery limit, near valves of line, etc.

For alloy steel/stainless steel pipes and fittings in stores/fabrication yard, color band (Minimum 1/2" wide) should be applied along the complete length of pipe, bends/tees, side-curved surface (on thickness) of flanges as well as valves as per the metallurgy.

In case of camouflaging requirements of civil defence or any other location requirements, the same shall be followed accordingly.

The specification for application of the complete Piping identification colour code, including base and bands colours, are presented in the following table confirming to RAL colour shades of Dutch Standard:

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RECOMMENDED RAL COLOUR CODE FOR PAINTING OF PIPING AND EQUIPMENT

Sl. NO	SERVICE	RECOMMENDED COLOUR FOR PAINT SYSTEM	RALCOLOUR CODE	
			BASE COLOUR	BAND COLOUR
1	LUBE OILS	Dark Admiralty grey with 1 green band	7012	6010
2	FUEL OIL	Black with 1 yellow band	9005	1023
WATER LINES				
3	RAW WATER	Sky blue with 1 black band	5015	9005
4	INDUSTRIAL WATER	Sky blue with 2 signal red band	5015	3001
5	DRINKING WATER	Sky blue with 1 green band	5015	6010
6	ETP TREATED WATER	Sky blue with 2 oxide red bands	5015	3009
FIRE PROTECTION SYSTEM (ABOVE GROUND)				
7	FIRE WATER FOAM& EXTINGUISHERS	Post office red	3002	
AIR & OTHER GAS LINES (UNINSULATED)				
8	INSTRUMENT AIR	Sea green with 1black band	6018	9005
9	NITROGEN	Sea green with 1orange band	6018	2011
10	GAS (FUEL)	Orange with 1 aluminium band	2011	9006
UNINSULATED EQUIPMENTS, TANKS AND STRUCTURES				

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJAN, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

11	HEATER STRUCTURE	Steel grey	7011
12	HEATER CASING	Heat resistant aluminium	9006
13	VESSELS & COLUMNS	Aluminium	9006
14	HEAT EXCHANGER	Heat resistant aluminum	9006
15	TANKS	Aluminum / Off white	9006
16	COMPRESSORS AND BLOWERS	Dark admiralty grey	7012
17	PUMPS	Navy blue	5014
18	MOTORS AND SWITCH GEAR	Bluish green	5024
19	HAND RAILING	Signal red	3001
20	STAIRCASE, LADDER AND WALKWAYS	Black	9005
21	LOAD LIFTING EQUIPMENT AND MONORAILS ETC	Leaf brown	8003
22	GENERAL STRUCTURE	Black	9005
Pipes and fittings of alloy steel and SS material in store			
23	5Cr-0.5Mo	Satin blue	5012
24	2 1/4Cr-1Mo	Aircraft yellow	1026
25	1 1/4Cr-1/2 Mo	Traffic yellow	1023
26	SS-304	Dark blue grey	5008
27	SS-316	Dark violet	4005

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJAN, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

28	SS-321	Navy blue	5014	
SAFETY COLOUR SCHEMES				
29	Dangerous obstruction	Black and alert orange band	9005	2008
30	Dangerous or exposed parts of machinery	Alert orange	2008	

16 IDENTIFICATION OF VESSELS, PIPING ETC.

Equipment number shall be stenciled in black or white on each vessel, column, equipment & machinery (insulated or un insulated) after painting. Line number in black or white shall be stenciled on all the pipe lines of more than one location as directed by Engineer-In-Charge, Size of letter printed shall be as below:

Column & Vessels - 150mm (high)

Pump, compressor & other machinery - 50mm (high)

Piping-40-150 mm

Identification of storage tanks

The storage tanks shall be marked as detailed in the drawing.

17 PAINTING FOR CIVIL DEFENCE REQUIREMENTS

Following items shall be painted for camouflaging if required by the client.

- a. All Columns
 - b. All tanks in Off-sites
 - c. Large Vessels
 - d. Spheres

Two coats of selected finishing paint as per defense requirement shall be applied in a particular pattern as per 20.3 and as per the instructions of Engineer-In-Charge.

Method of Camouflaging

Disruptive painting for camouflaging shall be done in three colours in the ratio of 5:3:2(all matt finish).

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORI JAN, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

Dark green

Light green

Dark medium brown

5:

3:

2:

The patches should be asymmetrical and irregular.

The patches should be inclined at 30° to 60° to the horizontal.

The patches should be continuous where two surfaces meet at an angle.

The patches should not coincide with corners.

Slits and holes shall be painted in dark shades.

Width of patches should be 1 to 2 meters.

18 INSPECTION AND TESTING

All painting materials including primers and thinners brought to site by contractor for application shall be procured directly from manufactures as per specifications and shall be accompanied by manufacturer's test certificates. Paint formulations without certificates are not acceptable.

Engineer-In-Charge at his discretion may call for tests for paint formulations. Contractor shall arrange to have such tests performed including batch-wise test of wet paints for physical & chemical analysis as per clause 24.4 of relevant ASTM test method. All costs there shall be borne by the contractor.

The contractor shall produce test reports from manufacturer regarding the quality of the particular batch of paint supplied. The Engineer-in-Charge shall have the right to test wet samples of paint at random for quality of same. Batch test reports of the manufacturer's for each batch of paints supplied shall be made available by the contractor.

The painting work shall be subject to inspection by Engineer-In-Charge at all times. In particular, following stage-wise inspection will be performed and contractor shall offer the work for inspection and approval of every stage before proceeding with the next stage. The record of inspection shall be maintained in the registers. Stages of inspection are as follows:

- (a) Surface preparation
- (b) Primer application
- (c) Each coat of paint

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJAN, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

In addition to above, record should include type of shop primer already applied on equipment e.g. Red oxide zinc chromate or zinc chromate or Red lead primer etc.

Any defect noticed during the various stages of inspection shall be rectified by the contractor to the entire satisfaction of Engineer-In-Charge before proceeding further. Irrespective of the inspection, repair and approval at intermediate stages of work, contractor shall be responsible for making good any defects found during final inspection/guarantee period/defect liability period as defined in general condition of contract. Dry film thickness (DFT) shall be checked and recorded after application of each coat and extra coat of paint should be applied to make-up the OFT specified without any extra cost to owner, the extra coat should have prior approval of Engineer-in-charge.

Primer Application

After surface preparation, the primer should be applied to cover the crevices, comers, sharp edges etc. in the presence of inspector nominated by Engineer-In-Charge.

The shades of successive coats should be slightly different in colour in order to ensure application of individual coats, the thickness of each coat and complete coverage should be checked as per provision of this specification. This should be approved by Engineer-In-Charge before application of successive coats.

The contractor shall provide standard thickness measurement instrument with appropriate range(s) for measuring.

Dry film thickness of each coat, surface profile gauge for checking of surface profile in case of sand blasting. Holiday detectors and pinhole detector and protector whenever required for checking in case of immersion conditions.

Prior to application of paints on surfaces of chimneys, the thickness of the individual coat shall be checked by application of each coat of same paint on M.S.test panel. The thickness of paint on test panels shall be determined by using gauge such as 'Elko meter'. The thickness of each coat shall be checked as per provision of this specification. This shall be approved by Engineer-In-Charge before application of paints on surface of chimney.

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJAN, ASSAM SPECIFICATION FOR SURFACE PREPARATION AND PAINTING	

At the discretion of Engineer-In-Charge, the paint manufacturer must provide the expert technical service at site as and when required. This service should be free of cost and without any obligation to the owner, as it would be in the interest of the manufacturer to ensure that both surface preparation and application are carried out as per their recommendations. The contractor is responsible to arrange the same.

Final inspection shall include measurement of paint dry film thickness, Adhesion, Holiday detection check of finish and workmanship. The thickness should be measured at as many points/ locations as decided by Engineer-In-Charge and shall be within +10% of the dry film thickness, specified in the specifications.

The contractor shall arrange for spot checking of paint materials for Sp.gr., glow time (ford cup) and spreading rate.

19 GUARANTEE

The contractor shall guarantee that the chemical and physical properties of paint materials used are in accordance with the specifications contained herein/to be provided during execution of work.

20 QUALIFICATION CRITERIA OF PAINTING CONTRACTOR/SUB-CONTRACTOR

Painting contractor must have necessary equipment, machinery, tools and tackles for surface preparation, paint application and inspection. The contractor must have qualified, trained and experienced surface preparator, paint applicator, inspector and supervisors. The contractor supervisor, inspector, surface preparator and paint applicator must be conversant with the standards referred in this specification.

Specification for Insulation

SPECIFICATION FOR INSULATION
1 SCOPE

This specification covers the minimum requirements for the design of insulation, the selection of insulating materials, and the application of insulation to piping, vessels, exchangers, and equipment for thermal insulation for the hot and cold services.

2 DESIGN CONDITION
2.1 General condition

Equipment shall be operated in onshore service conditions as described in the relevant project specification.

2.2 Application

- a) Thermal Insulation category, class and letter code to be indicated in the P&ID drawings/documents are as follows,

Table 1: Insulation Class

Class	Letter Code	Insulation category
1	HC	Heat conservation
2	CC	Cold conservation
3	PP	Personnel protection
4	FP	Frost Proofing
5	FI	Passive Fire Protection
6	AI	Acoustic Insulation
7	EP	External Condensation Protection

The Insulation class number shall be followed by N=No Heat Tracing or Y=Heat Tracing.

- b) Design temperature shall be used for selection of insulation material; for calculation of insulation thickness normal operating inside fluid temperature shall be used in case of hot and personnel protection insulation. In case of cold insulation minimum operating inside fluid temperature shall be used.
- c) Insulation thickness shall be followed as identified in P&ID drawing and in accordance with ASTM C680 calculation.

SPECIFICATION FOR INSULATION

3 MATERIAL REQUIREMENTS

3.1 General

- a) All thermal insulation materials used at site shall be asbestos-free in order to safeguard the health of individuals who are working in the vicinity.
- b) No flammable material shall be attached to the insulation.
- c) All insulation materials shall be free of fluorocarbons, chlorides and shall be chemically inert, vermin proof and water tight/water repellent.
- d) Suitable protective gadgets shall be provided in order to protect the workers from the hazards of insulation materials.
- e) The insulation material shall be kept dry at all the times during transport, storage and installation. Storage and handling shall be followed as per IS 10556.
- f) The insulation material shall meet the requirements of ASTM C795, when applied on austenitic stainless steel surfaces.
- g) Insulation for personnel protection shall be provided, when the pipe or vessel is exposed to a surface temperature of 60°C & above.
- h) Wherever Insulation thickness exceeds 75mm, the insulation shall be applied in multi layers with all joints staggered. Each layer shall be separately secured with metallic bands/wires.
- i) For electric traced lines, the tracer wires shall be wrapped with aluminium foil prior to insulation to protect the heating cables and improve the heat distribution. Insulation material for electrical traced piping shall be Polyisocyanurate or Polyurethane foam.

3.2 Material Selection

Selection of Insulation material for hot, cold and personnel protection shall be in accordance with Table-2.

Table 2: Insulation Material Selection

Tag	Insulation Material	Temperature limit
A	Rockwool	550°C
B	Glass wool	400°C
C	Calcium silicate	750°C
D	Cellular glass	-268°C to 427°C

SPECIFICATION FOR INSULATION

Tag	Insulation Material	Temperature limit
E	Polyurethane foams (PUF)	100°C
F	Polyisocyanurate foams (PIR)	120°C

3.3 Insulation Material

3.3.1 Mineral wool

- a) Mineral wool shall be made from mineral substances such as rock or glass processed from a molten state into fibrous form and shall be bonded with a suitable binder. Slag wool shall not be used.
- b) Preformed pipe insulation shall be in accordance with ASTM C547 Type II or Type III / IS 9842. Mineral wool preformed sections shall be used for pipe insulation. Preformed Mineral wool shall be usually supplied in two half sections for pipes of outer diameter up to 14 inch. Where preformed pipe insulation are not commercially available, blanket type insulation may be used.
- a) Metal-mesh covered, Bonded mineral fiber blanket insulation shall be in accordance with IS:8183/ASTM C592 TYPE II. Mineral wool blankets shall be used for vessels and bigger pipe sizes.
- b) Mineral fiber block & board thermal insulation shall be in accordance with IS:8183/ASTM C612 TYPE IV/ TYPE V.
- c) Mineral wool (Blanket-loose) thermal insulation shall be in accordance with ASTM C553 TYPE VII.
- d) Insulation shall be tested and test certificates on representative sample as per respective codes shall be furnished.

3.3.2 Calcium Silicate

- a) Calcium silicate shall be supplied in the form of flat blocks, Bevelled lags, Pipe section, and curved section shall be in accordance with IS 9428/ASTM 533.
- b) Insulation shall be tested and test certificates on representative sample as per respective codes shall be furnished.

SPECIFICATION FOR INSULATION

3.3.3 Cellular Glass

- a) Cellular Glass insulation shall be rigid, lightweight material containing millions of completely sealed glass cells. This unique cell structure is inherently water resistant and provides a highly effective vapor barrier (will not absorb flammable liquids or vapors).
- b) Cellular Glass shall be furnished in the form of Pipe section, Flat blocks and board segment shall be in accordance with ASTM C552.

3.3.4 Polyurethane Foam (PUF)

- a) Rigid Polyurethane Foam shall be in accordance with IS 12436 / ASTM C591 Type II. The foam shall be self extinguishing type.
- b) Sprayed rigid Polyurethane Foam material shall produce a complete fire-retardant system. The insulation material shall be in accordance with ASTM C1029 Type III.

3.3.5 Polyisocyanurate Foam (PIR)

- a) Rigid Polyisocyanurate Foam shall be in accordance with IS 12436 / ASTM C591 Type II.

3.4 Jacketing Materials for Insulation

In any application of thermal insulation, insulation requires protection from rain, sleet, wind, mechanical damage, chemical attack etc using any of the following jacketing materials

3.4.1 Aluminium

- a) In general, Aluminium sheets shall be used as weather protection jacketing material except in fire hazardous area, process liquids handling area or temperature above 550 °C, where stainless steel or aluminized steel shall be used.
- b) Aluminium jacketing shall be in accordance with IS-737/ASTM B209 for flat sheets and IS 1254 for Corrugated sheets.
- c) Suitable moisture barrier shall be provided for Aluminium sheet, on the side in contact with insulation. Jacketing material shall be provided with suitable corrosion resistance coating on the exterior surface.

SPECIFICATION FOR INSULATION**3.4.2 Stainless steel**

- a) Stainless steel jacketing shall be used where high mechanical strength, excellent fire retardance, excellent corrosion, weather resistance etc. are required.
- b) Stainless steel jacketing material shall be in accordance with ASTM A167 or A240, type 304 or 316.

3.4.3 Aluminized steel

- a) Aluminized steel jacketing material shall have Coating Type T2-300 in accordance with ASTM A463/A463M.

3.5 Auxiliary Materials

- a) Wires are generally used to secure insulation to pipe sizes NPS 12 and smaller. Annealed Galvanized steel wires shall be used for temperatures up to 370 Deg C and annealed SS304 wires for temperatures above 370 Deg C.
- b) Bands shall be used to secure insulation material for large diameter pipe size (over NPS 14) and vessel where insulation material is not secured by Wires. Galvanized steel or Stainless steel band shall be used.
- c) For fastening of Jacketing material Galvanized steel bands or Stainless steel bands shall be used.
- d) Insulation cement, Hard setting plaster, Mastic as required for securing insulation material shall be used.
- e) Aluminium foils of 0.1mm thickness shall be used for wrapping of SS surfaces.

4 INSULATION PROCEDURE**4.1 Insulation on Vessels and Exchangers**

- a) For Vessels of outside diameter DN900 and smaller preformed pipe insulation shall be used. For larger diameter vessels, blanket insulation shall be used.
- b) Blanket insulation on vertical vessels shall be applied with stagger joint arrangement. Top and bottom edges shall be securely tied over support rings with wire at no more than 300mm centers. Vertical and intermediate horizontal seams shall be laced together with gauge wire or

SPECIFICATION FOR INSULATION

hog rings at no more than 300mm centers. The insulation shall then be secured in place with bands spaced on, no more than 300mm centers. Nozzle projections through insulation shall be adequately insulated.

- c) Blanket insulation on horizontal vessels and exchangers shall be applied in a staggered joint arrangement with all edges securely laced together with wire or hog rings at no more than 300mm centers. Nozzle projections through insulation shall be adequately insulated. Further securing shall be with bands spaced at no more than 300mm centers.
- d) All equipment and vessel manholes, hatches, bolted or screwed cover plates, flanged ends, etc. shall have removable box type insulation, with same thickness of insulation as for adjacent surfaces. Insulation adjoining such equipment or vessel openings shall be tapered towards these openings to permit removal of bolts, screws, heads, covers or plates with no damage to adjacent surface insulation or cover.

4.2 Insulation on Pipes and Fittings

- a) Insulation shall be fitted closely to the pipe, and any unavoidable gaps in circumferential or longitudinal joints should be filled with compatible insulating material. Where there is more than one layer of insulating material, all joints should be staggered.
- b) For vertical and near vertical piping i.e. piping greater than 45deg angle from horizontal, downward displacement of the insulating material should be prevented by the use of supports such as metal rings, part rings, or studs.
- c) Bends shall be insulated to the same specification as the adjacent straight piping. Generally, pre-formed bends shall be used, but where these are not available site-mitred segments shall be used. Any other avoidable gaps that can appear between mitred segments shall be filled with compatible material.

4.3 Insulation on Flanges & Valves

- a) Valves and flanges shall be provided with removable box type insulation. Box shall be fabricated from sheet material specified for adjoining pipes.

SPECIFICATION FOR INSULATION

- b) Pipe Insulation on adjoining flanges shall be terminated a sufficient distance to allow removal of bolting without disturbing the adjacent insulation. The minimum distance should be equal to the bolt length plus 1 inch (25mm).
- c) Weather jacketing of Insulation over valves and flanges shall be pre fabricated in half sections and screwed together.
- d) The permanent insulation either side of the removable valve or flange box should be sealed to prevent liquid ingress when the box is removed.

Functional Specification for Package Instruments

**Functional Specification for Package
Instruments**

Functional Specification for Package Instruments

1.0 OBJECTIVE

The purpose of this specification, together with the referenced project documents, is to describe the minimum technical and functional requirements for the Instrumentation and control equipment.

1.1. Codes and Standards

The following codes and standards are applicable for the Instrument design.

Codes and Standard	Standards Description
All goods and services supplied shall meet all applicable local and international regulations on health, safety and environmental issues.	
American Gas Association (AGA)	
AGA Report No. 3	Orifice Metering of Natural Gas
American National Standards Institute (ANSI)	
ANSI B 1.20.1	Pipe Threads, General Purpose
ANSI B 16.5	Steel Pipe Flanges, Flanged Valves and Fittings
ANSI B 2.1	Pipe Threads
ANSI C 96.1	Temperature Measurement Thermocouples
American Petroleum Institute (API)	
API 598	Valve Inspection and Testing
API 6D	Specification for pipeline valves
API 6FA	Fire Test for Valves
API RP 500	Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class 1, Division 1 and Division 2
API RP 520	Sizing, Selection and Installation of Pressure Relieving Devices in Refineries, Part I and Part II
API RP 521	Guide for Pressure Relief and Depressuring Systems
API RP 526	Flanged Steel Safety Relief Valves
API RP 527	Commercial Seat Tightness of Safety Relief valves with Metal to Metal Seats
API RP 551	Process Measurement Instrumentation
API RP 552	Transmission Systems
API RP 554	Process Instruments and Control
American society of Mechanical Engineers (ASME)	
ASME – B31.1	Power Piping (Pressure Piping code)
ASME – B31.3	Process Piping
ASME PTC 19.3	Performance Test Code Temperature Measurement
ASME Section VIII	Sizing and Selection of Pressure Relief Valves
American Society for Testing and Materials (ASTM)	
ASTM A269	Stainless Steel Tube
ASTM A276.316L	Stainless Steel Fittings
ASTM F 1387	Standard specification for performance of piping and tubing mechanically attached fittings
B 16.10	Face to Face and End to End Dimensions of Ferrous Valves
B 16.104	Control Valve Leakages
B 16.34	Hydrostatic body and leak testing of isolation valves.
B 16.37	Hydrostatic Testing of Control Valves
B) Specific Codes and Standards for Instrumentation:	
British Standards	

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJAN, ASSAM Functional Specification for Package Instruments	

Codes and Standard	Standards Description
BS 1904	Specification for industrial platinum resistance thermometer sensors
BS 5501	Electrical Apparatus for Potentially Explosive Atmospheres
BS EN 60529	Specification for degrees of protection provided by enclosures (IP) codes
FCI 70.2	Leak Testing of Control Valves
International Electro-technical Commission (IEC)	
IEC 529	Classification of degree of protection provided by Enclosures.
Instrumentation Systems and Automation Society (ISA)	
ISA S 75.01.01	Flow equations for sizing control valves
ISA S 75.01.03	Face to Face Dimensions for Flanged Globe Style Control valves
ISA S-20	Specification Forms for Instruments
ISA/ANSI-S 84.01	Application of Safety Instrumented Systems for the Process Industry
ISA S-5.1	Instrumentation Symbols and Identification
ISA-S5.2	Binary Logic diagrams for process operations.
International Organization for Standardization (ISO)	
ISO 5167	Measurement of Fluid Flow by means of Orifice Plates
OMR Oil Mines Regulation (Latest edition)	
OMR Oil Mines Regulations 2017	
The design, manufacture, inspection, testing and installation of all equipment and system covered under this project shall conform to the latest editions of codes and standards at the time of procurement.	

1.2. GENERAL

All field mounted instrument and associated systems shall be reliable and suitable for continuous operation in the service conditions stated in the project specification.

The design and selection of process control instrument and systems shall include consideration of application suitability, reliability, quality, accuracy, repeatability, technology obsolescence, flexibility of use, compatibility with the environment (climatic and electrical classification), ease of maintenance, ease of operation.

All electronic instruments shall be suitable for area classification as per IEC codes certified intrinsically safe equipment shall be used or explosion proof enclosures may be considered. All intrinsically safe instruments shall be certified by the statutory bodies like ATEX/FM/UL/BASIEFA/CMRI/PTB or equivalent for use of the instruments classified area. All Electrical, Instrumentation equipment except junction boxes and solenoid valves shall be certified intrinsically safe (Ex'i) type.

All Electronic instruments shall have ingress protection to IP 65 as a minimum. Local gauges shall have ingress protection to IP 65. All instruments installed inside pressurized equipment rooms shall have ingress protection to IP 42 as a minimum.

1.3. PRESSURE AND DIFFERENTIAL PRESSURE GAUGE

Pressure gauge element shall be an elastic element like bourdon tube with material as a minimum SS 316. In case of bourdon type of gauge, the size of the bourdon tube shall be greater than 75% of the nominal diameter of the dial size.

Functional Specification for Package Instruments

Gauge construction shall ensure no leakage of process fluid to atmosphere and between the high pressure and low-pressure side (in case of differential pressure gauges) under normal condition.

The gauge socket shall be in one piece and shall also serve as element anchorage in case of bourdon tube type element, which shall be directly connected to the socket, without any capillary or tube in between. For other types of elements, the anchorage may be integral with the socket or connected with the socket using capillary tube with minimum bore of 3 millimeters.

Any joint in the process wetted system including joint between the element and the anchorage/socket shall be welded type only.

The pressure gauge shall have an over-range protection of at least 130% of maximum working pressure, as minimum.

The gauge movement material shall be SS 316. It shall be adjustable for calibration without dismantling the sensor unit.

The operating pressure shall fall in the middle 30% of the full working range i.e. operating pressure shall fall between 35% and 65% of the range selected.

Pressure gauge shall have safety type solid front case.

The gauge shall be weather proof to IP 65 as per IEC 60529 / IS 13947, as minimum.

Dial markings and dial color shall be as per IS 3624.

The pointer stops shall be provided at both ends of the scale to restrict the pointer movement beyond 5% above the maximum of scale and less than 5% below the minimum of the scale.

The dial cover shall be made out of shatter proof glass of thickness 1.5 to 3mm for gauges with dial size less than 100mm while minimum 3.0mm for gauges with dial size 100mm or greater.

All gauge shall be provided with a blow out device at the back i.e. blow out disc of aperture not less than 25mm for gauge with dial size 100mm and above, while 20mm for gauge with dial size less than 100mm.

The pressure gauge end connections shall be threaded (NPT) as per ANSI / ASME B. 1.20.1.

The accuracy of pressure gauges shall be ± 1 % of range. This accuracy is inclusive of repeatability and hysteresis of pressure gauges.

2 Valve manifold shall be supplied along with pressure instrument and 5 valve for differential pressure instrument. Material of construction of manifold shall be same as element material.

Snubber shall be considered when the service specified is pulsating type (i.e. pump discharge etc.). The material of construction shall be same as socket material.

Siphon shall be used to protect pressure measuring from excessive heating. U-form siphon shall be used for horizontal pressure tapping and trumpet-form siphon shall be used for vertical pressure tapping. Siphon material shall be same as element material.

1.4. PRESSURE AND DIFFERENTIAL PRESSURE TRANSMITTER

Pressure transmitters shall be suitable for use in a hot, humid and tropical industrial climate in which corrosive gases and/or chemicals may be present. As a minimum, all instruments and enclosures in field shall be metallic construction, dust proof and weatherproof to IP-65 as per IEC-60529/ IS-13947 and secure against the ingress of fumes, dampness, insects and vermin

All the pressure instruments shall be designed and manufactured for intrinsic safety.

Pressure transmitters shall be provided with lightning protection circuits and should be designed and manufactured to operate in 100% or above relative humidity environment.

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJA, ASSAM Functional Specification for Package Instruments	

The pressure transmitter shall have an over-range protection of at least 130% of maximum working pressure, as minimum.

Measuring element in vacuum service shall have under-range protection down to full vacuum, without undergoing a change in calibration or permanent set.

Range for instrument shall be selected in general, such that in normal process operation the indication is between 30% and 60% of span for linear and 60% to 80% of span for square root inputs.

The set range shall be 1.1 times the maximum process value or 1.4 times the operating process value whichever is higher rounded to the nearest ten.

Pressure transmitters shall be yoke mounted type unless specified otherwise. Meter electronics is used for pressure measurement and shall include all the associated items like pre-amplifier, converter, transmitter, integrator, integral output meter (loop power indicator)

These transmitters shall be SMART 2 wire type 4-20mA analog output with superimposed digital communication with HART, for SIL & Non SIL rated transmitters.

The transmitter shall be microprocessor based and it shall incorporate a non-volatile memory which shall store complete configuration data of transmitter and sensor characterization. All necessary signal conversions, including conversion to produce output with the required protocol shall be carried out in the transmitter electronics.

Transmitter shall also run complete diagnostic subroutines and shall provide diagnostic alarm messages for sensor as well as transmitter healthiness. In the event of detection failure, the output shall be driven to a predefined value, which shall be field configurable.

Transmitter accuracy shall be $\pm 0.25\%$ of span or better.

Electrical cable entry connection shall be 1/2" NPT.

The design of electronic instruments shall be in compliance with the electromagnetic compatibility requirements as per IEC-61000-4.

Plug-in circuit boards shall be designed and manufactured such that reverse insertion or insertion of wiring chord is prevented.

The display of integral output meter shall be in engineering units for pressure, differential pressure and flow and 100% linear for level.

Terminals for electrical connections shall be clearly identified, and polarity shall be permanently marked.

Peak to peak ripple and total noise level in analog output shall not exceed 0.25% of the maximum signal.

Transmitters shall be provided with external zero and span adjustments.

For differential pressure transmitters, over-range protection shall be able to protect the sensing element from the maximum design pressure applied to each side with opposite sides vented to atmosphere. All pressure instruments shall be mounted as close as possible to sensing point.

All pressure and differential pressure transmitters shall be provided with the drain / de-pressuring valves (2 valve or 5 valve manifold) after isolation valve.

All transmitters shall have an integral output meter.

1.5. TEMPERATURE GAUGES

Temperature gauges shall be of the separate socket type suitable for well installation. Upon assembly of components, the temperature gauge element shall firmly contact the bottom of the well.

Vendor shall ensure that the operating temperature falls in the middle 30% of the full working range i.e. 30% to 60% of the offered range.

The gauge movement material shall be SS 316 as minimum.

Functional Specification for Package Instruments

The case of bimetallic type of gauges shall be all angles rotatable type.

The gauge shall be weatherproof to IP65 as per IEC 60529/ IS 13947 as a minimum

The pointer stops shall be provided at both ends of the scale to restrict the pointer motion beyond 5% above the maximum scale and less than 5% below the minimum of the scale.

The dial shall be made out of shatter proof glass of thickness of minimum 3.0mm

The accuracy of temperature gauge shall be +1% of range.

Thermowell material shall be SS316, as minimum.

Thermowell with immersion length up to 500mm shall be machined out of forged bar stock. Built-up thermowell with welded well construction shall be considered for immersion length greater than 500mm.

Threaded end connections shall be NPT as per ANSI/ASME B 1.20.1

Thermowell immersion length shall be as follows:

Line Size	Immersion Length
Upto 6"	280mm
8" and above	320mm

1.6. TEMPERATURE TRANSMITTER

Temperature transmitters shall be suitable for use in a hot, humid and tropical industrial climate in which corrosive gases and/or chemicals may be present. As a minimum, all instruments and enclosures in field shall be metallic construction, dust proof and weatherproof to IP-65 as per IEC-60529/ IS-13947 and secure against the ingress of fumes, dampness, insects and vermin.

Transmitters shall be utilized for both RTD based and thermocouple based temperature measurements. For general temperature measurement and control, 3-wire RTD shall be the preferred choice for SMART transmitters, 4-20mA output. Alternatively, thermocouples may be used where the temperature is above 650 Deg C. Three wire elements used with RTD shall be Platinum Pt-100, 100 ohms at 0 Deg C, and fundamental interval of 38.5 ohms. RTD shall comply with IEC 751. All applications shall use single element RTD. The element head shall have 2 cable entries, one of which shall be fitted with a certified plug.

The electronic transmitters should be designed to be immune to Radio frequency & Electromagnetic interference with field strength of 15 volts / meter or less over frequency range of 50 Hz to 450 MHz.

All the Temperature transmitters shall be designed and manufactured for intrinsic safety.

All the transmitters shall be provided with lightning protection circuits and should be designed and manufactured to operate in 100% or above Relative Humidity environment.

Measuring element in vacuum service shall have under-range protection down to full vacuum, without undergoing a change in calibration or permanent set.

These transmitters shall be SMART 2 wire type having 4-20mA analog output with superimposed digital communication with HART protocol for SIL & Non SIL rated transmitters.

The transmitter shall be microprocessor based and it shall incorporate a non-volatile memory which shall store complete configuration data of transmitter and sensor characterization. All necessary signal conversions, including conversion to produce output with the required protocol shall be carried out in the transmitter electronics.

The Accuracy of Temperature transmitter shall be 0.1% of FSD.

Functional Specification for Package Instruments

The over-range/static pressure protection of the transmitter shall be 130% of range. Electrical cable entry connection shall be 1/2" NPT (F).

The temperature transmitter end connections shall be threaded (NPT) as per ANSI / ASME B1.20.1.

Thermowell end connection shall be flanged and flange face finish shall be as per ANSI/ASME B 16.5.

The transient protection and design of electronic instruments shall be in compliance with the electromagnetic compatibility requirements as per IEC-61000-4.

Plug-in circuit boards shall be designed and manufactured such that reverse insertion or insertion of wrong chord is prevented.

The display of integral output meter shall be in engineering units for temperature.

Terminals for electrical connections shall be clearly identified, and polarity shall be permanently marked.

Peak to peak ripple and total noise level in analog output shall not exceed 0.25% of the maximum signal.

Temperature sensing elements shall be installed in thermowell. Thermowells shall be solid drilled and tapered. Thermowell material shall be 316 stainless steel as minimum. The internal diameter of thermowell shall be to suit RTD elements of 6mm in diameter as standard. The surface of the thermowell shall be smooth and free from burrs and notches.

1.7. LEVEL TRANSMITTER

RADAR LEVEL TRANSMITTER

Radar Level Transmitters shall be taken suitability of radar technology where the following conditions exist:

- Low liquid permittivity and high or varying gas permittivity
- Deposition and build-up
- Foaming
- Vessel has internal interferences (causes of reflection)

Open path radar level transmitters shall be mounted on the top of the vessel or on an external chamber. Top of the vessel mounting shall be flanged type, located on internal stilling wells. Transmitters shall have the option of extending the transmitting antenna down from the mounting flange, up to 1m, on a solid extension piece supplied with the transmitter. Transmitters shall employ intelligent digital signal processing techniques to filter out false echo signals.

Guided Wave Radar transmitters shall be used for measuring level and interface application with Time Domain Reflectometry (TDR) principle. Guided Wave Radar transmitters shall be mounted on the top of the vessel or on an external chamber. The probe shall be rigid single / twin lead or co-axial design based on the liquid service. The still well shall be provided by the vessel VENDOR to suit the probe dimensions.

Guided Wave Radar Transmitters should be used only for interface level measurement as long there is sufficient difference between the di-electric constants. The integrated Guide Wave Radar + Capacitance type level measurement shall be used in preference in applications where thick emulsion or foam is expected to be present. Exceptionally, the Guided Wave Radar Transmitters may also be used for normal level measurement in make-up/drain tanks.

DIFFERENTIAL PRESSURE LEVEL TRANSMITTER

Differential pressure type level transmitters may be used where the application requires wide throttling ranges and fluid Specific Gravity is constant.

Seals shall be provided as required. These instruments shall have zero elevation/suppression adjustment wherever required.

Functional Specification for Package Instruments

Transmitters with remote diaphragm seals shall be mounted at or below the high-pressure nozzle (lower vessel nozzle). Provisions shall be made for relieving pressure between the block valve and the diaphragm seal.

Purge connections may be required on the process side of diaphragm seals in applications where plugging is likely occurs. Capillary tubing seal legs shall be mechanically protected and adequately supported to prevent sagging. Remote diaphragm seals used in vacuum service applications shall be specifically designed for vacuum service by the manufacturer. Welded capillary connections shall be specified for vacuum applications.

Fill fluid shall be rated for the maximum temperature and maximum vacuum conditions. The length of the diaphragm seal capillary tubing shall be designed to take into account routing requirements. The Capillary tubing shall be as per manufacturer standard lengths.

All flanges on the level instrument pressure retaining parts shall be of the same type and rating as the process flanges and shall be in accordance with the vessel trim specification.

The maximum error shall not exceed $\pm 1\%$ of the span. Units for level indicating scale 0 – 100%.

1.8. LEVEL GAUGES

Level Gauge may be transparent type or Reflex type depending on the nature of process fluid, for physical measurement of the level in the vessel / tanks.

Process connections shall be side and side.

All flanges on the level instrument pressure retaining parts shall be of the same type and rating as the process flanges, and shall be in accordance with the vessel trim specification.

Gauge Glasses shall be provided on all vessels except product storage tanks, to cover the complete operating range of level including the spans of level transmitters and level alarm switches.

Gauge glass assemblies shall be chosen for the design pressure and temperature of the respective vessel.

Body and cover plate material shall be to suit the process conditions. Bolts and nuts shall be to suit the body and cover plate material offered. The glass shall be toughened borosilicate which is resistant to thermal and mechanical shocks. Ball checks plunger seat and valve stem shall be type SS 316. Drain connection shall be $\frac{1}{2}$ " NPT and shall be provided with a SS 316 drain valve. Wherever necessary, higher-grade material suitable for the process conditions shall be used. Vent connection shall be $\frac{1}{2}$ " NPT on top of each gauge glass. Drain connections shall be piped to drip pans or drains.

1.9. ELECTROMAGNETIC FLOWMETER

Electro-magnetic flow meters shall be used as the flow measuring system with flanged end connections primarily as per ANSI B 16.5, the rating and facing of which shall be as per the piping specifications.

The flow direction shall be clearly stamped or cast on the body to avoid polarity errors. Meter shall have forward & reverse measurement functions and reverse flow shall be confirmed by status output / indication.

Meter signal / power cable entry shall be $\frac{1}{2}$ " NPTF respectively, as per ANSI B 2.1.

These transmitters shall be 2 wire type having 4-20mA analog signal with superimposed digital signal with HART communication protocol for SIL & Non SIL rated transmitters.

Functional Specification for Package Instruments

In addition, the meter shall be capable of providing the output in other required form (pulse, serial, contact, etc.,)

The meter enclosure housing the electrical parts shall be suitable for the hazardous area classification. Unless otherwise specified, the enclosure shall be Ex'd' type, Flameproof enclosures and IP 65 or better.

Electro-Magnetic Meter field coils shall be hermetically sealed. Coil insulation shall be class F suitable for high temperature. Suitable grounding type system and material shall be selected for the meter.

Field coils may operate on the alternating supply voltage. Replaceable electrodes/ Frequency excitation methods are also acceptable where the magnetic flow meter is operated on AC/DC voltages. Vendor shall indicate the power supply requirements and furnish the power consumption for the meter (sensor, transmitter, display, etc.) along with the sizing calculations for the selected meter. Standard Signal types and communication protocols shall be offered. Appropriate EMI / RFI protection for the meter shall be considered.

Meter shall not necessarily be of the line size indicated in the P&ID, but shall be sized for range of flow regime and the conductivity /velocity requirement desired for the meter. However, the meter shall be 'Full bore' meter with respect to its meter run. Straight run requirement shall be sized as per the manufacturer recommendations. Meeting the flow profile requirement for the meter by providing necessary straighteners / flow conditioners etc., shall be vendor responsibility.

Magnetic Flow Meter shall be Microprocessor based system, in explosion proof housing. Meter shall have a non-volatile memory for data access and data transfer to remote controllers / indicators / DCS. There shall be no data loss upon the loss of the power supply to the meter.

Where the process fluid may result in coating of the electrodes, suitable measures / special installation requirements to minimize such coating shall be a part of the design consideration in selection of meters. Monitoring of such adhesions [Electrode scaling/ Electrode corrosion], Electrode leakage, Liner deformation, gas bubbles and solid identification, shall be a part of the meter diagnostics. Meter shall also have diagnostics features such as incorrect installation and partial filled meter. Electrodes shall be replaceable type.

Where the fluid is having low conductivity / contain solids in the streams (like slurries containing magnetic particles), vendor shall offer system with suitable circuitry for compensating the signal changes so induced by the permeable solids.

The 'minimum' fluid conductivity shall be specified for which the meter performance is within specified values.

The configuration capabilities of the meter shall be for LCD display of indication of actual flow rate, forward, reverse, sum total flow indications, conductivity, temperature, status indications. The same shall be available as user selectable parameter on the LCD display of the meter.

The 'local' 2 line, 6 ½ digit (minimum) alphanumeric backlit LCD display shall be provided 'integral' with the meter / transmitter and shall be easily visible from grade.

Software security shall be provided in the meter. Upscale / downscale alarms & Engineering units shall be user selectable. Programming for range, alarms and display settings shall be possible through front face of the meter and without opening the transmitter housing in hazardous area. The programming method shall be touchpad keys / magnetic keys / optical key.

Manual / Auto zeroing (nulling) facility shall be provided for the meter to offset effects of nearby magnetic disturbances in 'no-flow' condition. This shall be done from the meter front face display without opening the cover in the Hazardous area.

Functional Specification for Package Instruments

The material requirements for Electro-Magnetic Flow Meters shall in general be internals of SS 316 minimum. As a minimum, the meter flow tube, electrodes and coil housing shall be SS 316. The housing shall be fully welded. Bolted coil housing with rubber or plastic gaskets is not acceptable.

Tube liners shall be selected to meet the process requirement and shall be proven for the application.

Transmitter housing and mounting accessories required for meter shall be SS 316 or better. Meter enclosure shall be suitable for the specified hazardous area. All instrument supports shall be galvanized type for installation.

Over range shall be designed for at least 130% of Max flow. Accuracy shall be $\pm 0.5\%$ of the reading or better. Repeatability shall be $\pm 0.1\%$

1.10. PRESSURE SAFETY RELIEF VALVE

The term "Safety Relief Valve" applies to all types of valves used as Thermal / Pressure relieving devices required in the ASME code. For definition of valve types reference shall be made to API RP 520 Part 1.

Relief valves shall be carbon steel with stainless steel trim as a minimum. Carbon steel springs with Nickel plating shall be used for temperature services lower than 250 Deg C. Tungsten alloy springs shall be used for temperatures greater than 250 Deg.C. Aluminum sprayed springs shall be used in corrosive services.

The minimum requirements for Safety Relief Valves shall be:-

- Enclosed spring
- Bolted bonnet
- Screwed cap, complete with fitted gag
- Full nozzle

Nozzle and disc seating areas shall be such that several maintenance lapping operations can be carried out.

Back pressure shall not exceed the pressure rating of the discharge flange.

Lifting levers shall be fitted to valves on steam, or air service. Lifting levers shall not be fitted to valves on process fluid services.

Pressure balance valves shall be used where downstream back pressure varies, as indicated on the relief valve datasheet.

All relief valves of size 1" and above shall be full nozzle full lift type. Relief valves with size less than 1" shall be modified nozzle type.

Flanged relief valves for process piping, excluding steam and air pressure piping, shall be either the enclosed spring type or pilot-operated type.

Balanced relief valves shall be used if the variable backpressure is more than 10% of valve set pressure or where the service is corrosive. Balanced relief valves suitable for variable Backpressure may also be used where appreciable savings in the discharge disposal system Piping can be affected by virtue of the increased allowable backpressure. Balanced bellow Materials shall be the same as the valve trim.

$\frac{3}{4}$ " and 1" relief valves may have screwed ends. All process Relief valve 1" size and larger shall have flanged inlet and outlet connections.

Thermal relief valves shall have a minimum orifice area of 38.7mm².

Lifting levers may be provided for periodic testing of the Safety Valve. Closed bonnet Construction shall be used.

All castings and welding shall be 100% radiographed.

The pressure relief valve shall meet the requirements of API recommended practice RP 526 "Flanged Steel Safety Relief Valves" and RP 521 "Pressure Relieving and Anti

Functional Specification for Package Instruments

Pressurizing system” and shall be of direct acting angle pattern, full nozzle entry and high capacity type.

The MPC Supplier shall size safety relief valve according to capacity, set point, reset differential and the blow down requirements of the Process for the Project.

The selected orifice shall be the next standard orifice size available above the calculated area. Valve capacity shall then be calculated based on the selected orifice code.

In Safety Relief valve sizing calculations, the fail open state of a control valve (if any) shall be taken into consideration.

Set point of the Safety Relief valves shall not be higher than the design pressure of the system being protected by the valve, except as permitted by the relevant API 521/526.

The allowing tolerances in set pressure are as below:

- ± 0.14 Kg/cm²g for set pressure up to and including 5 Kg/cm²g.
- $\pm 3\%$ for set pressure above 5 Kg/cm²g.

The material requirements for safety relief valve shall in general be according to Piping material specification and Valve material specification.

Relief valves for set pressures of 17.5 kg/cm²g (250 psig) or less a range of adjustment of plus or minus 10% of the set pressure.

Relief valves set at pressures higher than 17.5 kg/cm²g (250 psig) shall have springs suitable for a range of adjustment of plus or minus 5% of the set pressure. Range identification shall be provided on the spring.

Safety relief valve shall be installed after testing/setting for set pressure, blow down and seat tightness.

Discharges from all safety valves shall be individually routed to a safe location, unless specified otherwise. All safety valves discharge lines shall join the relief header from top and shall be at an angle of 30 to 40 degrees with the axis of the header.

All safety valves discharge and equipment depressurizing lines shall be free draining to vent header and shall have no pockets up to and including header.

Discharge piping shall be designed to avoid liquid collection, backpressure build up, and stress on the valve body under all conditions. A low point discharge drain may only be fitted on relief valves venting to atmosphere.

1.11. CONTROL VALVE

DESIGN PHILOSOPHY

Control Valve data sheet specify the minimum acceptable materials for the control valve body and trim. Alternate superior materials for the control valve body and trim shall also be acceptable subject to supplier assuming complete responsibility for proper selection of material for these parts for their compatibility with the process fluid and its operating conditions.

Control Valve data sheet specifies the control valve size, flow coefficient (CV) and required flow rangeability.

Vendor shall be responsible for

- ❖ Selecting their standard valve flow coefficient suitable for the specified service and process conditions specified in the data sheets.
- ❖ Selection of actuator to meet the shut off differential pressure indicated in the data sheets.
- ❖ Checking for cavitation, flashing and noise generated and provide suitable trim and treatment to limit these within appropriate limits.
- ❖ Whenever specifically indicated a detailed specifications sheet for each control valve which shall provide information regarding type, material of construction, capacity etc.,

Functional Specification for Package Instruments

of the control valve and its valve accessories. The material specifications and units of measurement indicated in the specification sheet shall to be the same standards as those in data sheet.

- ❖ Whenever the requirement of sizing calculation is specifically indicated in the materials requisitions, vendor shall furnish sizing calculation for each tag number clearly highlighting the standard used for calculation, noise level, cavitation or flashing, CV selected %age opening at minimum, normal and maximum flow, inlet & outlet velocity etc.
- ❖ Limitation, if any, in changing actuator orientation at site.
Deviations on technical requirements shall not be entertained. In case vendor has any valid technical reason, they must include the deviations tag number wise, summing up all the deviations from the data sheets and other technical specification along with the technical reasons for each of these deviations.

All documentation submitted by the vendor including their quotation, catalogues, drawings, installation, operation and maintenance manuals etc., shall be in English language only.

BODY

Control valves shall have flanged end connections integral to the valve body. Split body type valve design shall not be offered unless specifically indicated in the data sheets.

The minimum control valve body size shall be 1 inch. Control valve body size of less than 1 inch shall be offered only when specifically indicated in the data sheet.

The valve body rating should be equal to or higher than the flange rating specified in the data sheets.

The control valves shall be suitable for installation in horizontal as well as in vertical lines.

FLOW DIRECTION

In general, flow direction shall be as below:

- a) Flow tending to open for single seated unbalanced valve design.
- b) Flow entering between the seats for double seated valves.
- c) Flow entering at the side and leaving at the bottom for angle valves.

For valves design other than those specified above flow direction shall be as per manufacturer standard. Flow direction shall be clearly marked on the control valve body.

For 3 way control valves, service like mixing or diverting, shall be clearly identified with inlet and outlet end connection clearly marked on the control valve body.

END CONNECTIONS

Unless otherwise mentioned, end connection details shall be as below:-

- a) Threaded end connections shall be NPT as per ANSI/ASME B1.20.1
- b) Flanged end connections shall be as per ANSI/ASME B 16.5 or B 16.47-B or as specified in datasheet.
- c) Flange face finish shall be serrated concentric as per ANSI B 16.5
- d) Ring type joint flanges shall have octagonal grooves as per ANSI B 16.20

Face to face dimension of globe type control valves shall be in accordance with ANSI/ISA 75.08 Where provided control valve bottom drains shall be plugged off or blind flanged where a plug is used threads shall correspond to ANSI/ASME B1.20.1 (NPT). Where a flange is used its dimensions and rating shall correspond to ANSI/ASME B16.5.

Functional Specification for Package Instruments

MATERIAL OF CONSTRUCTION

The material of construction of control valves shall be as specified in the data sheet. No material shall be substituted by vendor without specific written approval from OIL / M/s KAVIN.

Control valve body, bonnet bottom flange, line flanges and other pressure containing assemblies shall be of the same material of construction as specified for valve body in the data sheets.

The bonnet flange and bottom flange shall have metallic spiral wound gaskets suitable for the specified service. The gaskets with asbestos bearing fillers shall not be used.

Vendor shall be responsible for selecting proper material for the internal parts of control valve. All such materials shall have the same or better specification than specified in the data sheets.

TRIM

The term 'trim' covers those parts of valve assembly (excluding the body, bonnet and bottom flange) which are exposed to and are in contact with the line medium consisting of but not limited to the seat ring, valve stem, valve plug, Valve plug guide, guide bushing and cage.

In case of rotary type of control valves like butterfly, ball, segmental ball, rotary plug, eccentric disc and rotary disc, the term trim covers disc/ball, seat ring, shaft and bearing.

GUIDING

Single seated globe (unbalanced) and angle type control valves shall have heavy top plug guiding. Stem guided control valve design shall not be acceptable unless specifically indicated elsewhere.

Single seated globe (balanced) control valves shall have cage guided design. The cage shall provide a continuous plug guiding.

Double seated valves shall have top and bottom or cage guiding and shall be of the pressure balanced type.

Unless specifically indicated otherwise, whenever cage type control valves are specified, top guided or top and bottom guided control valves can be offered provided it meets all other process and functional requirements. But whenever top or top and bottom type of guiding is specified, cage type control valves shall not be offered.

3 way control valves of either diverting or mixing type shall have top guiding Rotary control valves like butterfly segmental ball, eccentric rotary plug etc shall have blowout proof shaft guiding design.

Guide bushings shall be of a sufficiently hard material to resist side thrust on the plug.

TRIM DESIGN

Control valve manufacturer/vendor shall be responsible for trim selection and trim design of the control valve. However it shall meet the following minimum requirements:

- Control valve trim design shall suit the type of guiding specified.
- The trim design and material of construction shall be selected to minimize the risk of galling particularly in case of cage guided valves. Vendor shall select proper material pairs, surface finish, hardness and clearness wherever possibility of galling exist.
- Under extreme temperature conditions, vendor shall consider increased clearances at room temperature and seal welding of threaded seat rings etc. Hard facing of trim shall be used in high temperatures. For very low temperature application material used shall have adequate cold impact strength.
- For globe/angle/3way type of control valves, stem and plug shall be detachable and shall be attached together by suitable threaded design secured with a pin to avoid plug rotation during operation.

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJA, ASSAM Functional Specification for Package Instruments	

- e) For top and bottom guided control valves with sizes above 8" post and guide bushing design shall be used to prevent rotation of plug and stem.
- f) Whenever cavitations are expected, vendor shall select a special anti-cavitation trim design and shall use trim material of sufficiently high hardness.
- g) Whenever the possibility of aerodynamic noise in a control valve exists under any operating condition specified in data sheet, vendor shall select a special low noise trim for that application.

The plug inherent characteristics shall be as indicated. However following shall be followed unless otherwise specified:

- a) Control valves with low noise and anti-cavitation trim design shall have modified equal percentage or linear characteristics.
- b) Rotary type control valves shall have modified equal percentage or equal percentage characteristics.
- c) Control valves with flow coefficient less than 0.4 shall have equal percentage or linear characteristics.
- d) All other control valves shall have equal percentage characteristics. Whenever liner or modified equal percentage characteristics are specified equal percentage characteristics shall also be acceptable. Characterized positioner cam design to meet specified inherent control valve characteristics shall not be offered, unless specifically indicated.

LEAKAGE CLASS

- a) Leakage class as per ANSI FCI 70.2 shall be specified for each control valve. Where no leakage class is specified, the same shall be considered as Class IV. Higher leakage class shall be provided wherever indicated.
- b) For control valves specified with Class VI leakage class, vendor shall select the soft seat (elastomer) material suitable for the process conditions i.e., shut off pressure, maximum temperature and process fluid.

Control valve experiencing cavitation, flashing and noise are generally identified. In case vendor's calculation show occurrence of cavitation, flashing or noise under any of the specified process condition, vendor shall select proper type of valve trim to suit such process condition.

SIZING

The control valve capacities in terms of flow coefficient (CV) shown have been calculated based on the formulae given in the standard ANSI/ISA 75.01 "Control valve sizing equations".

All factors used while arriving at the sizing are also as per ANSI/ISA 75.01. Vendor must resize the control valves considering various factors specific to the offered valves.

Indicates calculated flow co-efficient values at minimum, normal and maximum operating conditions. Vendor shall calculate this co-efficient as per the offered Control valve and select the size considering valve openings as under:

- At maximum flow - less than 90% open
- At normal flow - typically 75% open
- At minimum flow - more than 15% open

Rangeability of globe type of valves shall be 30:1, as a minimum. Vendor shall ensure that the actual rangeability of offered valves shall meet these requirements. For other types of offered control valves, vendor to specify that the available rangeability of the offered valves meet the requirements specified.

Conventional butterfly valves shall be sized assuming a 60 degree opening at maximum flow. Wherever high performance butterfly valves are specified, these shall be sized considering maximum opening of 90 degree at maximum flow.

Functional Specification for Package Instruments**NOISE**

Vendor shall examine each control valve for noise generation possibilities. The noise level shall be calculated as per ISA 75.17 or any other equivalent standard.

Noise generated by control valve during operation shall be limited to OSHA specified levels i.e., the maximum allowable noise shall be less than 85dBA, when measured at a distance governed by ISA 75.17.

If the predicted noise level is found to exceed 85dBA SPL, control valve shall be treated for noise. Source treatment for noise shall be resorted to. When source treatment for noise is not sufficient to reduce the noise level below 85dBA, Vendor shall provide path treatment like diffuser plate/ silencer etc in addition to source treatment so as to reduce the level below 85dBA. Whenever additional path treatment is recommended, the maximum differential pressure across the silencer/diffuser plate shall not exceed 40% of the specified differential pressure.

Vendor shall also furnish noise calculations with and without the use of these devices and the noise abatement achieved in individual components.

PACKING BOX

The packing box shall be flanged bolted to the bonnet and shall meet the requirements specified.

Gasket material shall be as per Piping Material Specification.

Whenever specifically indicated, control valve shall have its packing box drilled and tapped to 1/4" NPT (F) for connecting external lubricator. When external lubricator is not provided, this hole shall be plugged.

An isolating valve shall be provided with all valves having external lubrication provision. Vendor shall specify the lubrication stick material used in each case.

For application in vacuum services, vendor to provide inverted packing design suitable for vacuum service. For pressure-cum-vacuum service, the control valve shall have dual packing design suitable for the application. Dual packing design shall also be provided for control valves in toxic service.

Wherever environmental packing design is specified, vendor shall supply special packing design suitable to minimize fugitive emission.

BONNET

The bonnet shall be flanged bolted to the body. Threaded bonnets are not acceptable.

Wherever the operating temperature of the fluid is above 200 °C, extension or radiation finned bonnet shall be provided. Vendor standard bonnet design shall also be acceptable if these are suitable for higher temperatures.

For temperature below 0°C, Vendor shall provide extended bonnet design. For valves in cryogenic application bonnet extension shall be as per BS-6364 as a minimum.

STEM

The stem surface finish shall be fine. Extra fine surface finish shall be provided wherever the packing material is PTFE.

The stem/shaft shall be designed for the maximum thrust of the actuator without any measurable deflection.

The valve stem/shaft shall be connected to the actuator stem/shaft by suitable arrangement to avoid backlash problem.

PNEUMATIC ACTUATOR

Actuator shall be sized for the shut-off differential pressure indicated in data sheets. However, for 3-way type control valve, the actuator shall be sized for maximum differential pressure, unless specifically indicated.

Functional Specification for Package Instruments

The actuator shall be designed to move the valve to the failure position specified. For failure position specified as 'fail-locked', vendor shall provide fail-lock relays to meet the requirement.

Non metallic actuator casing shall not be offered.

Springs shall be corrosion-resistant and shall be cadmium or nickel plated. Alternately vendor standard coating shall also be acceptable. These shall be of the enclosed type. The compression of the springs shall be adjustable.

In general, an actuator operating range of 0.2 to 1.0kg/cm²g is preferred. However when vendor standard actuator model is not able to meet the specified shutoff pressure, higher actuator operating range may be offered.

In general, spring opposed diaphragms type actuators shall be used. Only when this type of actuators become extremely unwieldy, based on the data specified in the data sheet, should a piston and cylinder type of actuator be considered. Whenever piston and cylinder actuator is considered, single acting spring return type shall be used. Whenever double acting springless type of actuator is unavoidable, all accessories like pilot valves, booster relays, non return valve, pressure gauge, volume tank etc. Shall be provided to ensure desired action on air failure. The volume tank shall be sized considering full stroking of the valve for two complete cycles. The volume tank shall be of carbon steel construction and sized as per ASME Section VIII with design pressure of 10kg/cm²g as a minimum. All accessories and tubings etc shall be 316 stainless steel constructions.

The actuator casings and diaphragms shall be designed for minimum twice the maximum pneumatic operating pressure of the control valve.

Valve stem position indicator shall be provided for every control valve. The position indicator scale shall be marked from 0 to 100% in steps of 10%.

In general side mounted hand wheels will be used. Hand wheels shall provide manual control in both opening and closing directions independent of spring action. Hand wheels shall be of non-rising type suitable for accurate valve positioning.

Actuator orientation shall be as per vendor recommended orientation. It shall be possible to change this orientation at site for the offered valve actuator combination in case it is found necessary.

ACTUATOR SIZING

Vendor shall be fully responsible for the sizing and selection of the correct actuator for the specified control valve. While sizing the actuator, vendor shall ensure that the actuator is able to develop sufficient thrust to properly seat the control valve plug/disc at the actuator air pressure (lowest specified pressure) and shut off conditions specified.

While sizing the actuator, vendor must ensure that the sizing factors indicated below are fully complied. Higher sizing factor may be considered if found necessary by vendor.

- a) For control valves with leakage class IV and below, the actuator shall be sized considering actuator thrust more than 1.3 times the total force induced by shut off conditions specified in the data sheet and the force required to overcome packing friction. Vendor shall utilize this factor as 1.5 in case the control valve is operating between 80% to 90% or 10% to 20% in any of the specified conditions.
- b) For control valves with leakage class V and above, the actuator shall be sized considering actual thrust more than 1.7 times the total force induced by specified shut off conditions in the data sheet and the force required to overcome packing friction.

Functional Specification for Package Instruments**POSITIONERS**

Positioners shall be smart type. They shall be direct acting, with an adjustable gain unless otherwise specified. Every positioner shall have two pressure gauges mounted on it, one each for air supply and for positioner output to actuator. In addition, pneumatic positioner shall have third pressure gauge for control signal. Positioners shall be side mounted on the control valve and shall have corrosion resistant linkages and rugged brackets, unless remote mounted positioner is offered when specified in the datasheet. Positioner material of construction shall be SS 316 and IP rating IP65 or better.

AIR FILTER REGULATOR

Vendor shall supply air filter regulator with each positioner complete with and integral output gauge. Air filter regulator shall be sized considering the air supply pressure and flow required to meet requirements specified. Filter material shall be sintered bronze. Filter size shall be maximum 5 microns. However, lower filter mesh size shall be considered to suit the electro pneumatic converter vendor's requirement.

1.12. ACTUATED ON-OFF VALVE

The specifications for the on-off valves and associated accessories shall be followed

Ball valves shall be of floating ball / trunnion mounted type as per PMS & VMS.

For trunnion mounted ball valves, seat shall be spring loaded.

All ball valves with leakage Class VI shall be provided with pressure equalization seats to relieve body-bonnet cavity over-pressure.

Ball valves shall be 2-piece valves. The valves shall be full port valves.

All on-off valves shall meet Class VI seat leakage class.

Valve body & flange rating shall be minimum 300# as per ANSI. Flanges for the shall be as per ASTM B 16.5.

Flow direction shall be stamped or cast on the body.

Bonnet shall be provided with cooling fins or extension when the fluid temperature is 230 °C and more and shall be of extension type for low temperature -18 °C and below.

For other services, standard bonnet shall be provided.

Valves shall be provided with anti-static devices to achieve electrical continuity between the ball, stem & the valve body.

Valve noise shall be restricted to 85dBA maximum at 1 meter distance away from the valve.

Valve actuator shall be painted green for air fail-to-open (FO) valves and red for air fail-to-lose (FC) valves.

TRIM

- Quick opening trim shall be used for On-Off and Shutdown Valves. Material of trim shall be as specified.
- Stem for ball valves shall be anti-blowout type.
- For trunnion mounted ball valves, seat spring shall be provided.

ACTUATOR

- Rotary piston actuators shall be provided for the ball valves. The actuators shall be spring return or double-acting type as per the fail-safe condition required. Local open/close indication shall be provided on the actuator.
- All actuators shall be adequate to fully stroke the valve under the maximum differential pressure specified by the process requirements. They shall be sized for the shut off differential pressure.
- No by-pass or hand wheel shall be provided for shutdown valves.

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJAN, ASSAM Functional Specification for Package Instruments	

- d) Limit switches shall be of Proximity type. They shall meet NAMUR requirements when used in classified area. Limit switches shall be provided both for close and open positions of the valves.
- e) Other auxiliary devices such as air lock relay, pilot relay, booster relay volume tank etc. shall be provided as parts of the actuating system in order to achieve the required stroke-speed, fail safe action.

SOLENOID VALVES

- a) Solenoid valves (Direct acting type) shall be used as the pilot valve for operation of On/Off valves.
- b) The solenoid valves shall be universal type three-way.
- c) Solenoid valve body & trim shall be of SS316, as minimum.
- d) Solenoid valves shall be in energized condition during normal operation. It shall have integral terminal box with 1/2" NPT(F) cable entry. Flying leads are not acceptable.

PNEUMATIC TUBES AND FITTINGS

- a) Material of pneumatic tubing & fittings shall be as specified.
- b) Fittings shall be double ferrule compression type consisting of two ferrules, nut and body with one selected compression fitting manufacturer used for all the valves.
- c) Internal tubing for on – off valves shall be either ¼" or ½" tube only. No other sizes are acceptable. On – off valve size for 4" and below the tubing internal and external to be ¼" and for sizes above 4", the internal and external tubing shall be ½" only.

TESTS

Valve Inspection & Testing shall be carried out as per API 598. The following tests shall be conducted:

- a) Dimension checking
- b) Hydro test (1.5 times design Pressure), leak test for body & seat for all valves as per API 598
- c) Seat Leakage Test as per ANSI B 16.104
- d) Material traceability test as per EN 10204.
- e) Radiography shall be carried out as below:

Radiography procedure, areas of casting to be radiographed shall be as per ASME B16.34 and acceptance criteria shall be as per ASME B16.34 Annexure-B. However for areas of casting to be radiographed for types of valves not covered in ASME B16.34, vendor shall enclose details of areas to be radiographed in line with ASME B16.34.

- a) IBR certification for valves in steam service, if any.
- b) All valve castings in hydrogen service shall undergo helium leak test. Test reports shall be provided. Wherever NACE is applicable necessary certifications shall be provided.
- c) * Pneumatic test for all pneumatic actuators at pressure 1.5 times of actuator design pressure (i) Calibration/Stroke Check
- d) * Testing of accessories (i.e. Solenoid valves, Air filter & regulator, etc)

Note: All tests prefixed with (*) shall be witnessed by owner/ owner's appointed third party inspector.

1.13. OIL IN WATER ANALYSER

The vendor shall be responsible for the selection of the Oil in Water Analyzer suitable for its Intended application, its procurement, tagging, packing, testing & calibration, preparation for Shipment, along with accessories, spares, and assistance where required for its installation & Commissioning at site.

Functional Specification for Package Instruments

The **VENDOR** shall supply the Analyzer complete with accessories to satisfy operational requirements under the conditions described in the document.

Vendor's scope of supply shall include the design, engineering, material selection, fabrication, assembly, inspection and test, calibration and certification of Analyzer and accessories.

The **VENDOR** Scope of Supply shall also include the following:

- a) Sample probes with facility for on-line installation / removal under line pressure.
- b) Nozzles size is 2" ANSI 150#RF. Vendor shall supply conax seal fitting and needle valve for on-line probe extraction.
- c) Sample conditioning systems, with all the necessary components like filters, pressure regulators, valves, heated pressure reducing systems etc. required for the satisfactory functioning of each analyzer system and measurement within the accuracy.
- d) Microprocessor based Analyzers, suitable for field installation and shall be located in the analyzer cabinet.
- e) Other auxiliaries, to complete the systems to achieve the intended functionality
- f) Inspection and Testing to complete analyzer systems at manufacturer's works
- g) Performance Guarantee for the entire system in terms of functionality and warranty against manufacturing defects, selection of substandard components and poor workmanship
- h) All special tools required for operation, removal, installation and maintenance purposes.
- i) Surface preparation and painting
- j) Start-up & Commissioning Spare Parts
- k) Two Year Operation Spare Parts (List of spares with part number, unit price and delivery schedule only)
- l) Documentation
- m) Packing, preservation, preparation for shipment.

DESIGN SPECIFICATION

This specification defines the minimum requirements for the engineering, manufacturing and delivery including, but not limited to, the design, material procurement, fabrication, inspection and testing of the Oil in Water Analyzer. The **VENDOR** shall note that all accessories should be supplied as a completely assembled unit for the Analyzer. The Vendor shall be solely responsible for design, engineering, manufacture, assembly, integration, inspection, test, delivery and commissioning of the Analyzer for services and design conditions.

Prior to dispatch the Oil in Water Analyzer, **VENDOR** shall carry out factory acceptance test (FAT) of complete integrated, assembled Analyzer by hooking up all field accessories.

GENERAL REQUIREMENT

The Oil in Water Analyzer assemblies, including all auxiliaries, shall have a minimum nominal design life of 20 years based on vendor's recommended maintenance procedures being followed during this period.

VENDOR is responsible for the complete design, manufacture, testing of the Oil in Water Analyzer to ensure compliance to design specification.

All components shall be clearly labeled for easy identification.

Tubing used within the sample conditioning systems and for the analyzer racks shall be SS 316, seamless, bright annealed, with minimum 2.5% Molybdenum and hardness not exceeding 80 Rb. Tube fitting shall be SS 316, double compression type, Swagelok.

Functional Specification for Package Instruments

Signal junction boxes used within the field installed sample conditioning system enclosures signal cables shall be SS 316, certified Ex'e'. Power distribution box shall be SS 316 Ex'd'. Cable glands and plugs shall be certified Ex'd' and the cable entry shall be M20. Material of Construction shall be nickel plated brass for Cable Glands and brass for Plugs.

All the electrical and electronic enclosures including Cable Glands and Plugs shall have a minimum ingress protection class of IP 65 per IEC 60529.

VENDOR shall submit detailed sample conditioning system scheme with bill of material, material of construction, size and layout.

ANALYZER CONSTRUCTION

Oil in Water Analyzer shall be microprocessor based, capable of continuous measurement in the fluid and meeting the functional requirements.

The analyzer enclosures shall be suitable for surface mounting.

VENDOR shall collaborate with CONTRACTOR / COMPANY such that the analyzers can be easily installed at site. VENDOR shall provide all necessary information.

IP 65 grade ingress protection as per IEC 60529 shall be provided for all field electronic instruments. All electronic field instruments shall be RFI / EMI immune (tested as IEC 60801). Each analyzer system shall include a sample probe/insertion regulator, sample transport tubing, sample conditioning system, microprocessor based analyzer, sample disposal system and junction boxes for signal Interfaces and electrical power supply.

The analyzer systems shall be provided with all other auxiliary items that are required for the installation and satisfactory operation of the analyzer systems to meet the intended functional requirements.

The total measurement delay (including sample transit time from the tip of the sample probe of the measurement cell, measurement cell residence time, signal processing and output signal damping) for the proposed arrangement shall be minimum. VENDOR shall utilize the tubing size of 3/8" OD for above consideration. The tubing size of 3/8" OD (0.065" wall thickness) will be used for the sample transportation, sample disposal and probe relief valve outlet to flare. Bulkhead connector fittings on analyzer rack and sample probe assembly shall be supplied by VENDOR.

VENDOR shall specify measuring time, Response Time, Accuracy, Repeatability, Maintenance procedure, Weight details, Power requirement and consumption details and probe details

VENDOR shall provide features of Automatic Cleaning System

REQUIREMENTS ON SAMPLE PROBES / INSERTION REGULATORS ASSEMBLY

VENDOR shall propose suitable sample take-off probe based on the process condition. Each sample probe design shall be such that true representative samples are collected for analysis and measurement by the sample conditioning systems and the analyzers.

Each sample probe shall preferably have an integral pressure regulator, with the point of pressure reduction located within the flowing stream near the tip of the probe, along with pressure gauge and relief valve at the outlet. Each sample conditioning system shall be provided with additional pressure regulators as demanded by the process and the proposed conditioning systems and the analyzers. VENDOR shall confirm that type of probe can work with the process condition.

Each Sample probe shall be designed for online Installation / removal under pressure. All the wetted parts of the sample probe assembly shall be min. SS 316. The pressure containing parts shall be of carbon steel, painted. For the selection of painting system, the flange/body shall be considered as non-insulated.

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA AND EAST KHAGORIJAN, ASSAM Functional Specification for Package Instruments	

Each sample probe shall be designed to resist stresses resulting from stream velocity, including any vortex shedding. VENDOR shall check and propose If any lateral support is required to limit vibration at the top end of the sample probe assembly. VENDOR shall refer to the attached process data sheets for the maximum velocity for the analyzers

REQUIREMENTS ON SAMPLE CONDITIONING SYSTEMS

Each sample conditioning system shall be designed such that the properties of the analyzed sample remains unaltered between the sample take-off and the analyzer inlet.

Each sample line and sample conditioning system shall contain the following as a minimum. All components shall be in SS 316 as a minimum.

- a) Sample cell
- b) Plugged bulkhead fittings for all tubing connection to be hooked-up at site
- d) Pressure regulators for pressure conditioning (if require)
- e) Pressure gauges
- f) Valves (check, isolation, etc.)
- g) Flow meters (armored rotameter) for flow measurement/control to the analyzers
- h) Heated regulators
- i) In-line guard filters to protect analyzers against particular matter
- j) Heaters.
- k) Sample coolers
- l) Vortex coolers

Each sample conditioning system shall be mounted in an enclosure supported by a free standing rack. The enclosure and rack shall be of SS 316 construction, suitable for hazardous area. The enclosure shall be ingress protected to IP 65.

The rack shall be designed for a single lift using four removable lifting lugs located at the strong points.

All external metallic parts of the electrical installation shall be bonded and earthed. The VENDOR shall provide two diagonally opposite M10 earthing bosses on the enclosure rack base for connection to the facility earth system.

Earthing within the racks shall be the responsibility of the VENDOR. The enclosure and the rack shall have continuous path to earth through each of the two earthing bosses, Earth conductors shall be annealed stranded copper with green/yellow PVC Insulation. All earth cables shall have a minimum cross sectional area of 25 sq.mm. Vendor also responsible to ensure that the Oil in Water Analyzer is protected from lightning surge.

Each sample conditioning system shall have facility to flush, vent and / or drain with vent and / or drain valve.

For outside local field component, all components shall have a minimum ingress protection class of IP65 as per IEC 60529.

The electronic modules shall be integral mounted unless otherwise specified in the data sheets. The electronic modules shall be easily replaceable without recalibration.

SIGNAL CABLE

All cable from device inside analyzer cabinet to vendor's JB shall be supplied and installed by analyzer vendor. VENDOR shall supply the signals cables complete with Ex'd' nickel plated brass cable glands between each analyzer and the sample conditioning system enclosure.

1.14. MATERIAL TAKE-OFF

Cable gland shall be Nickel Plated Brass suitable for Installation in classified area. Cable Glands shall be double compression explosion proof type and have an ingress protection of IP65.

All low power instrument cables shall be by single or multi-core copper stranded with XLPE or EPR insulation, low smoke, halogen free sheathed cables to relevant IEC standards. All the Instrument, Control and low voltage power cables shall be MUD resistant type. Cables shall be of stranded copper conductor.

Fire resistant & Flame retardant type cables are required for safety related instruments and ESD/F&G system devices. The fire resistant type cables shall conform to IEC 60331.

All control and analogue signal cables connected to DCS system shall be of flame retardant type. The Flame retardant cables shall conform to IEC 60332-3.

Electrical Cables shall have the following sheath colors as a standard

- IS Cables (Instrument Signal): Blue
- Non IS (Instrument Signal): Grey
- Low Power and Instrument Control: Black
- Instrument earth: yellow/green (with red mark at each end)
- IS earth: yellow/green (with blue mark at each end)

Instrument junction boxes shall be certified. For intrinsically safe circuits, boxes certified Increased Safety Ex e shall be used. For non-intrinsically safe circuits, boxes certified Explosion Proof / Flame proof Ex d shall be used. Boxes (Ex e, Ex d) shall have minimum IP 66 ingress protection.

Separate junction boxes shall be used for intrinsically safe wiring. Junction boxes in any cable path from field to control room shall be limited to one only unless otherwise.

Instrument junction boxes shall not be used for electrical power cables

For Ex d junction boxes cable entries shall have NPT threads; where this is not possible certified 316 SS adaptor shall be fitted.

All Ex e and Ex d enclosures shall have all spare entries sealed with suitably certified 316 SS plugs.

Entries shall be suitably spaced to enable ease of installation of cable glands. Tapped cable entries shall be of good quality, without stripped or damaged threads. The thread shall be continuous and shall permit the cable gland to fit squarely against the gland plate (or enclosure).

Where the gland plate is not thick enough for tapping, cable glands shall be fitted with double locknuts.

The threads of all cable glands and adaptors shall be greased on assembly.

Cable glands fitted to all Ex e enclosures, and industrial enclosures, may have a nylon or lead sealing washer between the Cable Gland and Gland Plate (or enclosure) to ensure IP 66 protection. Sealing washers shall not be fitted to glands entering Ex d enclosures.

All junction boxes shall be effectively sealed, once uncased or fitted into position. All lids shall be replaced during any break in work. Where this is impractical, e.g. large multi-cable junction boxes, a heavy PVC sheet shall be used to cover the junction box to exclude rain and dust.

All terminals (including unused terminals) shall be tightened down. For communing of terminals, feed through cross connection bar shall be used. Comb connectors shall not be used.

Junction box shall have terminals arranged in vertical orientation. IS terminal color shall be BLUE and NON IS terminal shall be GREY in color.

Functional Specification for Package Instruments**1.15. CABLE ROUTES, FIXING, SUPPORTING AND FASTENING**

In general, instrument cables shall be installed overhead on cable ladders, trays or on special constructions.

The cables shall be grouped according to the signal types. The main groups are:

- (a) Electrical signals.
- (b) Electronic and pyrometric signals.
- (c) Intrinsically safe signals, non-smart instruments.
- (d) Intrinsically safe signals, smart instruments.

Two (2) cable layers maximum are allowed per tray/ladder or trenches.

- (a) Distance of 100 mm should be provided between each group of signals.
- (b) A distance of at least 300 mm shall be provided between instrument cables and electrical low-voltage power cables.
- (c) Electrical low-voltage power cables shall not be laid in the same cable ladder/tray as those of instrument cables.
- (d) A distance of 300 mm should be provided between electrical and instrument cable crossings.

1.16. CABLE LADDERS/TRAYS, FIXING SUPPORTING

Fiber Reinforced Plastic (FRP) cable trays shall be used.

The cable trays shall be located away from where they are subject to mechanical damage, spilt liquids, escaping vapors and corrosive gases. Where cable trays are liable to damage by traffic, they shall be protected by freestanding and sturdy mechanical structures.

Cables may be laid sideways in the trays instead of pulling them through consecutive holes. Free space over the trays should depend on trays accessibility.

Angles in cable trays and/or trenches shall be based on the minimum bending radius of the thickest cable.

The cable trays should be designed considering the following:

- (a) Cable tray filling shall be such that 20% spare space remains on each cable ladder.
- (b) In case of main tracks, with several cable trays being used for the same cable group, these racks can be filled up, the required spare of 20% per group may be fulfilled by additional (empty) racks.

All fixing accessories such as saddles, cleats and bolting material shall be works manufactured from cadmium plated steel bolts adequate for the load to be imposed without undue stress or sagging. Cadmium plated steel materials shall be isolated from supporting steelwork by means of suitable hard Teflon pads, washers, etc.

Cable tray shall be of a rigid design and self-supporting between holding brackets without excessive deformation after the cables are installed (spacing of horizontal pipe rack members is three (3) meters.)

Cable tray systems shall be designed and installed to ensure electrical continuity throughout the run and such that water cannot collect or remain in any part of the system.

Cables installed aboveground shall be routed to avoid high-risk areas, e.g. high fire risk areas, and those areas where accidental leakage or spillage may occur and cause damage to cables supports.

Cable trays within a building may be without covers. Cable trays in the open area shall be provided with cover.

Where cables are required to be installed through or across the edges of tray or other metal work, the edge of the lips shall be smoothed painted with special paint and lined with a protective sleeving to avoid cable damage.

Supporting steelwork shall be manufactured from good quality heavy gauge steel. The material shall be painted in accordance with the specification for surface preparation and painting.

Precast concrete members should not be drilled for any reason. Fixing shall always be by means of clamping brackets in the most efficient way and in consultation with EPCM's representative.

Under no circumstances shall welding be carried out to any process plant equipment, vessels, pipelines or structures or to any protected surface, unless specifically indicated on the drawings and documentation and then in strict accordance with a procedure subject to EPCM's approval.

Fixings to the above should be made where brackets and so on, have already been provided, or when agreed, by the use of purpose built clamps.

CABLE ENTRY SEALINGS

Where cables have to be led through exterior walls or partitions with a fire blocking, water blocking or sealing function, gastight cable transits shall be installed.

The cable transits should be well accessible with respect to mounting, inspection and testing for leaks.

The spare space to be kept in the cable transits should correspond to the spare space on the cable trays, but should at least be such that after final assembly 20% additional cables can be led through.

All cable and cabinet entries through the floors shall be sealed with polyurethane foam.

1.17. INSTALLATION INSTRUCTIONS

The MPC Supplier shall ensure that all equipment is mounted in its correct location, piped and wired correctly in accordance with drawings and specifications prior to pre-commissioning.

The MPC Supplier shall ensure that all manufacturer's instructions applicable to instrument handling and installations are complied with. The MPC Supplier shall ensure that control panels and consoles are adequately protected against damage during installation.

The MPC Supplier shall ensure that following labels are attached to relevant equipment after testing :

(a) Red labels for loop testing complete.

(b) Yellow labels for hydraulic test.

Junction boxes shall be mounted in the vertical plane, and protected during construction against the ingress of moisture; unused entry holes are to be blanked off.

All cable and wiring connections shall be clearly marked with the correct designation as shown on drawings and specifications.

The type, design and methods of manufacture of racks, brackets and other special supporting steelwork shall be subject to the approval of the consultant.

The number and size of brackets, racks, clips or other support equipment or cables in position without imposing strain on the equipment or cables and the finished installation shall present a neat appearance.

The drilling, cutting and/or welding to steel work or building structures shall not be carried out without prior approval of the consultant. Drilling, cutting and/or welding to pressure vessels or pipe work are not permitted under any circumstances.

Where the MPC Supplier is required to cut away and repair the building, the materials used for repairing shall be the same as the original materials and the standard of workmanship at least equal to the original standard.

Functional Specification for Package Instruments

The MPC Supplier shall provide personnel who will be conversant with the types of instrumentation to be installed.

Instruments shall be located as shown on the instruments location plans, however, final location and orientation of instruments shall take into consideration the ease of accessibility for service and maintenance and “readability” from walkways, platforms, ladders, grade, etc.

Prior to installation of instruments, particularly those of delicate nature, consideration must be given to the amount and type of other activities taking place in the area e.g. erection of vessels, steel work, piping, scaffolding etc.

1.18. INSTRUMENT PROCESS PIPING AND TUBING

All tubing shall be imperial sizes, expressed in nominal outside diameter (OD) and all threads shall be NPT ANSI B 1.20.1.

Tubing shall be of TP 316 / 316L (dual certified) material to ASTM ‘A 269’ or equivalent (i.e., BS 970-316-S31, DIN4401 or ASME SA 479-316), unless otherwise specified. Molybdenum content shall be 2.5% minimum and carbon content of $\leq 0.03\%$. The minimum size shall be $\frac{1}{4}$ ” OD.

Stainless steel tubing shall be soft annealed seamless TP 316 / 316L (dual certified) as per ASTM A269. Sizes shall be as follows:

Instrument “hook-ups” shall be in accordance with drawings provided and shall be prefabricated as far as practical and possible. Instrument piping shall be installed using the minimum number of fittings, but executed so that the removal of the instrument for maintenance is possible. All pressure lines and pneumatic lines to and from instruments are to be thoroughly cleaned of burrs, internal slivers and foreign matter before being put into operation. Where a pipe rack is not provided, pneumatic lines and/or cables (generally three (3) or less) may be strapped to sub air headers.

Air supply piping and cable ladders shown on piping and structural drawings respectively shall be supported by existing steel work; sub air header piping and cable racks (branches) shall be supported by materials delivered by the MPC Contractor.

Process lead lines, tubes, etc., shall be fixed throughout their length by means of approved saddles, clips and/or cleats. For lengths up to 1 m the instrument pressure piping is self-supporting, for longer lengths the instrument piping shall be supported at approximately 1 m intervals and shall be protected against damage. Process lead lines and tubes passing through floors or other positions where they are liable to mechanical damage, shall be protected.

When instrument piping supports are clamped on structures of a different material, insulating barriers, e.g. tape or gasket material shall be applied to prevent electrolytic corrosion. When instrument piping supports have to be fixed to fireproofed plant structures, these support should be applied welded to the steel structure before the fireproofing is applied, otherwise the supports should be fixed by means of clamps around the fireproofing, if allowed by civil engineering.

Screwed instrument connections shall not be seal welded. Instrument process piping shall be routed and sloped to avoid any pockets or traps, otherwise, drip pots shall be installed at low points.

Specification for Electrical requirements
for MPC-3 Package

1 SCOPE

This Electrical Specification broadly outlines the minimum requirements for the Design, Engineering, Selection, Sizing and Installation of the electrical equipment and associated systems of the installation/ facility. The philosophies as described in following section shall be referred for those equipment / system which are applicable for this project.

The electrical scope shall include design, engineering, procurement, manufacture, testing at manufacturers' works, packing, transportation, unloading, storage, insurance, transportation from stores to erection site, erection, site testing, commissioning, demonstration of performance guarantee test of the electrical equipment and handing over to OWNER including submission of hardcopy and soft copy of all as-built drawings, O&M manuals etc. required for successful operation of the facilities. The scope indicated in the following clauses shall be read in conjunction with detailed technical specification of this tender and the bid drawings. The major items covered are detailed as follows:

- Electrical equipment such as electric motors, Lighting and Distribution Boards (As required)
- On skid cabling and cable trays with supports, including interconnecting cabling
- On skid Lighting (Normal, Emergency and Critical), small power receptacles and Lighting & Small Power Distribution Board
- Terminal boxes at skid edge for field connection by MPC Contractor (except motors)
- Cable glands
- On skid earthing system (safety and continuity)
- Earth bolts for skid earthing to structure
- Supports for motor control stations (As required)

2 CODES AND STANDARDS

- a) The equipment shall comply with the requirements of the latest revision of the following standards issued by BIS unless otherwise specified.

CODES

IS-1646	Code of practice for the fire safety of buildings – Electrical Installations
IS-2189	Code of practice for selection: installation and maintenance of automatic fire detection and alarm system
IS-3043	Code of practice for Earthing
IS-3646	Code of practice for Interior Illumination
IS-5571	Guide for selection of electrical equipment for hazardous area
IS-5572	Classification of Hazardous Area (other than mines) having flammable gases and vapours for electrical installation
IS 5780	Electrical apparatus for explosive gas atmospheres
IS 5831	PVC insulation and sheath of electric m cables
IS-6665	Code of practice for industrial Lighting
IS 7098-Part-1	Cross linked polyethylene insulated PVC sheathed cables: Part 1 for working voltage upto and including 1100 V
IS / IEC 60529	Degree of protection provided by enclosures (IP Code)
IEC 60228	Specification for conductor of insulated cables
IEC 60287	Electric cables - Calculation of the current rating (Current rating equations (100% load factor) and calculation of losses)
IEC 60502-1	Power cables with extruded insulation and

OISD-STD-110	their accessories for rated voltages from 1kV (Um=1.2kV) up to 30kV (Um=36kV)
OISD-RP-149	Recommended Practices on Static Electricity
OISD STD-173	Design Aspects for Safety in Electrical System
	Fire Protection System for Electrical Installations

- b) In case of imported equipment standards of the country of origin shall be applicable if these standards are equivalent or stringent than the applicable Indian standards.
- c) In case Indian standards are not available for any equipment, standards issued by IEC / BS / VDE / IEEE / NEMA or equivalent agency shall be applicable.
- d) In case of any contradiction between various referred standards specifications data sheet and statutory regulations the following order of priority shall govern:
- Statutory regulations
 - Design Basis
 - Equipment specification
 - Codes and standards

3 ELECTRICAL SYSTEM VOLTAGE AND VARIATIONS

3.1 Voltage levels

LV Switchgear	415 V +6/-10%%, 50 Hz $\pm$ 3%, 3 Phase, 3 Wire
Lighting & Small Power Distribution	240 V +6/-10%%, 50 Hz $\pm$ 3%, between Phase to Phase, 2 Wire
Heat tracing power distribution	240 V +6/-10%%, 50 Hz $\pm$ 3%, between Phase to Phase, 2 Wire and Earth
UPS system (for control & protection circuits, PLC,	240 V $\pm$ 1%, 50 Hz $\pm$ 3%, 1 Phase, 2 Wire

instrumentation)

3.2 Control supply Voltage

SL. NO	CIRCUIT	RATED VOLTAGE (V)	SOURCE OF SUPPLY
1	Motor Control	110V AC for Safe Area Motors	Through Incomer control transformer wire bus
		30V DC for classified area motors	Internally derived from intrinsically safe relay

3.3 Short Circuit Levels

Switchboards and distribution boards shall be designed to meet the following short circuit levels:

415 V Systems: 50 kA (rms) for 1 sec

240 V Systems: 16 kA (rms) for 1 sec

(UPS) System: 10 kA (rms) for 1 sec

System protective devices (relays, fuses, breaker trip units, etc.) shall be selected and coordinated to ensure that the closest interrupter to the point of short circuit (or high overload) shall open first and minimize disturbances on the rest of the system.

4 ELECTRICAL EQUIPMENT FOR CLASSIFIED AREAS

All the areas within the Battery limits shall be classified for degree and extent of hazard from flammable materials. The basis for hazardous area classification recognizes the differing degrees of probability with which flammable atmosphere may arise in the installation, in terms of the frequency of occurrence and the probable duration of existence on each occasion.

Following factors shall be considered for proper selection of electrical apparatus and equipment for areas where flammable gas or vapor risks may arise:

- Area classification, i.e. Zone 0, 1 or 2
- Gas group classification, i.e. gas groups IIA, IIB or IIC.

- c) Temperature classification i.e. T3/T6.
- d) Environmental conditions in which apparatus is to be installed.
- e) apparatus in particular shall be installed in safe area. Substation and control room shall be located in safe area. Electrical equipment intended for service in hazardous area shall be selected in accordance with IS : 5571 and these shall be certified by recognized testing/certifying authorities of country of origin (e.g. CIMFR, LCIE, UL, FM, PTB, Baseefa etc.).
- f) For details on hazardous area classification, enclosure protection etc. OISD standard 113, National Electric Code, IS 5571, 5572, Petroleum Rules and Oil Mines Regulations shall be referred.

Wherever practicable, electrical apparatus in general and switch and control

However, irrespective of area classification, all the electrical equipment which are located in hazardous areas, shall be of Ex'd' type, Flame proof enclosures. All indigenous flameproof equipment shall have valid BIS / International license as a mandatory.

5 DEGREE OF PROTECTION

The degree of protection against dust and water ingress, necessary for individual electrical items is determined by the equipment duty, its environment, its location and the hazardous area classification. The equipment located outside or subject to deluge from fire water system/rains are to be of specified weather proof construction and protected against the most adverse conditions that are anticipated. These enclosures are to be classified to IP-55 as a minimum degree of protection, increased as necessary where the location/situation demands. Indoor equipment shall be a minimum of IP-52 protection and accessible equipment within enclosures will be a minimum of IP-22 degree of protection. Ingress protection of IP-42 shall be considered for only indoor equipment with specific ventilation requirements.

6 ELECTRICAL EQUIPMENT PROTECTION

- 6.1.1 Electrical system and equipment shall conform to the amendment regulation 100, Sub regulations (1) of Central Electricity Regulations 2010.

7 EQUIPMENT DESIGN BASIS

7.1.1 LV Motors shall be:

- a) Energy Efficient Type (IE2).
- b) TEFC, minimum IP55 for indoor, outdoor or under shed installation, severe duty, high efficiency, squirrel cage induction type.
- c) Suitable for satisfactory operation at 415 V +/- 10 %, 50 Hz +/- 3 %, 3 Phase.
- d) Suitable for DOL starting or soft starter starting or VFD starting as applicable. Starting current shall not exceed 7.0 times the rated current for motors rated up to 37 kW; 6.0 times for motors rated 37 kW and above.
- e) Class F insulation with temperature rise limited to Class B.
- f) For motors in Zone 1 / Zone 2 classified areas, flameproof (Ex'd') construction shall be used. In classified areas, all motors shall be rated for temperature class T3, gas group IIA/B, minimum IP-55 ingress protection.
- g) Space heaters shall be provided for motors rated 30 kW and above.
- h) Noise level shall be maintained as per IEC 34-9.
- i) Motor vibration shall be within the limit specified in IS 4729.

8 MOTOR CONTROL & MONITORING

8.1.1 Each motor shall be equipped with a local control station near the motor in the field according to relevant P&ID requirement.

8.1.2 Local control station shall include the following equipment as per individual requirement:

- a) Start & Stop push buttons
- b) Ammeter (for motors rated for 30kW and above)
- c) Auto / Manual or Local / Remote selector switch based on process requirement specified in P&ID.

8.1.3 Stop push button shall generally have stay put feature, be of lockable type.

8.2 AC & DC Distribution Boards (AS required)

8.2.1 AC and DC Distribution boards, such as those to cater to lighting and small power circuits, heat tracing loads, Main & Telecom UPS consumers, DC system loads, etc. shall preferably of indoor type, wall or floor mounted in electrical room. These boards shall be typically rated 240 V (Phase to Phase), 3 Phase, 3 Wire, 50 Hz.

8.3 Lighting System

8.3.1 Areas which are normally accessible to personnel movement or where equipment is installed shall be sufficiently illuminated. Lighting system shall be designed as per standard industry practice and the illumination intensities shall comply to IS 3646 and OISD RP 149 guidelines.

8.3.2 Sufficient lighting shall be provided so as to enable plant operators to move safely within the accessible areas of plant and to perform routine operations. In the event of normal power failure, emergency lighting should be provided. Desired lux level shall be achieved considering that both the lighting fixtures, normal as well as emergency one are energized. In the event of normal power failure, emergency lighting shall remain energized through emergency power source.

a) Normal / Emergency lighting shall be on 240 V AC (Phase - Phase), 50 Hz.

b) Critical lighting shall be on 110 V DC UPS.

8.3.3 As a good engineering practice the AC emergency load is generally considered as 20-25% of Normal Lighting load.

8.3.4 The operational philosophy recommended is, under normal operation, both emergency and normal lighting shall be fed by Normal power source. On failure of normal supply, emergency lighting load will be transferred to emergency source after the start of EDG set within 60 seconds. Critical lighting (DC supply based) will be normally kept 'ON' and during Normal/emergency power failure, battery will provide power.

8.3.5 As per CEAR recommendations, Energy conservation measures shall be adopted while designing the lighting system. Illumination system shall be

Energy Efficient/LED based as far as practicable. For battery backed emergency lighting, only Energy Efficient/ LED fixtures shall be used.

8.3.6 Outgoing circuits shall be protected by MCB + ELCB and incomer by MCCB. Arrangement shall be such that in case of earth leakage in one outgoing circuit, the entire DB need not be tripped. The total estimated load of each circuit shall not exceed 80% of circuit rating. Load on each circuit shall be limited to One (1) kW. Minimum 20% spare circuits shall be provided in each distribution board / panel.

8.3.7 Illumination intensities defined in IS 3646 and OISD RP 149 shall be considered as in-service values after applying a maintenance factor of minimum 0.8 and a utilization factor depending on the type of lighting fixture. These figures are the minimum vertical component values for the locations described on a horizontal plane being 0.75 m from the floor levels in buildings and the ground or platform levels in other areas.

8.3.8 Phase to phase voltage in the lighting system shall be limited to the maximum of 250V.

8.3.9 All lighting fixtures and equipment shall be connected between two phases at a voltage 240V phase to phase.

8.3.10 In case of lighting of building within the plant premises, double pole switches or 2-pole MCBs shall be used in lighting circuits instead of conventional single pole switches.

8.3.11 SOCKET OUTLETS

- a) Small power loads shall be powered from plant lighting panel.
- b) Each receptacle circuit shall be protected by MCB + ELCB. Not more than two socket outlets shall be supplied by one circuit.
- c) Convenience socket outlets shall have necessary mechanical interlocks and earthing facilities. The enclosure shall have suitable protection for site conditions specified (flame proof, weather proof, dust proof, corrosion resistant, etc.).
- d) Adequate number of three-pin sockets of rating 15A, 240 V ph to ph with earth connection shall be provided for lamps and portable tools at suitable

locations Hand lamps and portable tools shall be earthed through flexible cords.

8.4 Earthing system

8.4.1 Earthing system in general, shall cover the following

- a) Equipment earthing for personnel safety,
- b) System neutral earthing, and
- c) Static and lightning protection.

8.4.2 The earthing system envisages an earthing network with designed number of earth electrodes attached to it. The following shall be earthed:

- a) Metallic non-current carrying parts of all electrical apparatus such as motors, lighting/power panels, terminal boxes, control stations, lighting fixtures, receptacles etc.
- b) Steel structures, loading platform etc.
- c) Cable trays and racks, lighting mast and poles.
- d) Cable shields and armor

8.4.3 As far as possible, all earth connections shall be visible for inspection.

8.4.4 All connections shall be carefully made and adequately locked against loosening. Normally earthing system shall comprise of Aluminium strip as main earth grid along with suitably located Aluminium disconnecting plates to provide multiple earth connections between earth grid and equipment and for connections between main earth grid and electrodes.

8.4.5 Connections between Aluminium earth electrode and the disconnecting plates shall be done by Aluminium strip. For highly corrosive areas, PVC insulated Aluminium / Copper Conductor cable (un-armoured) can be used.

8.4.6 The maximum values of earth fault current for the design of the earthing system shall be taken as follows:

415 systems: 50 kA for 1 sec

8.4.7 CONNECTION

- a) All electrical equipment is to be doubly earthed by connecting two points on equipment to a main earthing ring. The cable armor shall be earthed through the cable glands.
- b) Two copper earthing leads shall be provided for Generator neutrals and each shall be directly connected to a separate earth pit which in-turn shall be connected to main earthing grid.
- c) Anchor bolts or fixing bolts shall not be used for earthing connection.
- d) All hardware used for earthing installation shall be hot dip galvanized or zinc passivated. Spring washers shall be used for all earthing connections of equipment.
- e) Wherever the equipment does not have provision of termination of Aluminium Strip directly, suitable tinned copper jumpers lugged on both ends shall be used.
- f) For sensitive electronic process equipments & PLC system, separate earth pit with copper plate electrodes & copper strips of suitable size shall be provided. These shall be clean earth. These shall be separate from electrical earth system.
- g) The earthing conductor shall be sized based on fault current and its duration. Minimum Earthing conductor sizes for major equipment shall be as per OISD RP 149.

8.5 Cabling

8.5.1 Design Criteria for Power cable shall be as follows:

- (a) Continuous current carrying capacity
- (b) Short circuit rating –
 - Incomer - Short circuit withstand for 0.6 second
 - Tie feeders at Generator Panel - Short circuit withstand - 0.6 sec.
 - Breaker controlled motors and Distribution transformers. 0.16 sec.
- (c) Voltage drop – As stated in Clause 8.2 of this design basis.
- (d) Derating Factor considering laying conditions.

(e) All Power and Control Cables shall be with copper conductor

8.5.2 Minimum Cross-section of cable conductors:

- LV Power Cables : 2.5 mm² (Min)
- LV Control Cables : 2.5 mm² (Min)
- Lighting cables : 2.5 mm² (Min)

In cases where the minimum cross-sectional area requirement is higher than 240 mm², single core cables shall be utilized.

8.5.3 415V System Power Cables shall be 1100V grade, single / multicore, stranded copper conductor, XLPE insulated, with PVC inner sheath, armoured and outer sheath made of specially formulated FRLS PVC compound. Single core cables shall have aluminium wire / formed wire armour, whereas multicore cables shall have galvanized steel strip armour.

8.5.4 110V DC system cables shall be 1100V grade; stranded copper conductor cables identical to 415V system power cables described above shall be used.

8.5.5 Lighting wires shall be 2.5 / 4 Sq.mm, single core, stranded, copper conductor, PVC insulated wires conforming to IS: 694 (1990) / IEC-227 part-1 to 5 (1979) / IEEE -719 (1981) shall be used.

8.5.6 Control cables shall be 1100V grade, multicore, 1.5 / 2.5 sq.mm cross section, stranded copper conductor having 7 strands, PVC insulated as per IS 1554, inner PVC sheathed, and outer sheath made of FRLS PVC compound conforming to the performance requirements outlined above shall be used. For multi-core control cables, no of core to be chosen with 20% of total cores or min. 1 core shall be kept as spare in addition to actual core requirement.

8.6 Cable carrier system

8.6.1 Cables from Switchgear Units and MLDBs shall be routed on prefabricated ladder type FRP cable trays with supported on site fabricated tray supports inside the buildings.

8.6.2 Separate cable trays shall be used for 415V power, control and instrumentation cables. FRP sheet cover shall be used in all exposed cable trays in outdoor areas.

8.6.3 In Substation / Indoor areas the cables shall be laid on FRP ladder type/perforated cable trays running in the built up RCC trenches.

8.6.4 Cables shall be laid in overhead cable racks / RCC trenches filled with sand / pipe racks / in outdoor areas. Other areas the cables shall be laid in overhead FRP ladder/perforated cable trays which shall be supported from slabs/walls/Columns and pipe racks as found suitable.

8.6.5 CABLE TRAYS

- a) All cable trays shall be of ladder type or perforated type construction of various sizes with accessories. There shall be a maximum spacing of 2000mm between horizontal cable tray supports and 1500 mm between vertical cable tray supports, except fittings (elbows, tees, etc.) which shall be supported at each splice.
- b) Solid bottom trays shall be provided for all special noise-sensitive circuits and analog instrumentation circuits. For instrumentation and control cables perforated cable trays shall be used.
- c) Clearance: The minimum design vertical spacing for trays shall be 300 mm measured from the bottom of the upper tray to the bottom of the lower tray excluding the thickness of the support of the upper tray. At least a 300 mm clearance shall be maintained between the top of a tray and beams, piping, or other obstacles to facilitate installation of cables in the tray. A working space of not less than 600 mm shall be maintained on at least one side of each tray.
- d) These shall be prefabricated FRP trays.
- e) The cable trays shall be categorized into two, Power and control the width of trays used shall be of 150,300,450,600 & 750mm wide. Flange height shall be 100mm and 50mm for power and control trays respectively.
- f) Power trays shall be loaded in single tier for 75% and control trays shall be loaded in double tier for 75%.

Package specification for Civil and Structural works

**PACKAGE SPECIFICATION FOR CIVIL AND
STRUCTURAL WORKS**

1 SCOPE

This specification defines the minimum requirements for the design, material procurement, manufacturing & assembly of Structural works.

2 ANALYSIS AND DESIGN

- a) All analysis and design work related with civil or structural steel shall be carried out using STAAD Pro latest version.
- b) Limit State Method of design as per IS 456 shall be followed in the design of concrete structures and detailing as per IS13920:1993 unless otherwise specified elsewhere in this document for special structures.
- c) Limit State Method of design as per IS 800 shall be followed in the design of steel structures unless otherwise specified elsewhere in this document for special structures.
- d) Working stress method of design shall be followed as per IS 456 for liquid retaining structures unless otherwise specified elsewhere in this document for special structures.

3 DESIGN LOADS

All loading for this project shall be designed as per IS 875, IS 1893, IS 3370 & IS 13920.

4 DESIGN PHILOSOPHY OF RCC STRUCTURES

4.1 GENERAL

- a) All liquid retaining/storage RCC structures shall be leak-proof and designed as uncracked section as per IS 3370: 2009. However, the parts of such structures not coming in contact with the liquid shall be designed according to IS:456 except ribs of beams of suspended floor slabs & counterforts of walls (located on the side remote from the liquid) and roof which shall be designed as uncracked section. No increase in permissible stresses in concrete and reinforcement shall be made under wind or seismic conditions for such structures.
- b) The walls and base slabs of liquid retaining/storage structures shall be provided with reinforcement on both faces for thickness greater than or equal to 150mm. In all liquid retaining structures, PVC water bars (minimum size 230mm wide, 5mm thick) shall be provided at each

**PACKAGE SPECIFICATION FOR CIVIL AND
STRUCTURAL WORKS**

construction joint.

- c) Unless otherwise specified minimum grade of RCC to be used for Liquid Retaining Structures and its foundations shall be M30 (refer clause 6.1 of IS 3370 (Part-1): 2009), conforming to IS: 456. Minimum cement content and maximum water cement ration shall be as specified in Table-1 of IS 3370 (Part-1): 2009.
- d) Unless otherwise specified 75mm thick PCC of M20 (refer clause 6.1 of IS 3370 (Part-1): 2009). The PCC concrete shall extend 75mm beyond the foundation.
- e) High strength Deformed Thermo mechanically treated (TMT) Steel bars of minimum grade.
- f) Fe 500, conforming to IS: 1786 shall be used. Mild Steel round bars shall not be used as reinforcement.

5 DESIGN PHILOSOPHY OF STEEL STRUCTURES

5.1 GENERAL

- a) All steel bars, sections, plates, and other miscellaneous steel materials, etc. shall be free from loose mill scales, rust as well as oil, mud, paint or other coatings. The materials, construction specifications such as dimensions, shape, weight, tolerances, testing etc., for all materials covered under this section, shall conform to respective IS codes.
- b) The design of all structural steel work will be carried out in accordance with Limit State Design method as per IS 800: 2007.
- c) Design, fabrication and erection of all structural steel works shall be carried out in accordance with the following IS Codes as applicable to the specific structures, viz. IS 800:2007, IS:801, IS:802, IS:806, IS:814, IS:816, IS:875, IS:1893, IS:3502, IS:9178, IS:9595, IS:6533 etc. Basic consideration of structural framework shall primarily be stability, ease of fabrication / erection and overall economy satisfying relevant Indian Standard Codes of Practice.
- d) Simple and fully rigid design as per IS: 800 shall be used. Where fully rigid joints are adopted they shall generally be confined to the major axis of the column member.

**PACKAGE SPECIFICATION FOR CIVIL AND
STRUCTURAL WORKS**

- e) Structural elements continuously exposed to temperatures above 200deg.C shall be designed for reduced stress as per Table 4 of IS: 6533 (Part 2). The expected temperature of steel components shall not be allowed to exceed 400deg.C.

5.2 STEEL GRADE

Structural steel shall be of yield stress of 250 MPa conforming to Grade A of IS: 2062. Tubular steel shall conform to Yst 240 of IS: 1161. All Holding down Bolts (HD Bolts) or threaded rods for non-post tensioned applications shall be out of Mild Carbon Steel conforming to IS 2062 with $F_y = 250$ MPa.

5.3 FIREPROOFING OF STEEL STRUCTURES

Fire-proofing of steel structures, wherever required as per OISD-STD-164, shall be done for 2 hours fire rating.

5.4 DESIGN CRITERIA

STEEL STAIRCASE, LADDERS, HANDRAILS AND GRATINGS

- Steel staircases for main approaches to operating platforms shall have channels provided as stringers with minimum clear width of 750mm and slope of app.41 degree. The vertical height between successive landings shall not be less than 2.6m nor exceed 4.0meters. Treads shall be minimum 230mm wide made of grating (with suitable nosing) spaced equally so as to restrict the rise to maximum 200mm. The minimum width of concrete staircase for control rooms/switch houses etc. shall be 1000mm.
- All handrails, staircase steps and platform gratings shall be hot dip galvanized as per specs/IS Codes.
- Ladders shall be provided with safety cages when the top of the ladder is more than 3.0 m above the landing level. Safety cages shall start 2.1 meter above the lower landing level. Ladders shall be of 450mm clear width with 20mm diameter MS rungs spaced at 300mm (maximum). Ladders shall preferably be vertical.
- Handrails, 1000mm high, shall be provided to all walkways, platforms, and staircases. Toe plate (100mmx5mm) shall be provided for all hand railing (except for staircases). Spacing of uprights shall be 1500mm

**PACKAGE SPECIFICATION FOR CIVIL AND
STRUCTURAL WORKS**

(maximum).

- e) Types of hand railing shall be provided as under:
 - f) i. For walkways, platforms (except platform supported on vessels) and staircases: Top rail, mid rail and upright shall be 32 (M) NB MS tubes.
 - g) ii. For platforms supported on vessels: Top rail shall be 32 (M) NB MS tubes but mid rail (flat 50x6) and upright (angle 50x50x6) shall be of structural steel.
- h) All M.S. Tubes and fittings for handrail shall confirm to IS 1239.
- i) MS Gratings shall be Electro-forged/Weld forged/welded, hot dip galvanized and minimum 25 mm deep. The maximum size of voids in the grating shall be limited to 30mm x 100mm. The minimum weld length shall be as per IS: 816.
- j) Galvanization shall be done in accordance with IS: 2629 and tested as per IS: 2633 and IS: 6745. Quantity of zinc coating shall be minimum 610 g/m² of surface area.

SKIDS AND BASE FRAMES

Following design considerations shall be taken into account for pre-fabricated structures including power skids:

- a) External forces acting on the pre-assembly and its components due to transportation, shipping and lifting shall be derived by Transportation and Heavy Lift Contractor. The final design shall take into account all stresses included in the pre-assembly frame due to these forces. Increased section sizes or additional temporary members and bracing are to be included as necessary. Design of base steelwork for pre-assemblies will normally depend on the magnitude of transportation, shipping and lifting loads. Transportation and heavy lift philosophy shall be established prior to commencement of design.
- b) The primary members shall be adequately cross-braced to prevent flexing or distortion of preassembly during transportation, lifting and installation. Equipment mounted on preassemblies shall not be considered as bracing for the “in-place condition”. The pre-assembly and equipment support

**PACKAGE SPECIFICATION FOR CIVIL AND
STRUCTURAL WORKS**

shall be designed to withstand transportation load acceleration.

- c) Worst state cases shall be used in the absence of firm data from Transportation and Heavy Lift Contractor. When definitive data becomes available it shall be checked against the factors used.
- d) Equipment shall be arranged, as nearly as practicable, such that the centre of gravity of the assembly lines up with the physical centre of the skid. The offset shall be dimensioned and the lifting lugs shall be positioned such that the lifting is leveled.
- e) The skid base shall be designed as all welded units to sound structural engineering principles.
- f) The skid base shall comprise at least 3 equally spaced primary beams adequately cross braced to prevent flexing or distortion of the skid during transport and installation.
- g) Equipment mounted on the skid shall not contribute to the structural strength of the skid.
- h) Each skid shall further be capable of being winched onto a flat transporter without skid
- i) Distortion or damage to equipment.
- j) Suitably designed pad type lifting lugs or other approved lifting arrangements shall be provided to facilitate loading and unloading of each fully assembled skid. If required by the designed method of lifting, one spreader bar in total shall be provided for each size of skid, to allow single point pick-up. Lifting lugs shall be designed for double the anticipated loads OR in other words, a dynamic amplification factor of 2.0 shall be considered for the design of lifting lugs and main beams.
- k) Steelwork shall be designed to be suitable for supporting all items of equipment. Floor grating or chequered plates shall not be used as a mounting for equipment or for supports.
- l) Metal thickness at points of equipment or support bolting shall be not less than 10 mm.

Piping Design Basis

1 SCOPE

This design basis briefly covers the basic requirements for the design of piping systems. These shall be adhered by MPC contractor(s) or his sub-contractor(s) or skid package suppliers during the course of engineering & construction.

2 DESIGN PHILOSOPHY / CRITERIA**2.1 Equipment Layout**

a) Equipment layout shall be developed based on the following data:

- P&IDs.
- Overall Plot Plan.
- Plant North, true North and Wind direction.
- Equipment Data Sheets.
- Process Flow

b) The following aspects shall be considered during development of equipment layout:

- All Skids are modularized type except Storage Tanks.
- Process Requirement - i.e. proper interconnection between equipment as per P&IDs to achieve the intended process parameters.
- Economy of piping material- Minimize the quantity of piping.
- Erection & Construction requirement -Erection scheme and schedule of all equipment must be considered during equipment layout to have smooth erection, approach road for cranes / derrick etc.
- Safety Requirements-As a minimum, OMR-2017 & 'OISD Std. 118' shall be followed.
- Firefighting facilities shall be provided as per 'OISD' & 'NFPA' norms.
- Constructability, Operation and Maintenance Requirement:
 - Overhead and side clearances for individual equipments
 - Horizontal & overhead clearances for easy movement of working Personnel
 - Provision of Mobile crane access
 - Provision for Laydown area
 - Provision of operator's cabin

PIPING DESIGN BASIS**2.2 Piping Layout**

- a) Piping shall be grouped as far as possible for the ease of supports.
- b) Column / vessel platforms should be designed in such a way so that all the nozzles should be approachable from platforms.
- c) Pump discharge check valve if installed in vertical lines shall be fitted with a drain connection as close as possible downstream of the valve.
- d) All valves shall be located at operable height.
- e) Pockets in the flare header and blow down system shall be prohibited.
- f) Relief valve discharge piping shall be taken to safe location as per OISD requirements.
- g) Low point drain and High point Vents shall be provided as required for the system.

3 CLEARANCES & ACCESSIBILITY**3.1 Vertical and Horizontal Clearance**

- h) Over head clearance shall be maintained to 2.2 m.
- i) Horizontal clearance around equipments and walkway shall be around 900mm.

3.2 Platforms with ladder access shall be provided for

- a) Items that require occasional operating access including valves, spectacle blind
- b) And motor operated valves, heater stack sampling points.
- c) Man ways above grade on equipment.

3.3 Ladder Location

- a) Wherever practicable, ladder shall be so arranged that users face equipment or platform rather than facing open space.
- b) Landings shall be staggered. No ladder shall be more than 6M in one flight.
- c) Platforms, ladders & stairways shall be consistent with access & safety requirements.

3.4 Material Handling

- a) Material handling access shall be provided for each maintenance item of the rotating equipments, valves etc.
- b) Mobile Crane access shall be considered for Layout design.

4 SPECIFICATION FOR DELIVERABLES

4.1 General

- a) 3D model 'STEP file' for Critical equipments such as Engine, Pump, etc. shall be provided by MPC Contractor. The 3D model file shall match with the dimensions of the specific Equipment Model supplied for the project. EPCM shall prepare the 3D Modeling based on the provided documents.
- b) All dimensions and sizes shall be in SI units (mm) with the exception of line sizes (NPS), which shall be indicated in inches.

4.2 Quality Control

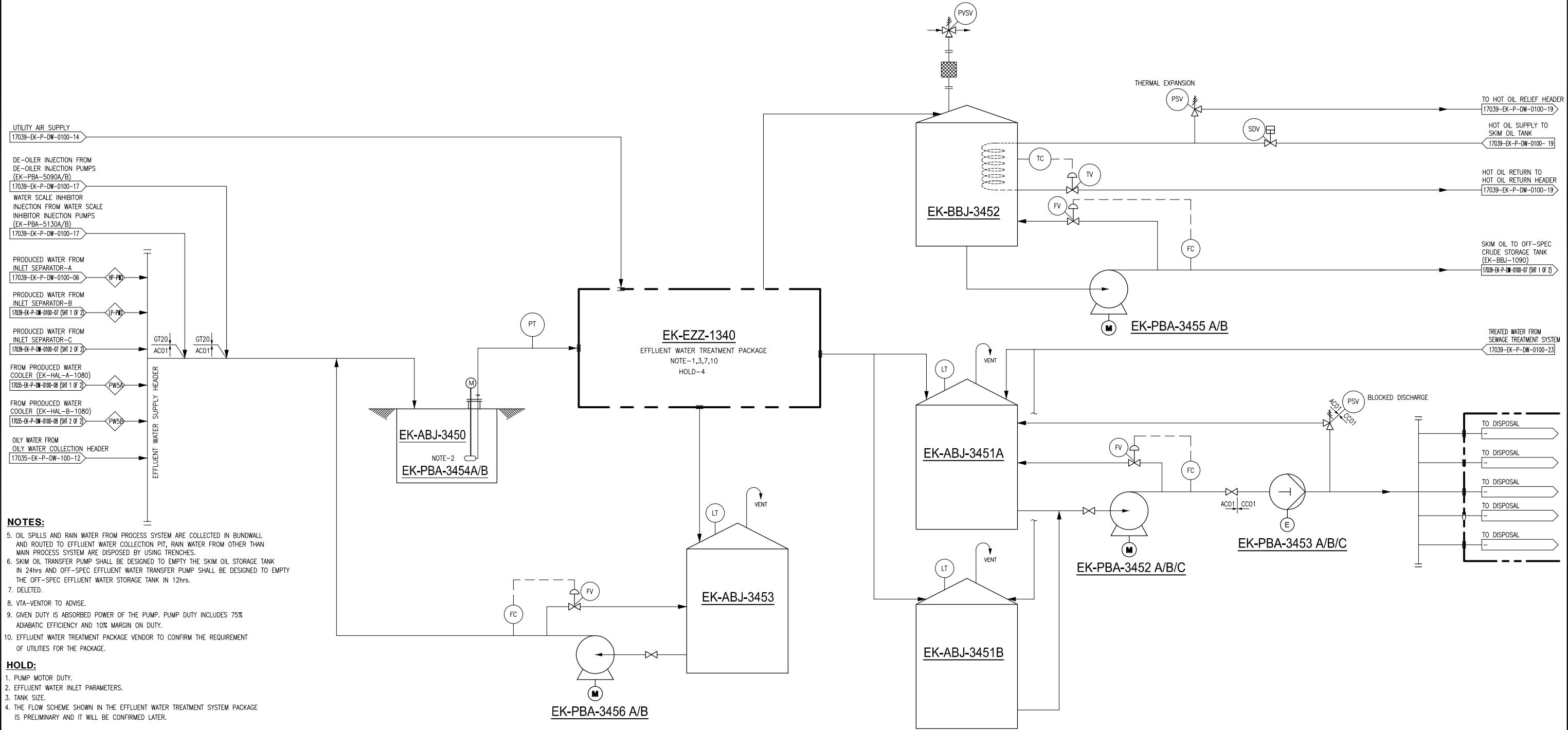
- a) EPCM CONSULTANT and/or its representative reserves the right to audit the progress, quality and work in general at any time to assure that they are in accordance with the specifications and within schedule.

4.3 2D CAD

- a) CAD drawings shall be generated using a version of AutoCAD 2016. Other computer aided drafting programs may be used with EPCM CONSULTANT approval
- b) Drawings shall be generated using the standard EPCM CONSULTANT layers and font sizes. Line type and colors will be layer dependent. EPCM CONSULTANT approval shall be obtained for any deviation from these standards.

Section - III
Annexure

TAG NUMBER		EK-EZZ-1340	EK-ABJ-3451A/B	EK-ABJ-3450	EK-BBJ-3452	EK-ABJ-3453	TAG NUMBER	EK-PBA-3452A/B/C	EK-PBA-3453A/B/C	EK-PBA-3454A/B	EK-PBA-3455A/B	EK-PBA-3456A/B
DESCRIPTION		EFFLUENT WATER TREATMENT PACKAGE (1x100%)	CLARIFIED WATER STORAGE TANK (2x50%)	EFFLUENT WATER STORAGE TANK	SKIM OIL TANK	OFF-SPEC EFFLUENT WATER STORAGE TANK	DESCRIPTION	CLARIFIED WATER BOOSTER PUMPS (3x50%)	CLARIFIED WATER DISPOSAL PUMPS (3x50%)	EFFLUENT WATER TRANSFER PUMP (2x100%)	SKIM OIL TRANSFER PUMPS (2x100%)	OFF-SPEC EFFLUENT WATER TRANSFER PUMPS (2x100%)
TYPE		—	VERTICAL CONE ROOF	RECTANGULAR (UNDERGROUND)	VERTICAL CONE ROOF ATMOSPHERIC	VERTICAL CONE ROOF	TYPE	CENTRIFUGAL	RECIPROCATING, GAS ENGINE DRIVEN TYPE	CENTRIFUGAL,VERTICAL	CENTRIFUGAL	CENTRIFUGAL
SERVICE		EFFLUENT WATER	CLARIFIED WATER	EFFLUENT WATER	SKIM OIL	OFF-SPEC EFFLUENT WATER	SERVICE	CLARIFIED WATER	CLARIFIED WATER	EFFLUENT WATER	SKIM OIL	OFF-SPEC EFFLUENT WATER
PRESSURE	DESIGN kg/cm² g	VTA	FOW+0.07 kg/cm²	FOW+0.07 kg/cm²	FOW+0.07 kg/cm²	FOW+0.07 kg/cm²	DESIGN PRESSURE kg/cm² g	15	80	10	10	10
	OPERATING kg/cm² g	VTA	ATM	ATM	ATM	ATM	DESIGN TEMPERATURE °C	85	85	85	90	85
TEMPERATURE	DESIGN °C	85	85	85	90	85	OPERATING TEMPERATURE °C	51	51	51	55	51
	OPERATING °C	51	51	51	55	51	DISCHARGE PRESSURE kg/cm² g	10	70.3	5	5	5
DESIGN CAPACITY m³/hr/KLPD		46/1108	554 kL	1108 kL	150 kL	554 kL	DIFFERENTIAL PRESSURE kg/cm²	10	60.3	5	5	5
DIMENSION mm		VTA	8100 (I/D) x 12000(H) (HOLD-3)	20000 (L) x 18000(W) x 4000(H) (HOLD-3)	5500 (I/D) x 8000(H) (HOLD-3)	8450 (I/D) x 12600(H) (HOLD-3)	DESIGN CAPACITY m³/hr/KLPD	46/1108 (EACH)	46/1108 (EACH)	46/1108	150	46/1108
DESIGN CODE		VTA	ROARKS FORMULAE	—	API 650, OISD 108	ROARKS FORMULAE	ABSORBED POWER kW	18.5 (NOTE-9)	113.5 (NOTE-9) (EACH)	9.23 (NOTE-9)	1.25 (NOTE-6)	9.23 (NOTE-6)
MATERIAL OF CONSTRUCTION		VTA	CS +3mm CA	RCC	CS +3mm CA; HEATING COIL: SS316	CS +3mm CA	MOTOR DUTY kW	—	—	11 (HOLD-1)	— (HOLD-1)	— (HOLD-1)
							DESIGN CODE	API-610	API-674	API-610	API-610	API-610
							MATERIAL OF CONSTRUCTION	CASING : CS +3mm CA, INTERNAL: SS316	CASING : CS +3mm CA, INTERNAL: SS316	CASING : CS +3mm CA, INTERNAL: SS316	CASING : CS +3mm CA, INTERNAL: SS316	CASING : CS +3mm CA, INTERNAL: SS316



NOTES:

1. EFFLUENT WATER TREATMENT PACKAGE VENDOR TO FINALIZE THE FLOW SCHEME WITH IN THE PACKAGE AS PER INLET EFFLUENT WATER AND OUTLET TREATED WATER SPECIFICATION.

2. EFFLUENT WATER TREATMENT PACKAGE INLET PARAMETERS:- (HOLD-2)

OIL IN WATER	10000 PPM
PH	7-9
TSS	100 PPM
TURBIDITY	100-180 NTU
COD	180-1400 PPM
BOD	80-135 PPM
DISSOLVED OXYGEN	UPTO 6 PPM
SRB	10 ⁴ TO 10 ⁶ CFU/ML
ANY OTHER BACTERIAL ACTIVITY	NOT MEASURED

3. AS PER ASSAM STATE POLLUTION CONTROL BOARD, EFFLUENT WATER DISCHARGE SHALL MEET THE BELOW AS MINIMUM.

(i) OIL IN WATER < 10 PPM

(ii) SLUDGE CONTENT – NIL

(iii) OUTLET TEMPERATURE – 51°C

(iv) pH – 6.5 TO 8.5

(v) TSS – 98% REMOVAL OF SUSPENDED SOLIDS > 10 MICRONS.

(vi) DISSOLVED OXYGEN < 0.2 ppm.

(vii) BACTERIAL ACTIVITY LIKE SRB, GAB, IRB&APB – NIL.

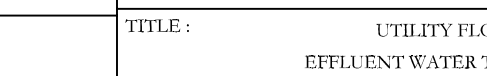
4. EFFLUENT WATER TREATMENT PACKAGE SHALL BE DESIGNED ON THE PHILOSOPHY OF ZERO DISCHARGE FROM THE INSTALLATION WITH NIL SLUDGE.

B	14 FEB 18	ISSUED FOR BID	DAM	PSN/TKV/MSB/MSR
A	28 NOV 17	ISSUED FOR REVIEW	DAM	PSN/TKV/MSB/MSR
REV	DATE	DESCRIPTION	DRAWN	CHK. APPR.

COMPANY:



EPCM CONSULTANT :



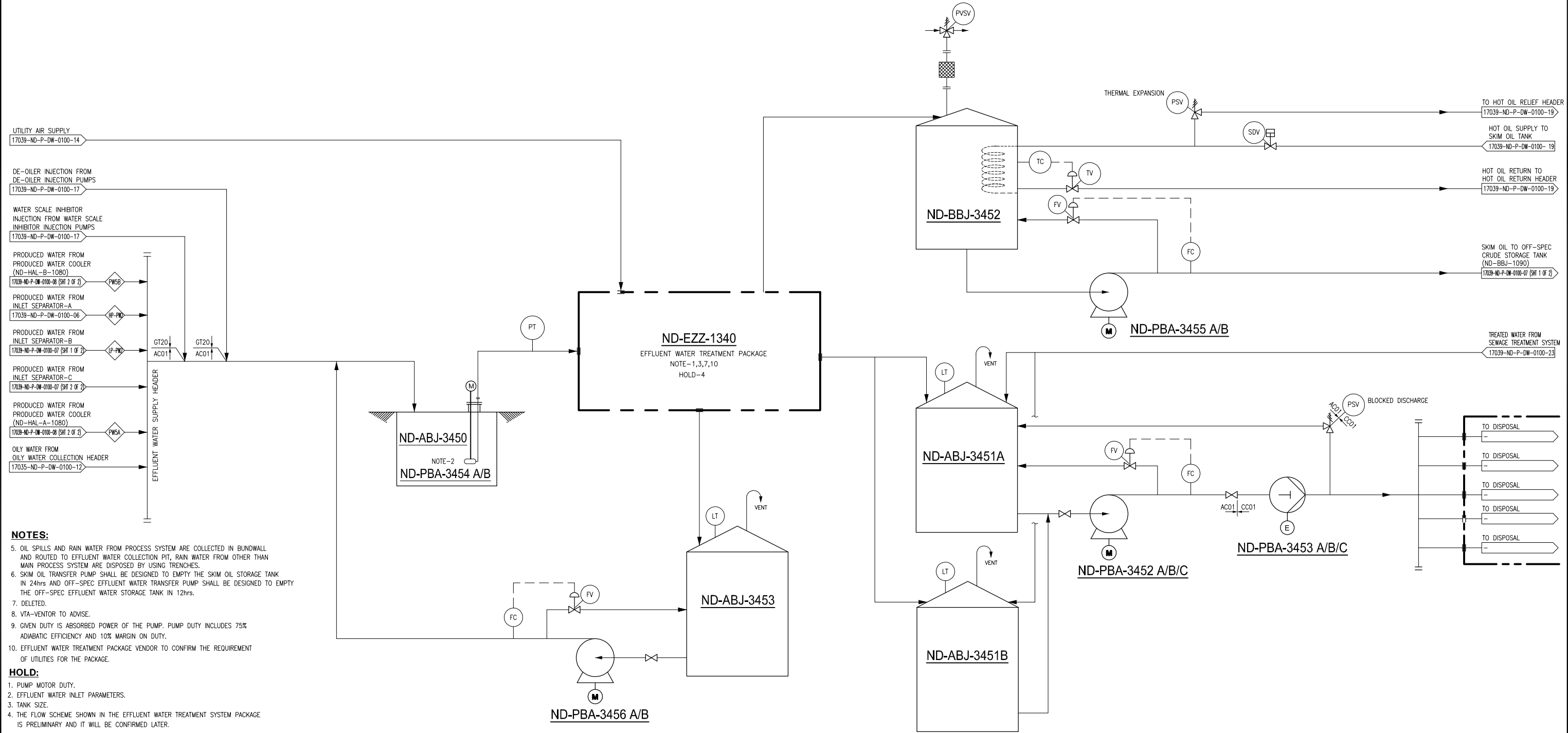
PROJECT : CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN

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TITLE : UTILITY FLOW DIAGRAM
EFFLUENT WATER TREATMENT SYSTEM

PROJECT NO.: KIP-17039	PROJECT SITE:	EAST KHAGORIJAN
DRAWING NO.: 17039-EK-P-DW-0100-11	REV: B	SHEET : 1 OF 1
		SCALE : NTS

TAG NUMBER		ND-EZZ-1340	ND-ABJ-3451A/B	ND-ABJ-3450	ND-BBJ-3452	ND-ABJ-3453	TAG NUMBER	ND-PBA-3452A/B/C	ND-PBA-3453A/B/C	ND-PBA-3454A/B	ND-PBA-3455A/B	ND-PBA-3456A/B
DESCRIPTION		EFFLUENT WATER TREATMENT PACKAGE (1x100%)	CLARIFIED WATER STORAGE TANK (2x50%)	EFFLUENT WATER STORAGE TANK	SKIM OIL TANK	OFF-SPEC EFFLUENT WATER STORAGE TANK	DESCRIPTION	CLARIFIED WATER BOOSTER PUMPS (3x50%)	CLARIFIED WATER DISPOSAL PUMPS (3x50%)	EFFLUENT WATER TRANSFER PUMP (2x100%)	SKIM OIL TRANSFER PUMPS (2x100%)	OFF-SPEC EFFLUENT WATER TRANSFER PUMPS (2x100%)
TYPE		—	VERTICAL CONE ROOF	RECTANGULAR (UNDER GROUND)	VERTICAL CONE ROOF, ATMOSPHERIC	VERTICAL CONE ROOF	TYPE	CENTRIFUGAL	RECIPROCATING GAS ENGINE DRIVEN TYPE	CENTRIFUGAL, VERTICAL	CENTRIFUGAL	CENTRIFUGAL
SERVICE		EFFLUENT WATER	CLARIFIED WATER	EFFLUENT WATER	SKIM OIL	OFF-SPEC EFFLUENT WATER	SERVICE	CLARIFIED WATER	CLARIFIED WATER	EFFLUENT WATER	SKIM OIL	OFF-SPEC EFFLUENT WATER
PRESSURE	DESIGN kg/cm² g	VTA	FOW + 0.07 kg/cm²	FOW + 0.07 kg/cm²	FOW + 0.07 kg/cm²	FOW + 0.07 kg/cm²	DESIGN PRESSURE kg/cm² g	15	80	10	10	10
	OPERATING kg/cm² g	VTA	ATM	ATM	ATM	ATM	DESIGN TEMPERATURE °C	85	85	85	90	85
TEMPERATURE	DESIGN °C	85	85	85	90	85	OPERATING TEMPERATURE °C	51	51	51	55	51
	OPERATING °C	51	51	51	55	51	DISCHARGE PRESSURE kg/cm² g	10	70.3	5	5	5
DESIGN CAPACITY m³/hr/KLPD		46/1108	23/554 kL	46/1108 kL	150 kL	554 kL	DIFFERENTIAL PRESSURE kg/cm²	10	60.3	5	5	5
DIMENSION mm		VTA	8100 (I/D) x 12000(H) (HOLD-3)	20000 (L) x 18000(W) x 4000(H) (HOLD-3)	5500 (I/D) x 8000(H) (HOLD-3)	8450 (I/D) x 12600 (H) (HOLD-3)	DESIGN CAPACITY m³/hr/KLPD	46/1108 (EACH)	46/1108 (EACH)	46/1108	150	46/1108
DESIGN CODE		VTA	ROARKS FORMULAE	—	API 650 OISD 108	ROARKS FORMULAE	ABSORBED POWER kW	18.5 (NOTE-9)	113.5 (NOTE-9) (EACH)	9.23 (NOTE-9)	1.25 (NOTE-6)	9.23 (NOTE-6)
MATERIAL OF CONSTRUCTION		VTA	CS +3mm CA	RCC	CS +3mm CA, HEATING COIL: SS316	CS +3mm CA	MOTOR DUTY kW	—	—	11 (HOLD-1)	(HOLD-1)	(HOLD-1)
							DESIGN CODE	API-610	API-674	API-610	API-610	API-610
							MATERIAL OF CONSTRUCTION	CASING : CS +3mm CA, INTERNAL: SS316	CASING : CS +3mm CA, INTERNAL: SS316	CASING : CS +3mm CA, INTERNAL: SS316	CASING : CS +3mm CA, INTERNAL: SS316	CASING : CS +3mm CA, INTERNAL: SS316



NOTES:

1. EFFLUENT WATER TREATMENT PACKAGE VENDOR TO FINALIZE THE FLOW SCHEME WITH IN THE PACKAGE AS PER INLET EFFLUENT WATER AND OUTLET TREATED WATER SPECIFICATION.

2. EFFLUENT WATER TREATMENT PACKAGE INLET PARAMETERS:- (HOLD-2)

OIL IN WATER	10000 PPM
PH	7-9
TSS	100 PPM
TURBIDITY	100-180 NTU
COD	180-1400 PPM
BOD	80-135 PPM
DISSOLVED OXYGEN	UPTO 6 PPM
SRB	10 ⁴ TO 10 ¹⁰ CFU/ML
ANY OTHER BACTERIAL ACTIVITY	NOT MEASURED

3. AS PER ASSAM STATE POLLUTION CONTROL BOARD, EFFLUENT WATER DISCHARGE SHALL MEET THE BELOW AS MINIMUM,

(i) OIL IN WATER < 10 PPM

(ii) SLUDGE CONTENT – NIL

(iii) OUTLET TEMPERATURE – 51°C

(iv) pH – 6.5 TO 8.5

(v) TSS – 98% REMOVAL OF SUSPENDED SOLIDS > 10 MICRONS.

(vi) DISSOLVED OXYGEN < 0.2 ppm.

(vii) BACTERIAL ACTIVITY LIKE SRB, GAP, IRB&APB – NIL.

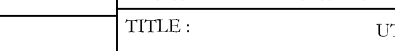
4. EFFLUENT WATER TREATMENT PACKAGE SHALL BE DESIGNED ON THE PHILOSOPHY OF ZERO DISCHARGE FROM THE INSTALLATION WITH NIL SLUDGE.

B	14 FEB 18	ISSUED FOR BID	DAM	PSN/TKV	MSB/MSR
A	24 NOV 17	ISSUED FOR REVIEW	DAM	PSN/TKV	MSB/MSR
REV	DATE	DESCRIPTION	DRAWN	CHK.	APPR.

COMPANY:



EPCM CONSULTANT :



PROJECT : CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN

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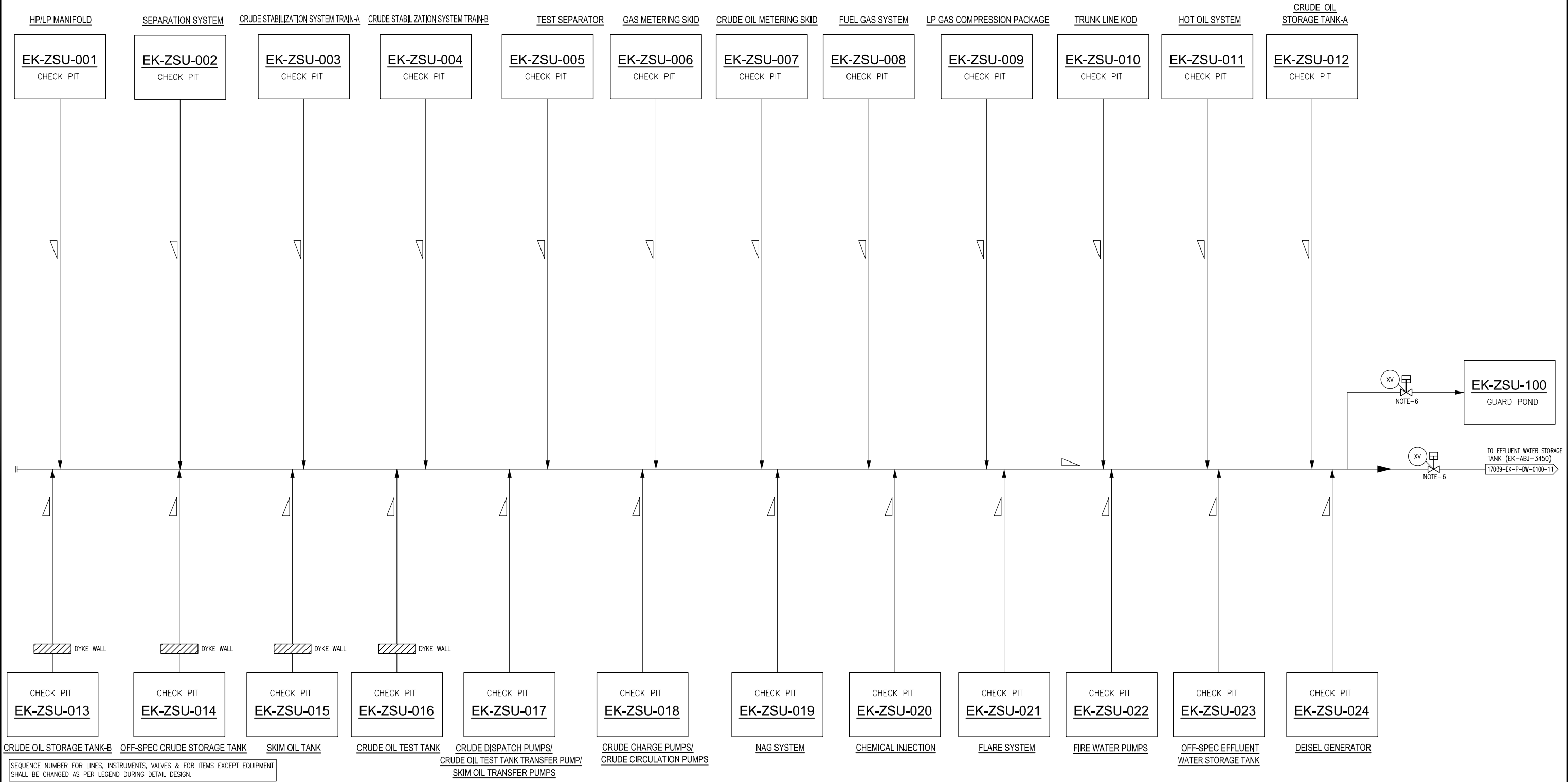
TITLE : UTILITY FLOW DIAGRAM
EFFLUENT WATER TREATMENT SYSTEM

PROJECT NO.: KIP-17039	PROJECT SITE:	NADUA
DRAWING NO.: 17039-ND-P-DW-0100-11	REV: B	SHEET : 1 OF 1
		SCALE : NTS

TAG NUMBER		EK-ZSU-001 to 024	EK-ZSU-100
DESCRIPTION		CHECK PIT	GUARD POND
TYPE		UNDER GROUND PIT	UNDER GROUND PIT
SERVICE		OILY WATER / STORM WATER	STORM WATER
PRESSURE	DESIGN kg/cm ² g	FOW	FOW
	OPERATING kg/cm ² g	ATM + LIQUID HEAD	ATM + LIQUID HEAD
TEMPERATURE	DESIGN °C	80	80
	OPERATING °C	AMB	AMB
DESIGN CAPACITY		NOTE-3	–
DIMENSION		(NOTE-5)	27500 (L) x 25000 (W) x 4000 (D) (HOLD-1)
DESIGN CODE		–	–
MATERIAL OF CONSTRUCTION		RCC WITH EPOXY INNER	RCC WITH EPOXY INNER

TABLE-1 CHECK PIT SIZES:

CHECK PIT TAG NO.	DIMENSION mm (L x W x D) (HOLD-2)
EK-ZSU-003, 004, 005, 006, 007, 008, 010, 020, 024	100 x 700 x 1000
EK-ZSU-002, 001, 009, 018, 021, 022, 023, 019	200 x 700 x 1000
EK-ZSU-011, 015, 016, 017	300 x 700 x 1000
EK-ZSU-012, 013, 014	700 x 700 x 1000

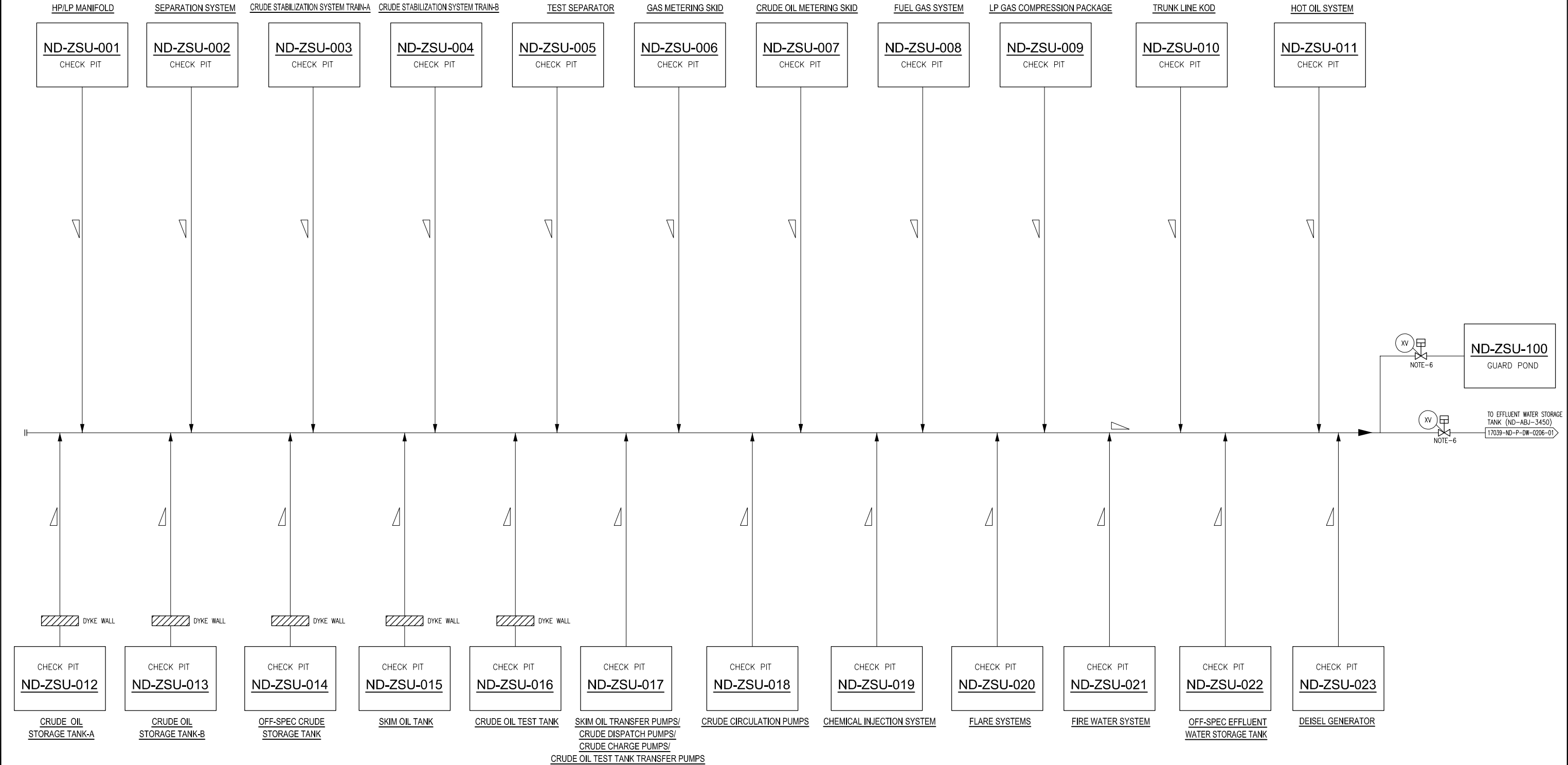


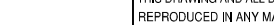
NOTES: 1. OILY CONTAMINATED WATER/OTHER SPILLAGES FROM OIL STORAGE TANK AND OTHER PROCESS AREAS SHALL BE ROUTED VIA PIPE. DURING RAINY SEASON, FIRST 15 MINUTES OF RAIN WATER FROM OIL CONTAMINATED AREA SHALL BE ROUTED TO EFFLUENT TREATMENT PACKAGE VIA PIPES, AFTER 15 MINUTES THE WATER SHALL BE ROUTED TO GUARD POND. 2. DELETED. 3. CHECK PIT IS SIZED FOR MINIMUM OF 0.5min RESIDENCE TIME. 4. ALL PIPE SHALL HAVE MINIMUM SLOPE OF 1:100. 5. REFER TABLE-1 FOR CHECK PIT SIZES.	6. OILY WATER FROM OILY WATER COLLECTION PIT SHALL BE ROUTED TO EFFLUENT WATER STORAGE TANK FOR FIRST 15 MINUTES VIA XV (OPERATED MANUALLY FROM DCS) AND EXCESS RAIN WATER AFTER 15 MINUTES SHALL BE DIVERTED TO GUARD POND VIA XV (OPERATED MANUALLY FROM DCS).																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															

TAG NUMBER		ND-ZSU-001 to 023	ND-ZSU-100
DESCRIPTION		CHECK PIT	GUARD POND
TYPE		UNDER GROUND PIT	UNDER GROUND PIT
SERVICE		OILY WATER / STORM WATER	STORM WATER
PRESSURE	DESIGN kg/cm ² g	FOW	FOW
	OPERATING kg/cm ² g	ATM + LIQUID HEAD	ATM + LIQUID HEAD
TEMPERATURE	DESIGN °C	80	80
	OPERATING °C	AMB	AMB
DESIGN CAPACITY		NOTE-3	–
DIMENSION		NOTE-5	26000 (L) x 25000 (W) x 4000 (D) (HOLD-1)
DESIGN CODE		–	–
MATERIAL OF CONSTRUCTION		RCC WITH EPOXY INNER	RCC WITH EPOXY INNER

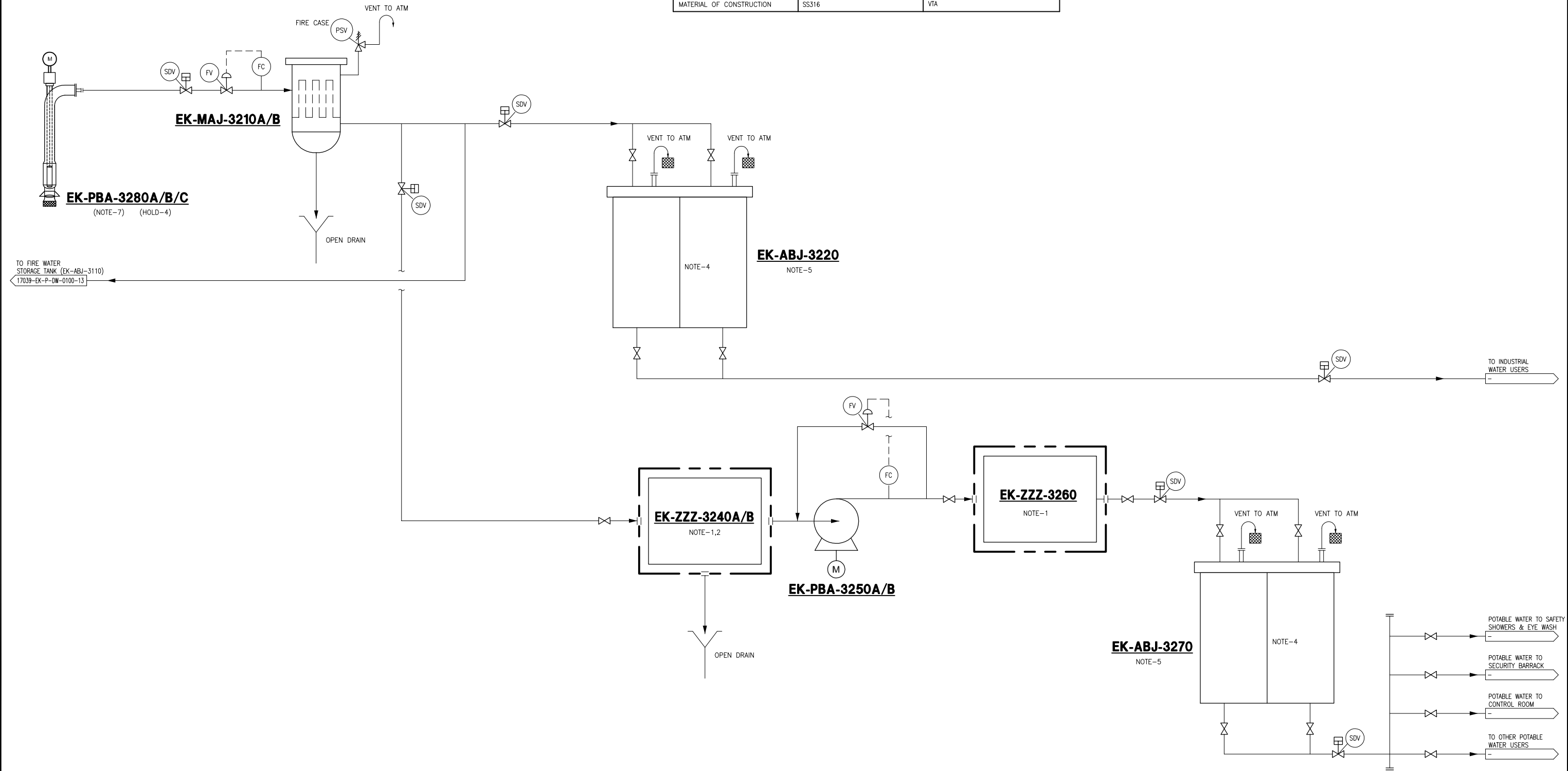
TABLE-1 CHECK PIT SIZES:

CHECK PIT TAG NO.	DIMENSION mm (L x W x D) (HOLD-2)
ND-ZSU-003, 004, 005, 006, 007, 008, 010, 018, 019, 023	100 x 700 x 1000
ND-ZSU-002, 009, 020, 021	200 x 700 x 1000
ND-ZSU-001, 011, 015, 016	300 x 700 x 1000
ND-ZSU-017	400 x 700 x 1000
ND-ZSU-012, 013, 014	700 x 700 x 1000



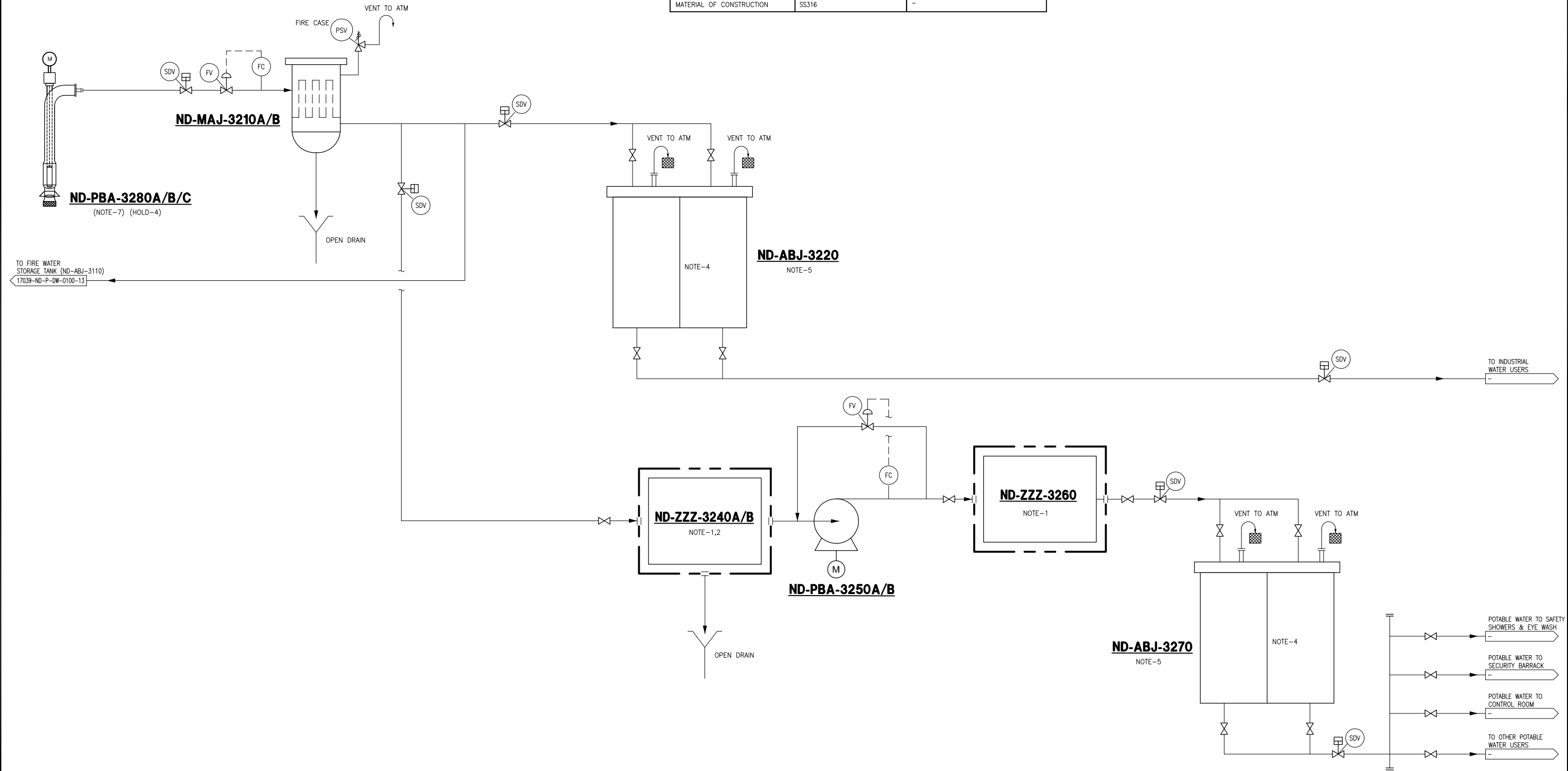
NOTES: 1. OILY CONTAMINATED WATER/OTHER SPILLAGES FROM OIL STORAGE TANK AND OTHER PROCESS AREAS SHALL BE ROUTED VIA PIPE. DURING RAINY SEASON, FIRST 15 MINUTES OF RAIN WATER FROM OIL CONTAMINATED AREA SHALL BE ROUTED TO EFFLUENT TREATMENT PACKAGE VIA PIPES, AFTER 15 MINUTES THE WATER SHALL BE ROUTED TO GUARD POND. 2. DELETED. 3. CHECK PIT IS SIZED FOR MINIMUM OF 0.5min RESIDENCE TIME. 4. ALL PIPE SHALL HAVE MINIMUM SLOPE OF 1:100. 5. REFER TABLE-1 FOR CHECK PIT SIZES.	6. OILY WATER FROM OILY WATER COLLECTION PIT SHALL BE ROUTED TO EFFLUENT WATER STORAGE TANK FOR FIRST 15 MINUTES VIA XV (OPERATED MANUALLY FROM DCS) AND EXCESS RAIN WATER AFTER 15 MINUTES SHALL BE DIVERTED TO GUARD POND VIA XV (OPERATED MANUALLY FROM DCS).						COMPANY: Oil India Limited EPCM CONSULTANT : KAVIN™						PROJECT : CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN					
	HOLD: 1. GUARD POND SIZE. 2. CHECK PIT SIZE.												THIS DRAWING AND ALL DESIGN DETAILS AND DATA SHOWN HEREON, IS THE SOLE PROPERTY OF OIL INDIA LTD AND SHALL NOT BE REPRODUCED IN ANY MANNER OR USED FOR ANY PURPOSE WHATSOEVER, EXCEPT BY WRITTEN PERMISSION OF OIL INDIA LTD.					
													TITLE : UTILITY FLOW DIAGRAM OILY WATER COLLECTION SYSTEM					
													PROJECT NO.: KIP-17039					
													DRAWING NO.: 17039-ND-P-DW-0100-12					
							PROJECT SITE: NADUA											
							REV: B											
							SHEET : 1 OF 1											
							SCALE : NTS											

TAG NUMBER		EK-MAJ-3210 A/B	EK-ABJ-3220	EK-ZZZ-3240 A/B	EK-ZZZ-3260	EK-ABJ-3270	TAG NUMBER		EK-PBA-3250 A/B	EK-PBA-3280 A/B/C
DESCRIPTION		IRON REMOVAL FILTER (2x100%)	INDUSTRIAL WATER STORAGE TANK	RO WATER MAKER (2x100%)	UV STERILIZER UNIT	POTABLE WATER STORAGE TANK	DESCRIPTION		POTABLE WATER PUMP (2x100%)	DEEP WELL PUMPS (3x50%)
TYPE		VERTICAL, CARTRIDGE	ATMOSPHERIC TANK	REVERSE OSMOSIS	MEMBRANE	ATMOSPHERIC TANK	TYPE		CENTRIFUGAL	CENTRIFUGAL, SUBMERSIBLE
SERVICE		WATER	WATER	WATER	WATER	WATER	SERVICE		WATER	RAW WATER
PRESSURE	DESIGN kg/cm ² g	10/FV (HOLD-3)	FOW+0.07 kg/cm ²	10/FV (HOLD-3)	10	FOW+0.07 kg/cm ²	DESIGN PRESSURE kg/cm ² g	10	6 (HOLD-3)	
	OPERATING kg/cm ² g	6 (HOLD-3)	ATM	5.8 (HOLD-3)	4	ATM		80	VTA	
TEMPERATURE	DESIGN °C	80	80	80	80	80	OPERATING TEMPERATURE °C	AMB	VTA	
	OPERATING °C	AMB	AMB	AMB	AMB	AMB		4	VTA	
DESIGN CAPACITY (MMSCMD/KLPD)		~ /840 (NOTE-8)	~ /50 KL (NOTE-8)	~ /840	~ /210	~ /66 kL NOTE-3	DISCHARGE PRESSURE kg/cm ² g		4	VTA
							DIFFERENTIAL PRESSURE kg/cm ²		4	VTA
DIMENSION mm		219 (O/D) x 1226 (S/F) (HOLD-2)	3700 (I/D) x 6000 (H) (HOLD-2)	-	-	4200 (I/D) x 6000 (H) (HOLD-2)	DESIGN CAPACITY KLPD		210	432 (EACH) (HOLD-4)
DUTY kW		-	-	-	-	-	MOTOR DUTY kW		1.43 (HOLD-1)	VTA
DESIGN CODE		ASME SEC.VIII DIV-1	ROARKS FORMULAE, FOR STRESS & STRAIN	-	-	ROARKS FORMULAE, FOR STRESS & STRAIN	ABSORBED POWER kW		3 (NOTE-6)	VTA
MATERIAL OF CONSTRUCTION		CS + 3mm CA	CS + 3mm CA	VTA	VTA	SS 316L	DESIGN CODE		API-610	VTA
							MATERIAL OF CONSTRUCTION		SS316	VTA



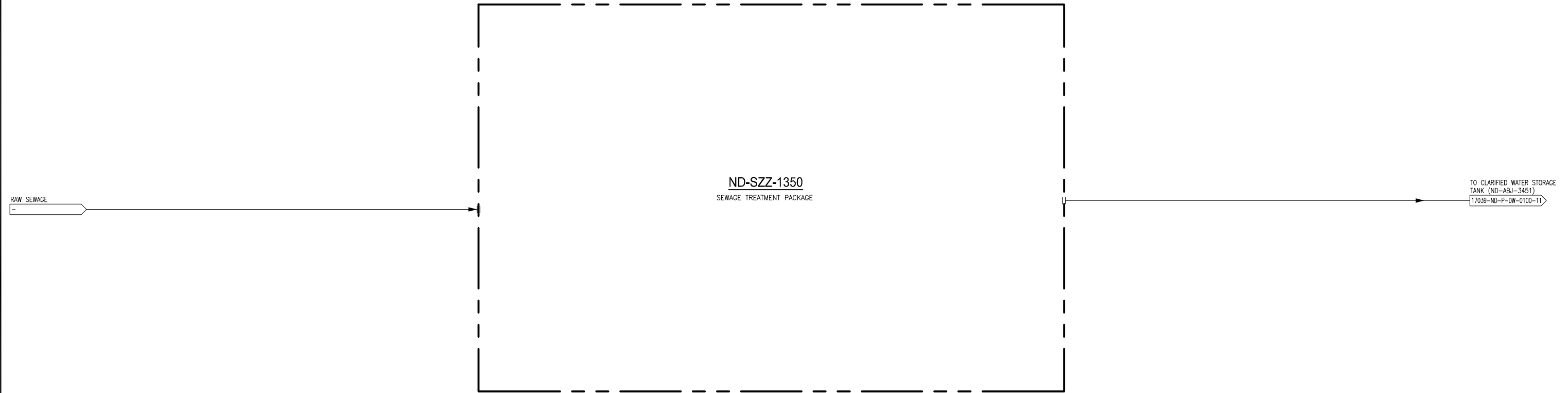
NOTES: 1. RO WATER MAKER, UV STERILIZER UNIT TO MEET "BIS 10500" STANDARD SPECIFICATIONS FOR POTABLE WATER. 2. RO WATER MAKER EFFICIENCY SHALL BE CONSIDERED AS 25% AND TO BE CONFIRMED BY VENDOR. 3. POTABLE WATER SYSTEM SHALL BE DESIGNED FOR THE CAPACITY OF 100 USGALLONS/PERSON/DAY FOR 50 PERSONS. 4. INDUSTRIAL AND POTABLE WATER STORAGE TANK HAVE TWO COMPARTMENTS OF EQUAL CAPACITY TO FACILITATE CLEANING AND REPAIRS. 5. POTABLE, INDUSTRIAL WATER DISTRIBUTION SHALL BE GRAVITY FLOW. HENCE THE INDUSTRIAL WATER, POTABLE WATER STORAGE TANK SHALL BE LOCATED AT THE ELEVATION ABOVE ALL USERS. MINIMUM SUPPLY PRESSURE AT THE LAST CONSUMER OF THE UNIT SHALL BE 1kg/cm ² g. HOLD: 1. MOTOR DUTY TO BE CONFIRMED. 2. EQUIPMENT SIZE, TANK SIZE TO BE CONFIRMED. 3. OPERATING AND DESIGN PRESSURE IS PRELIMINARY AND WILL BE CONFIRMED LATER. 4. CAPACITY OF ONE BOREWELL AND NUMBER OF BOREWELL TO BE CONFIRMED DURING DETAIL DESIGN.	6. PUMP DUTY INCLUDES 10% MARGIN WITH 75% ADIABATIC EFFICIENCY. 7. MINIMUM RAW WATER REQUIRED FOR CONTINUOUS OPERATION IS 36m ³ /hr FROM BORE WELL THE FIRE WATER TANKS WILL BE FILLED IN APPROX 24hrs. 8. INDUSTRIAL WATER STORAGE TANK WILL BE FILLED IN 1hrs 25 mins AND THE FILTER IS DESIGNED FOR 36 m ³ /hr.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	

TAG NUMBER		ND-MAJ-3210 A/B	ND-ABJ-3220	ND-ZZZ-3240 A/B	ND-ZZZ-3260	ND-ABJ-3270	TAG NUMBER	ND-PBA-3250 A/B	ND-PBA-3280 A/B/C (HOLD-3)
DESCRIPTION		IRON REMOVAL FILTER (2x100%)	INDUSTRIAL WATER STORAGE TANK	RO WATER MAKER (2x100%)	UV STERILIZER UNIT	POTABLE WATER STORAGE TANK	DESCRIPTION	POTABLE WATER PUMP (2x100%)	DEEP WELL PUMPS (3x50%)
TYPE		VERTICAL, CARTRIDGE	ATMOSPHERIC TANK	REVERSE OSMOSIS	MEMBRANE	ATMOSPHERIC TANK	TYPE	CENTRIFUGAL	CENTRIFUGAL, SUBMERSIBLE
SERVICE		WATER	WATER	WATER	WATER	WATER	SERVICE	WATER	RAW WATER
PRESSURE	DESIGN kg/cm ² g	10/FV (HOLD-3)	FOW+0.07 kg/cm ²	10/FV (HOLD-3)	10	FOW+0.07 kg/cm ²	DESIGN PRESSURE kg/cm ² g	10	6 (HOLD-3)
	OPERATING kg/cm ² g	6 (HOLD-3)	ATM	5.8 (HOLD-3)	4	ATM	DESIGN TEMPERATURE °C	80	-
TEMPERATURE	DESIGN °C	80	80	80	80	80	OPERATING TEMPERATURE °C	AMB	-
	OPERATING °C	AMB	AMB	AMB	AMB	AMB	DISCHARGE PRESSURE kg/cm ² g	4	-
DESIGN CAPACITY (MMSCMD/KLPD)		-/840 (NOTE-8)	-/50 KL (NOTE-8)	-/840	-/210	-/66 KL NOTE-3	DIFFERENTIAL PRESSURE kg/cm ²	4	-
DIMENSION mm		219 (O/D) x 1226 (S/F) (HOLD-2)	3700 (I/D) x 6000 (H) (HOLD-2)	-	-	4200 (I/D) x 6000 (H) (HOLD-2)	DESIGN CAPACITY KLPD	210	432 (HOLD-4)
DUTY kW		-	-	-	-	-	MOTOR DUTY kW	1.43 (HOLD-1)	-
DESIGN CODE		ASME SEC.VIII DIV-1	ROARKS FORMULAE FOR STRESS AND STRAIN	-	-	ROARKS FORMULAE FOR STRESS AND STRAIN	ABSORBED POWER kW	3 (NOTE-6)	-
MATERIAL OF CONSTRUCTION		CS + 3mm CA	CS + 3mm CA	VTA	VTA	SS 316L	DESIGN CODE	API-610	-
VENT TO ATM							MATERIAL OF CONSTRUCTION	SS316	-



NOTES: 1. RO WATER MAKER, UV STERILIZER UNIT TO MEET "BIS 10500" STANDARD SPECIFICATIONS FOR POTABLE WATER. 2. RO WATER MAKER EFFICIENCY SHALL BE CONSIDERED AS 25% AND TO BE CONFIRMED BY VENDOR. 3. POTABLE WATER SYSTEM SHALL BE DESIGNED FOR THE CAPACITY OF 100 USGALLONS/PERSON/DAY FOR 50 PERSONS. 4. INDUSTRIAL AND POTABLE WATER STORAGE TANK HAVE TWO COMPARTMENTS OF EQUAL CAPACITY TO FACILITATE CLEANING AND REPAIRS. 5. POTABLE, INDUSTRIAL WATER DISTRIBUTION SHALL BE GRAVITY FLOW. HENCE THE INDUSTRIAL WATER, POTABLE WATER STORAGE TANK SHALL BE LOCATED AT THE ELEVATION ABOVE ALL USERS. MINIMUM SUPPLY PRESSURE AT THE LAST CONSUMER OF THE UNIT SHALL BE 1 $\text{kg/cm}^2\text{g}$.		6. PUMP DUTY INCLUDES 10% MARGIN WITH 75% ADIABATIC EFFICIENCY. 7. MINIMUM RAW WATER REQUIRED FOR CONTINUOUS OPERATION IS 36 m^3 /hr FROM BORE WELL. THE FIRE WATER TANKS WILL BE FILLED IN APPROX 24hrs. 8. INDUSTRIAL WATER STORAGE TANK WILL BE FILLED IN 1hrs 25min AND THE FILTER IS DESIGNED FOR 36 m^3 /hr.		HOLD: 1. MOTOR DUTY TO BE CONFIRMED. 2. EQUIPMENT SIZE, TANK SIZE TO BE CONFIRMED. 3. OPERATING AND DESIGN PRESSURE IS PRELIMINARY AND WILL BE CONFIRMED LATER. 4. CAPACITY OF ONE BOREWELL AND NUMBER OF BOREWELL TO BE CONFIRMED DURING DETAIL DESIGN.		COMPANY: 		PROJECT : CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN THIS DRAWING AND ALL DESIGN DETAILS AND DATA SHOWN HEREON, IS THE SOLE PROPERTY OF OIL INDIA LTD AND SHALL NOT BE REPRODUCED IN ANY MANNER OR USED FOR ANY PURPOSE WHATSOEVER, EXCEPT BY WRITTEN PERMISSION OF OIL INDIA LTD.	
						EPCM CONSULTANT : 		TITLE : UTILITY FLOW DIAGRAM RAW WATER SYSTEM	
REV		DATE	DESCRIPTION	DRAWN	CHK.	APPR.	PROJECT NO.: KIP-17039	PROJECT SITE:	NADUA
							DRAWING NO.: 17039-ND-P-DW-0100-18	REV: B	SHEET : 1 OF 1
									SCALE : NTS

TAG NUMBER		ND-SZZ-1350
DESCRIPTION		SEWAGE TREATMENT PACKAGE
TYPE		–
SERVICE		SEWAGE
PRESSURE	DESIGN $\text{kg/cm}^2 \text{ g}$	VTA
	OPERATING $\text{kg/cm}^2 \text{ g}$	VTA
TEMPERATURE	DESIGN $^{\circ}\text{C}$	VTA
	OPERATING $^{\circ}\text{C}$	VTA
DESIGN CAPACITY $\text{m}^3/\text{hr/KLPD}$		VTA
DIMENSION mm		VTA
DESIGN CODE		VTA
MATERIAL OF CONSTRUCTION		VTA



NOTES:
1. SEWAGE TREATMENT PACKAGE SHALL BE DESIGNED FOR 50 PERSONS.
2. SEWAGE TREATMENT SYSTEM TO BE DESIGNED AS PER THE PCB/CPCB NORMS.
3. EFFLUENT WATER OUTLET SPECIFICATION ARE
(i) OIL IN WATER < 10 ppm
(ii) SLUDGE CONTENT – NIL
(iii) OUTLET TEMPERATURE – 51°C
(iv) pH–6.5–8.5
(v) TSS–98% REMOVAL OF SUSPENDED SOLIDS > 10 MICRONS
(vi) DISSOLVED OXYGEN <0.2 ppm
(vii) SRB–NIL
(viii) ANY OTHER BACTERIAL ACTIVITY LIKE GAB, IRB & APB–NIL.
(IX) OIL AND GREASE –< 10mg/l

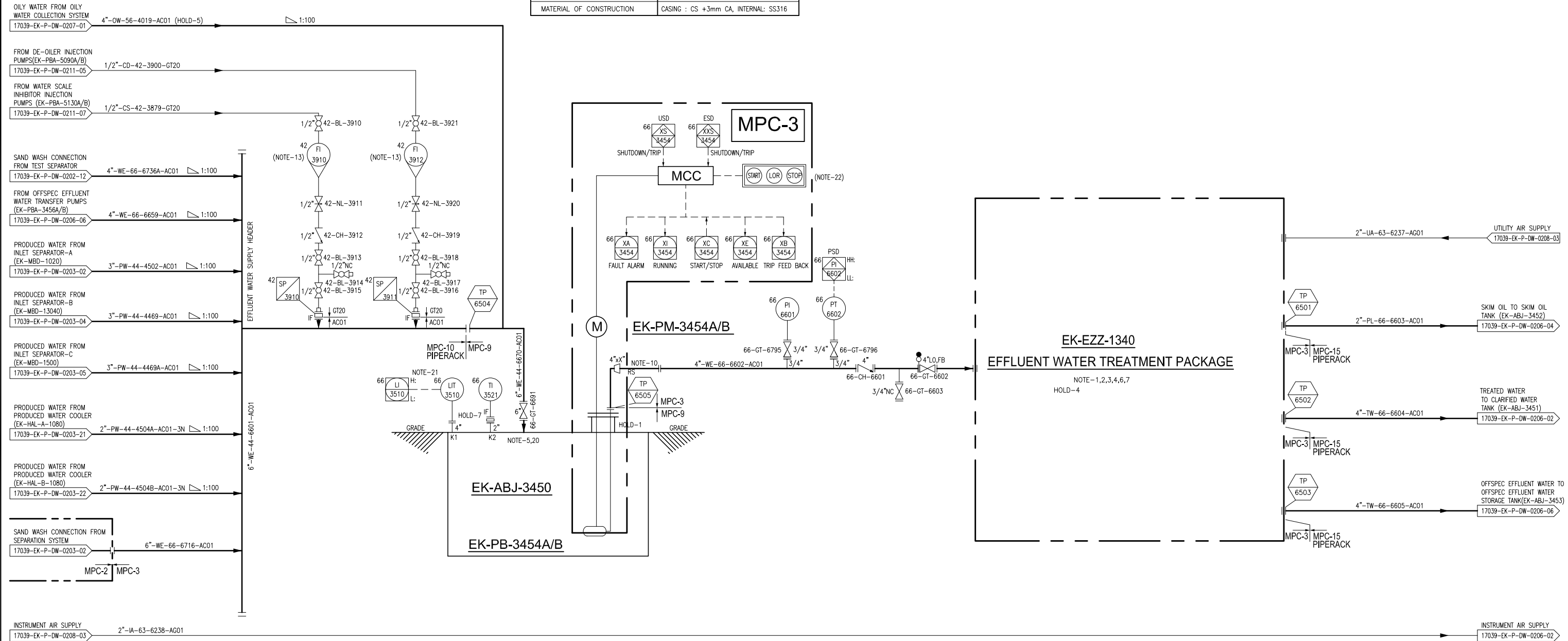
B	14 FEB 18	ISSUED FOR BID	DAM	PSN/TKV	MSB/MSR		
A	24 NOV 17	ISSUED FOR REVIEW	DAM	PSN/TKV	MSB/MSR		
REV	DATE	DESCRIPTION	DRAWN	CHK.	APPR.		

COMPANY:


EPCM CONSULTANT :


PROJECT : CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJJAN			
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TITLE : UTILITY FLOW DIAGRAM SEWAGE TREATMENT PACKAGE			
PROJECT NO.: KIP-17039		PROJECT SITE:	NADUA
DRAWING NO.:	17039-ND-P-DW-0100-23	REV: B	SHEET : 1 OF 1 SCALE : NTS

TAG NUMBER				EK-EZZ-1340				EK-ABJ-3450				TAG NUMBER				EK-PBA-3454A/B			
DESCRIPTION				EFFLUENT WATER TREATMENT PACKAGE				EFFLUENT WATER STORAGE TANK				DESCRIPTION				EFFLUENT WATER TRANSFER PUMP (2x100%)			
TYPE				—				RECTANGULAR (UNDER GROUND)				TYPE				CENTRIFUGAL, VERTICAL			
SERVICE				EFFLUENT WATER				EFFLUENT WATER				SERVICE				EFFLUENT WATER			
PRESSURE		DESIGN	kg/cm ² g	VTA				FOW+0.07 kg/cm ²				DESIGN PRESSURE		kg/cm ² g	10				
		OPERATING	kg/cm ² g	VTA				ATM						DESIGN TEMPERATURE °C			85		
TEMPERATURE		DESIGN	°C	85				85				OPERATING TEMPERATURE		°C	51				
		OPERATING	°C	51				51						DISCHARGE PRESSURE kg/cm ² g			5		
DESIGN CAPACITY		m ³ /hr/KLPD		46/1108 (EACH) (NOTE-12)				1108 kL				DIFFERENTIAL PRESSURE		kg/cm ²	5				
DIMENSION		mm		VTA				20000 (L/D) x 18000(W) x 4000(H) (NOTE-17) (HOLD-3)				DESIGN CAPACITY		m ³ /hr/KLPD	46/1108 (NOTE-12,18)				
DESIGN CODE		VTA		—				—				ABSORBED POWER		kW	9.23 (NOTE-9)				
MATERIAL OF CONSTRUCTION		VTA		VTA				RCC				MOTOR DUTY		kW	11 (HOLD-6)				
OILY WATER FROM OILY WATER COLLECTION SYSTEM												DESIGN CODE		API-610					
												MATERIAL OF CONSTRUCTION		CASING : CS +3mm CA, INTERNAL: SS316					



NOTES:

- EFFLUENT WATER STORAGE TANK IS DESIGNED TO HANDLE THE PRODUCED WATER FROM PROCESS SYSTEM (INLET SEPARATOR-A/B/C, PRODUCED WATER COOLER-A/B) AND RAIN WATER (FIRST 15 MINUTES OF RAIN WATER WILL BE TREATED IN ETP AND REST WILL BE ROUTED TO GUARD POND)
- EFFLUENT WATER TREATMENT PACKAGE VENDOR TO CONFIRM THE REQUIREMENT OF UTILITIES FOR THE PACKAGE.
- DISCHARGE WATER QUALITY SHALL COMPLY WITH PCB/CPCB NORMS, WHICHEVER CARRIES STRINGENT SPECIFICATION FOR INJECTION/DISPOSAL.
- VTA-VENTOR TO ADVISE.
- ABSORBED POWER WITH 10% MARGIN ON FLOW RATE.
- REMOVABLE SPOOL PIECE FOR MAINTENANCE PURPOSE.
- HIGH POINT VENT AND LOW POINT DRAIN SHALL BE PROVIDED WHEREVER APPLICABLE.
- ETP WATER TREATMENT PACKAGE INCLUDES 10% MARGIN ON FLOW RATE.
- EFFLUENT WATER STORAGE TANK IS IN CONSTRUCTION CONTRACTOR SCOPE AND EFFLUENT WATER TRANSFER PUMP TO BE LOOSE SUPPLIED BY ETP PACKAGE SUPPLIER.
- SLUDGE FROM ETP SHALL BE ROUTED TO SLUDGE TREATMENT SYSTEM. SLUDGE TREATMENT SYSTEM IS ETP PACKAGE SUPPLIERS SCOPE. SLUDGE TRANSFER PUMP FROM EFFLUENT WATER STORAGE TANK TO SLUDGE TREATMENT SYSTEM TO BE SUPPLIED BY ETP PACKAGE VENDOR.
- SLUDGE DISPOSAL IS IN OIL SCOPE.
- CHEMICALS, AIR, PROCESS WATER REQUIRED FOR EFFLUENT TREATMENT SYSTEM IS IN ETP PACKAGE SUPPLIERS SCOPE.
- EFFLUENT WATER STORAGE TANK IS DESIGNED FOR 24 hours STORAGE OF EFFLUENT WATER INLET FLOWRATE AT 80% TANK VOLUME.
- EFFLUENT WATER TRANSFER PUMP IS DESIGNED TO EMPTY THE EFFLUENT WATER STORAGE TANK IN 24 hours.
- ALL INSTRUMENTS, VALVES, LINE NUMBERS SHALL BE PREFIXED BY UNITNAME 'EK'.
- SKIMMING FACILITY TO BE PROVIDED.
- ULTRASONIC TYPE LEVEL TRANSMITTER.
- AMMETER SHALL BE PROVIDED IN LCS FOR MOTORS ABOVE 30 KW.

HOLD:

- PUMP NOZZLE SIZE.
- LINE SIZE TO BE CONFIRMED.
- TANK SIZE.
- THE FLOW SCHEME SHOWN IN THE EFFLUENT WATER TREATMENT SYSTEM PACKAGE IS PRELIMINARY AND IT WILL BE CONFIRMED LATER.
- LINE SIZE TO BE CONFIRMED.
- PUMP MOTOR DUTY.
- LEVEL TRANSMITTER NOZZLE SIZE.

MPC-3

NOTES:

- EFFLUENT WATER TREATMENT PACKAGE VENDOR TO FINALIZE THE FLOW SCHEME WITH IN THE PACKAGE AS PER INLET EFFLUENT WATER AND OUTLET TREATED WATER SPECIFICATION.
- EFFLUENT WATER TREATMENT PACKAGE INLET PARAMETERS:-

OIL IN WATER	10000 ppm
PH	7-9
TSS	UPTO 100 ppm
DISSOLVED OXYGEN	UPTO 7 ppm
SRB	10 ³ TO 10 ⁶ CFU/ML
ANY OTHER BACTERIAL ACTIVITY LIKE GAB, IRB & APB	NOT MEASURED.

3. EFFLUENT WATER OUTLET SPECIFICATION ARE

- OIL IN WATER < 10 ppm
- SLUDGE CONTENT - NIL
- OUTLET TEMPERATURE - 51°C
- pH-6.5-8.5
- TSS-98% REMOVAL OF SUSPENDED SOLIDS > 10 MICRONS
- DISSOLVED OXYGEN <0.2 ppm
- SRB-NIL
- ANY OTHER BACTERIAL ACTIVITY LIKE GAB, IRB & APB-NIL.
- OIL AND GREASE -< 10mg/lit

- EFFLUENT WATER TREATMENT PACKAGE SHALL BE DESIGNED ON THE PHILOSOPHY OF ZERO DISCHARGE FROM THE INSTALLATION WITH NIL SLUDGE.

COMPANY:



EPCM CONSULTANT :



PROJECT : CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN

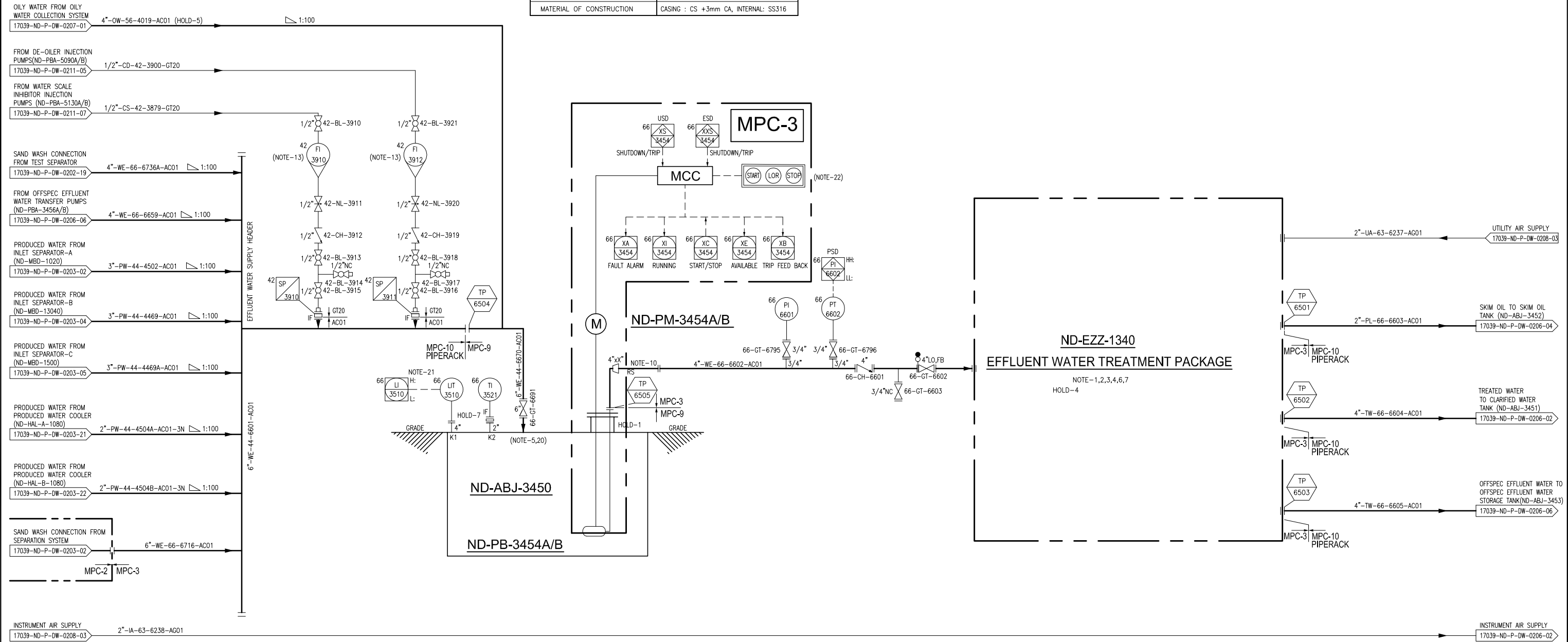
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TITLE : PIPING AND INSTRUMENTATION DIAGRAM
EFFLUENT WATER TREATMENT PACKAGE

PROJECT NO.: KIP-17039	PROJECT SITE:	EAST KHAGORIJAN
DRAWING NO.: 17039-EK-P-DW-0206-01	REV: B	SHEET : 1 OF 1 SCALE : NTS

TAG NUMBER			ND-EZZ-1340	ND-ABJ-3450	TAG NUMBER	ND-PBA-3454A/B		
DESCRIPTION			EFFLUENT WATER TREATMENT PACKAGE	EFFLUENT WATER STORAGE TANK	DESCRIPTION		EFFLUENT WATER TRANSFER PUMP (2x100%)	
TYPE			—	RECTANGULAR (UNDER GROUND)	TYPE		CENTRIFUGAL, VERTICAL	
SERVICE			EFFLUENT WATER	EFFLUENT WATER	SERVICE		EFFLUENT WATER	
PRESSURE	DESIGN	kg/cm ² g	VTA	FOW+0.07 kg/cm ²	DESIGN PRESSURE	kg/cm ² g	10	
	OPERATING	kg/cm ² g	VTA	ATM	DESIGN TEMPERATURE	°C	85	
TEMPERATURE	DESIGN	°C	85	85	OPERATING TEMPERATURE	°C	51	
	OPERATING	°C	51	51	DISCHARGE PRESSURE	kg/cm ² g	5	
DESIGN CAPACITY		m ³ /hr/KLPD	46/1108 (EACH) (NOTE–12)	1108 kL	DIFFERENTIAL PRESSURE		kg/cm ²	5
DIMENSION		mm	VTA	20000 (I/D) x 18000(W) x 4000(H) (NOTE–17) (HOLD–3)	DESIGN CAPACITY		m ³ /hr/KLPD	46/1108 (NOTE–12,18)
DESIGN CODE		VTA	—	—	ABSORBED POWER		kW	9.23 (NOTE–9)
MATERIAL OF CONSTRUCTION		VTA	RCC	RCC	MOTOR DUTY		kW	11 (HOLD–6)
OILY WATER FROM OILY WATER COLLECTION SYSTEM					DESIGN CODE		API–610	
					MATERIAL OF CONSTRUCTION		CASING : CS +3mm CA, INTERNAL: SS316	

MPC-3



NOTES:

- EFFLUENT WATER STORAGE TANK IS DESIGNED TO HANDLE THE PRODUCED WATER FROM PROCESS SYSTEM (INLET SEPARATOR-A/B/C, PRODUCED WATER COOLER-A/B) AND RAIN WATER (FIRST 15 MINUTES OF RAIN WATER WILL BE TREATED IN ETP AND REST WILL BE ROUTED TO GUARD POND)
- EFFLUENT WATER TREATMENT PACKAGE VENDOR TO CONFIRM THE REQUIREMENT OF UTILITIES FOR THE PACKAGE.
- DISCHARGE WATER QUALITY SHALL COMPLY WITH PCB/CPCB NORMS, WHICHEVER CARRIES STRINGENT SPECIFICATION FOR INJECTION/DISPOSAL.
- VTA–VENTOR TO ADVISE.
- ABSORBED POWER WITH 10% MARGIN ON FLOW RATE.
- REMOVABLE SPOOL PIECE FOR MAINTENANCE PURPOSE.
- HIGH POINT VENT AND LOW POINT DRAIN SHALL BE PROVIDED WHEREVER APPLICABLE.
- ETP WATER TREATMENT PACKAGE INCLUDES 10% MARGIN ON FLOW RATE.
- EFFLUENT WATER STORAGE TANK IS IN CONSTRUCTION CONTRACTOR SCOPE AND EFFLUENT WATER TRANSFER PUMP TO BE LOOSE SUPPLIED BY ETP PACKAGE SUPPLIER.

- SLUDGE FROM ETP SHALL BE ROUTED TO SLUDGE TREATMENT SYSTEM. SLUDGE TREATMENT SYSTEM IS ETP PACKAGE SUPPLIERS SCOPE. SLUDGE TRANSFER PUMP FROM EFFLUENT WATER STORAGE TANK TO SLUDGE TREATMENT SYSTEM TO BE SUPPLIED BY ETP PACKAGE VENDOR.
- SLUDGE DISPOSAL IS IN OIL SCOPE.
- CHEMICALS, AIR, PROCESS WATER REQUIRED FOR EFFLUENT TREATMENT SYSTEM IS IN ETP PACKAGE SUPPLIERS SCOPE.
- EFFLUENT WATER STORAGE TANK IS DESIGNED FOR 24 hours STORAGE OF EFFLUENT WATER INLET FLOWRATE AT 80% TANK VOLUME.
- EFFLUENT WATER TRANSFER PUMP IS DESIGNED TO EMPTY THE EFFLUENT WATER STORAGE TANK IN 24 hours.
- ALL INSTRUMENTS, VALVES, LINE NUMBERS SHALL BE PREFIXED BY UNITNAME 'ND'.
- SKIMMING FACILITY TO BE PROVIDED.
- ULTRASONIC TYPE LEVEL TRANSMITTER.
- AMMETER SHALL BE PROVIDED IN LCS FOR MOTORS ABOVE 30 KW.

HOLD:

- PUMP NOZZLE SIZE.
- LINE SIZE TO BE CONFIRMED.
- TANK SIZE.
- THE FLOW SCHEME SHOWN IN THE EFFLUENT WATER TREATMENT SYSTEM PACKAGE IS PRELIMINARY AND IT WILL BE CONFIRMED LATER.
- LINE SIZE TO BE CONFIRMED.
- PUMP MOTOR DUTY.
- LEVEL TRANSMITTER NOZZLE SIZE.

SEQUENCE NUMBER FOR LINES, INSTRUMENTS, VALVES & FOR SPECIALITY ITEMS EXCEPT EQUIPMENT SHALL BE CHANGED AS PER LEGEND DURING DETAIL DESIGN.

NOTES:

- EFFLUENT WATER TREATMENT PACKAGE VENDOR TO FINALIZE THE FLOW SCHEME WITH IN THE PACKAGE AS PER INLET EFFLUENT WATER AND OUTLET TREATED WATER SPECIFICATION.
- EFFLUENT WATER TREATMENT PACKAGE INLET PARAMETERS:–

OIL IN WATER	10000 ppm
PH	7–9
TSS	UPTO 100 ppm
DISSOLVED OXYGEN	UPTO 7 ppm
SRB	10 ³ TO 10 ⁶ CFU/ML
ANY OTHER BACTERIAL ACTIVITY LIKE GAB, IRB & APB	NOT MEASURED.

- EFFLUENT WATER OUTLET SPECIFICATION ARE
 - OIL IN WATER < 10 ppm
 - SLUDGE CONTENT – NIL
 - OUTLET TEMPERATURE – 51°C
 - pH–6.5–8.5
 - TSS–98% REMOVAL OF SUSPENDED SOLIDS > 10 MICRONS
 - DISSOLVED OXYGEN <0.2 ppm
 - SRB–NIL
 - ANY OTHER BACTERIAL ACTIVITY LIKE GAB, IRB & APB–NIL.
 - OIL AND GREASE –< 10mg/lit
- EFFLUENT WATER TREATMENT PACKAGE SHALL BE DESIGNED ON THE PHILOSOPHY OF ZERO DISCHARGE FROM THE INSTALLATION WITH NIL SLUDGE.

COMPANY:



EPCM CONSULTANT:



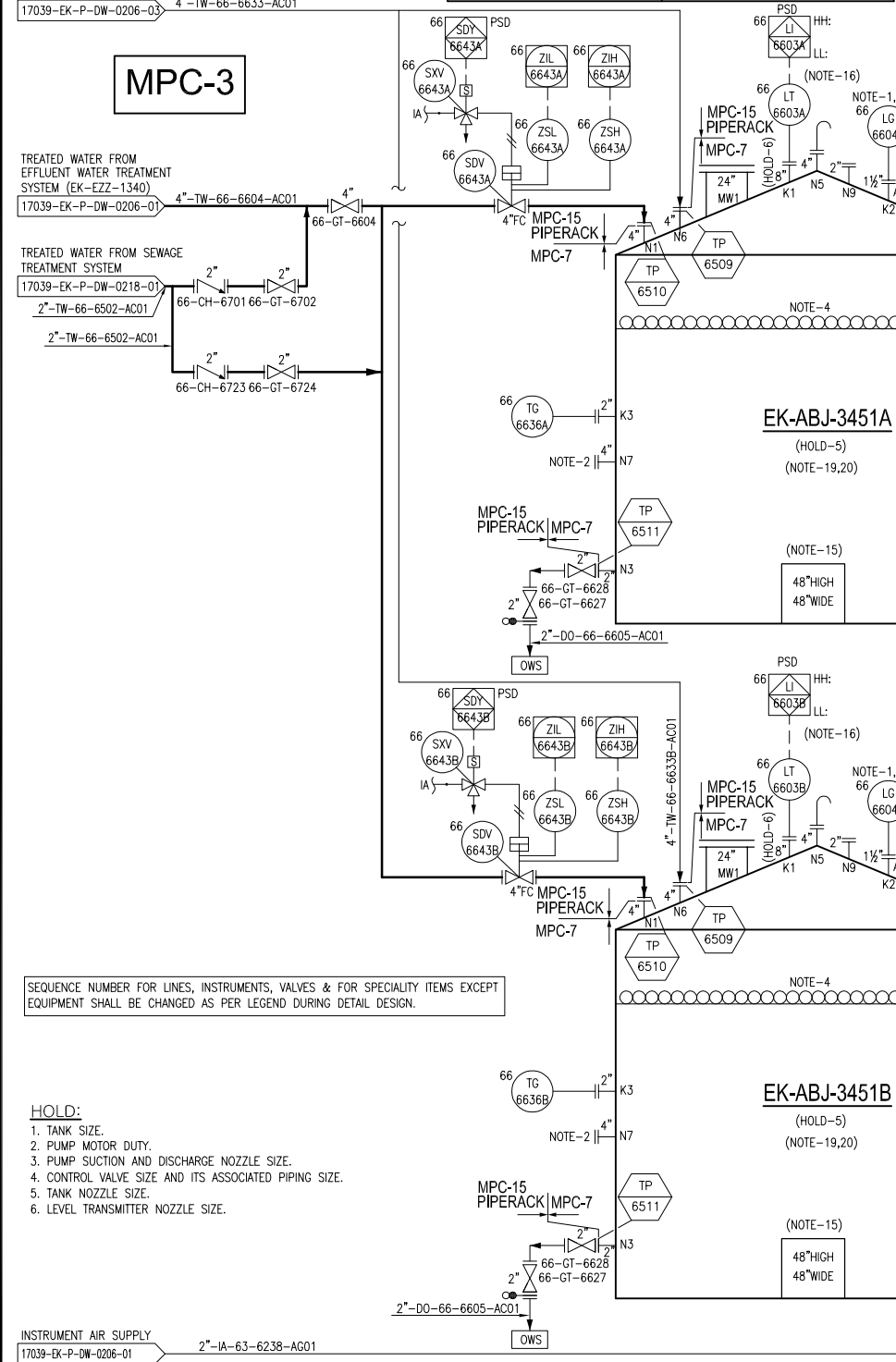
PROJECT : CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN

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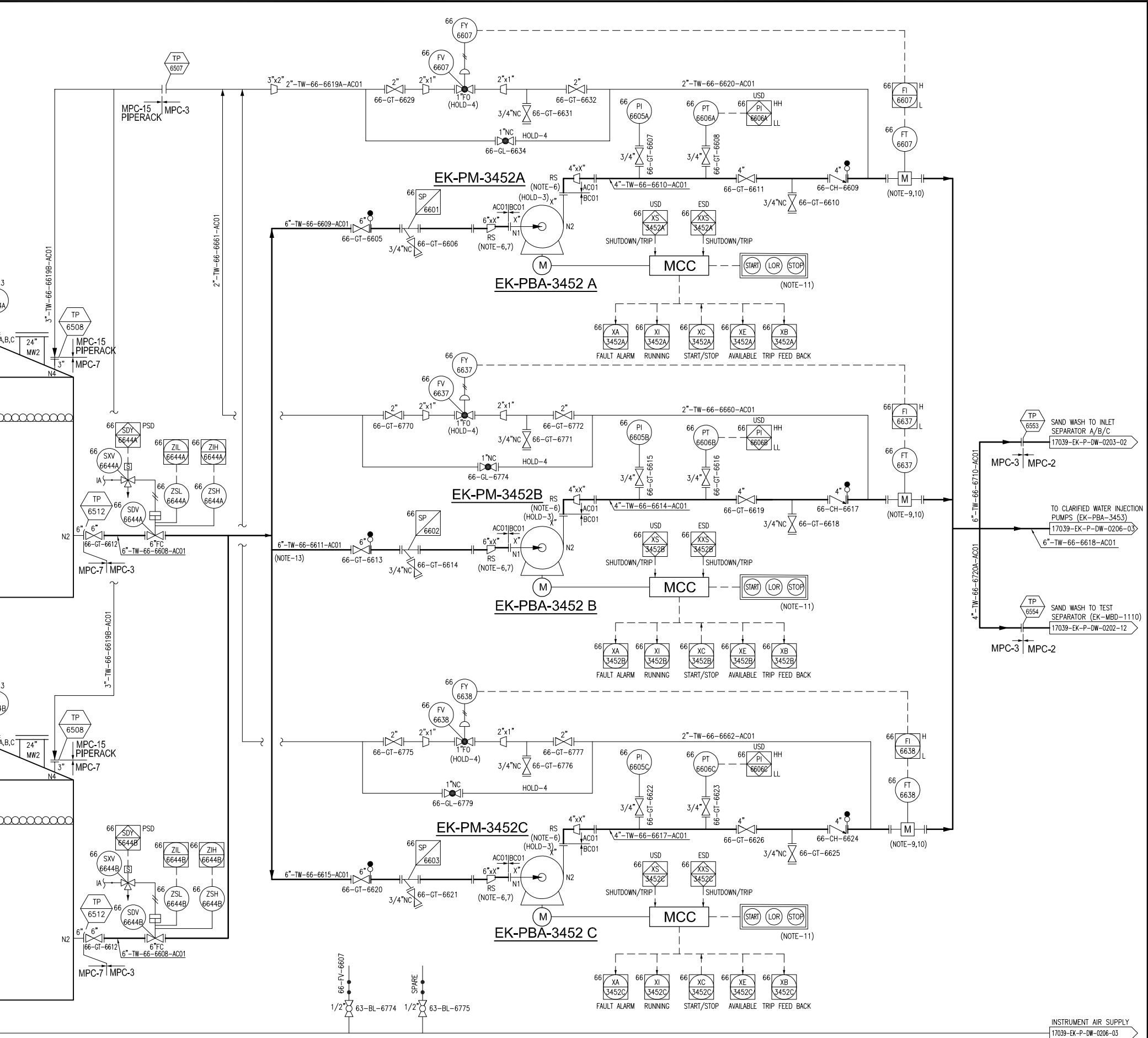
TITLE : PIPING AND INSTRUMENTATION DIAGRAM
EFFLUENT WATER TREATMENT PACKAGE

PROJECT NO.: KIP-17039	PROJECT SITE:	NADUA
DRAWING NO.: 17039-ND-P-DW-0206-01	REV: B	SHEET : 1 OF 1 SCALE : NTS

TAG NUMBER	EK-ABJ-3451A/B	TAG NUMBER	EK-PBA-3452A/B/C
DESCRIPTION	CLARIFIED WATER STORAGE TANK (2x50%)	DESCRIPTION	CLARIFIED WATER BOOSTER PUMPS (3x50%)
TYPE	VERTICAL CONE ROOF	TYPE	CENTRIFUGAL
SERVICE	CLARIFIED WATER	SERVICE	CLARIFIED WATER
PRESSURE	DESIGN kg/cm ² g FOW + 0.07 kg/cm ²	DESIGN PRESSURE kg/cm ² g	15
	OPERATING kg/cm ² g ATM	DESIGN TEMPERATURE °C	85
TEMPERATURE	DESIGN °C 85	OPERATING TEMPERATURE °C	51
	OPERATING °C 51	DISCHARGE PRESSURE kg/cm ² g	10
DESIGN CAPACITY	m ³ /hr/KLPD 554 KL	DIFFERENTIAL PRESSURE kg/cm ²	10
DIMENSION	mm 8100 (I/D) x 12000 (H) (NOTE-17) (HOLD-1)	DESIGN CAPACITY m ³ /hr/KLPD	46/1108 (EACH) (NOTE-14)
DESIGN CODE	ROARK'S FORMULAE, API-650	ABSORBED POWER kW	18.5 (NOTE-5)
MATERIAL OF CONSTRUCTION	CS +3mm CA	MOTOR DUTY kW	HOLD-2
PSV RELIEF FROM CLARIFIED WATER INJECTION PUMPS (EK-PBA-3453A/B/C)		DESIGN CODE	API-610
17039-EK-P-DW-0206-03 4"-TW-66-6633-AC01		MATERIAL OF CONSTRUCTION	CASING : CS +3mm CA, INTERNAL: SS316

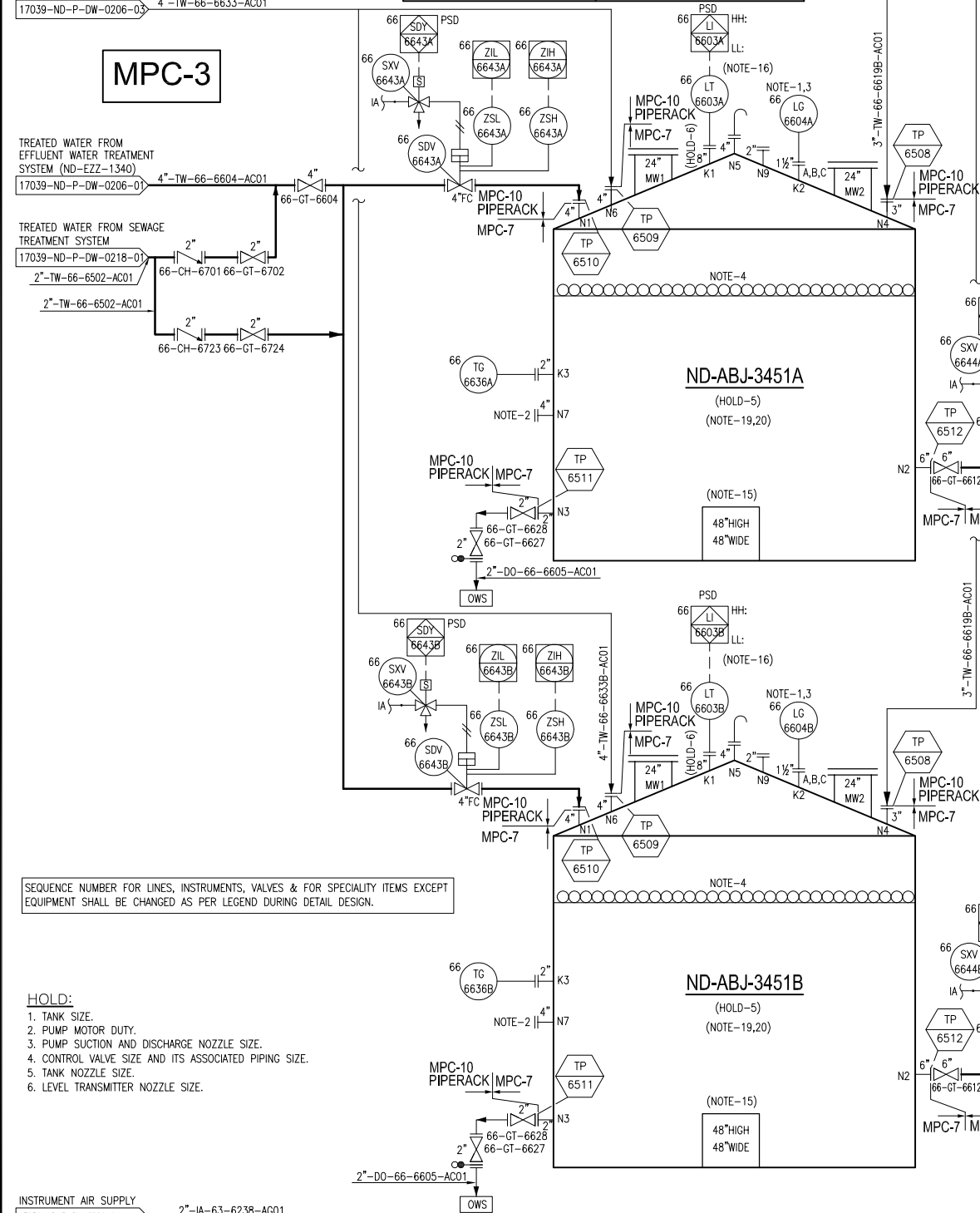


NOTES:	11. AMMETER SHALL BE PROVIDED IN LCS FOR MOTORS ABOVE 30 KW.
1. FLOAT AND TAPE TYPE LEVEL GAUGE.	12. DELETED.
2. SPARE NOZZLE.	13. PIPING TO BE SYMMETRICAL TO ENSURE EQUAL FLOW TO ALL PUMPS.
3. FOR FLOAT AND TAPE TYPE LEVEL GAUGE 3 NOS. OF 1½" NOZZLE SHALL BE PROVIDED.	14. CLARIFIED WATER BOOSTER PUMP IS DESIGNED TO EMPTY THE CLARIFIED WATER STORAGE TANK IN 12 HOURS.
4. PLASTIC BALLS SHALL BE FLOATED ON THE LIQUID SURFACE TO PREVENT OXYGEN INGRESS AND SAME SHALL BE CONFIRMED DURING DETAIL DESIGN.	15. CLEANOUT DOOR SHALL BE SUITABLE FOR WHEEL BARROW ACCESS FOR FACILITATING SEDIMENTS/SLUDGE CLEANING PROCESS.
5. DUTY INCLUDE 10% MARGIN WITH 75% ADIABATIC EFFICIENCY.	16. GUIDED WAVE RADAR TYPE LEVEL TRANSMITTER.
6. REMOVABLE SPOOL PIECE IS FOR MAINTENANCE PURPOSE.	17. CLARIFIED WATER STORAGE TANK IS DESIGNED FOR 24 hours STORAGE OF TREATED WATER INLET FLOWRATE AT 80% TANK VOLUME.
7. ECCENTRIC REDUCER WITH FLAT TOP.	18. ALL INSTRUMENTS, VALVES, LINE NUMBERS SHALL BE PREFIXED BY UNIT NAME 'ND'.
8. PIPING SHALL BE PROVIDED WITH HIGH POINT VENTS AND LOW POINT DRAINS.	19. TANK AND ITS ASSOCIATED INSTRUMENTS, INTERNALS DESIGN BY EPCM AND SUPPLIED BY MPC-15 CONTRACTOR.
9. MAGNETIC TYPE FLOW TRANSMITTER.	20. CATHODIC PROTECTION ARRANGEMENTS SHALL BE PROVIDED BY MPC-7 CONTRACTOR.
10. PIPING SHALL BE PROVIDED WITH STRAIGHT LENGTH OF 5D UPSTREAM AND 3D DOWNSTREAM.	



COMPANY:	Oil India Limited	PROJECT :	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN
EPCM CONSULTANT :	KAVIN	THIS DRAWING AND ALL DESIGN DETAILS AND DATA SHOWN HEREON, IS THE SOLE PROPERTY OF OIL INDIA LTD AND SHALL NOT BE REPRODUCED IN ANY MANNER OR USED FOR ANY PURPOSE WHATSOEVER, EXCEPT BY WRITTEN PERMISSION OF OIL INDIA LTD.	
		TITLE :	PIPING AND INSTRUMENTATION DIAGRAM
		PROJECT NO.:	KIP-17039
		DRAWING NO.:	17039-EK-P-DW-0206-02
		PROJECT SITE:	EAST KHAGORIJAN
		REV. B	SHEET : 1 OF 1
		SCALE :	NTS

TAG NUMBER		ND-ABJ-3451A/B	TAG NUMBER		ND-PBA-3452A/B/C
DESCRIPTION		CLARIFIED WATER STORAGE TANK (2x50%)	DESCRIPTION		CLARIFIED WATER BOOSTER PUMPS (3x50%)
TYPE		VERTICAL CONE ROOF	TYPE		CENTRIFUGAL
SERVICE		CLARIFIED WATER	SERVICE		CLARIFIED WATER
PRESSURE	DESIGN kg/cm ² g	FOW + 0.07 kg/cm ²	DESIGN PRESSURE	kg/cm ² g	15
	OPERATING kg/cm ² g	ATM	DESIGN TEMPERATURE	°C	85
TEMPERATURE	DESIGN °C	85	OPERATING TEMPERATURE	°C	51
	OPERATING °C	51	DISCHARGE PRESSURE	kg/cm ² g	10
DESIGN CAPACITY m ³ /hr/KLPD		554 KL	DIFFERENTIAL PRESSURE	kg/cm ²	10
DIMENSION mm		8100 (I/D) x 12000(H) (NOTE-17) (HOLD-1)	DESIGN CAPACITY m ³ /hr/KLPD	46/1108 (EACH) (NOTE-14)	
DESIGN CODE		ROARK'S FORMULAE, API-650	ABSORBED POWER	kW	18.5 (NOTE-5)
MATERIAL OF CONSTRUCTION		CS +3mm CA	MOTOR DUTY	kW	HOLD-2
PSV RELIEF FROM CLARIFIED WATER INJECTION PUMPS (ND-PBA-3453A/B/C)			DESIGN CODE	API-610	
			MATERIAL OF CONSTRUCTION	CASING : CS +3mm CA, INTERNAL: SS316	



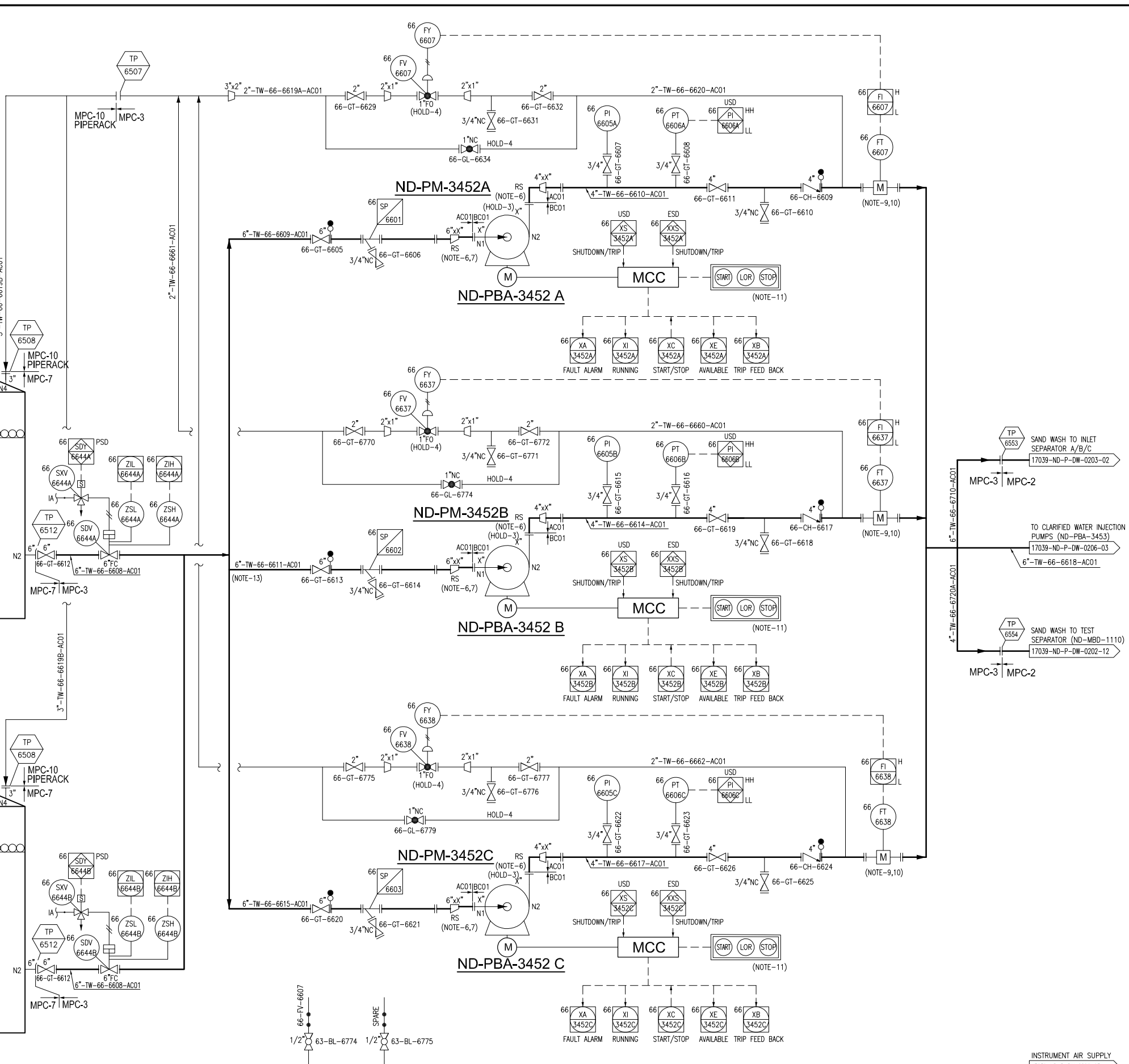
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NOTES:

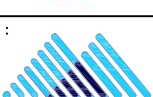
1. FLOAT AND TAPE TYPE LEVEL GAUGE.
2. SPARE NOZZLE.
3. FOR FLOAT AND TAPE TYPE LEVEL GAUGE 3 NOS. OF 1½" NOZZLE SHALL BE PROVIDED.
4. PLASTIC BALLS SHALL BE FLOATED ON THE LIQUID SURFACE TO PREVENT OXYGEN INGRESS AND SAME SHALL BE CONFIRMED DURING DETAIL DESIGN.
5. DUTY INCLUDE 10% MARGIN WITH 75% ADIABATIC EFFICIENCY.
6. REMOVABLE SPOOL PIECE IS FOR MAINTENANCE PURPOSE.
7. ECCENTRIC REDUCER WITH FLAT TOP.
8. PIPING SHALL BE PROVIDED WITH HIGH POINT VENTS AND LOW POINT DRAINS.
9. MAGNETIC TYPE FLOW TRANSMITTER.
10. PIPING SHALL BE PROVIDED WITH STRAIGHT LENGTH OF 5D UPSTREAM AND 3D DOWNSTREAM.
11. AMMETER SHALL BE PROVIDED IN LCS FOR MOTORS ABOVE 30 KW.
12. DELETED.
13. PIPING TO BE SYMMETRICAL TO ENSURE EQUAL FLOW TO ALL PUMP.
14. CLARIFIED WATER BOOSTER PUMP IS DESIGNED TO EMPTY THE CLARIFIED WATER STORAGE TANK IN 12 HOURS.
15. CLEANOUT DOOR SHALL BE SUITABLE FOR WHEEL BARRROW ACCESS FOR SEDIMENTS/SLUDGE CLEANING PROCESS.
16. GUIDED WAVE RADAR TYPE LEVEL TRANSMITTER.
17. CLARIFIED WATER STORAGE TANK IS DESIGNED FOR 24 hours STORAGE. WATER INLET FLOWRATE AT 80% TANK VOLUME.
18. ALL INSTRUMENTS, VALVES, LINE NUMBERS SHALL BE PREFIXED BY UN.
19. TANK AND ITS ASSOCIATED INSTRUMENTS, INTERNALS DESIGN BY EPCO SUPPLIED BY MPC-10 CONTRACTOR.
20. CATHODIC PROTECTION ARRANGEMENTS SHALL BE PROVIDED BY MPC-7

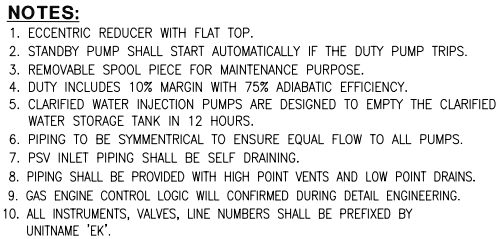
NOTES:

1. FLOAT AND TAPE TYPE LEVEL GAUGE.
2. SPARE NOZZLE.
3. FOR FLOAT AND TAPE TYPE LEVEL GAUGE 3 NOS. OF 1½" NOZZLE SHALL BE PROVIDED.
4. PLASTIC BALLS SHALL BE FLOATED ON THE LIQUID SURFACE TO PREVENT OXYGEN INGRESS AND SAME SHALL BE CONFIRMED DURING DETAIL DESIGN.
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6. REMOVABLE SPOOL PIECE IS FOR MAINTENANCE PURPOSE.
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8. PIPING SHALL BE PROVIDED WITH HIGH POINT VENTS AND LOW POINT DRAINS.
9. MAGNETIC TYPE FLOW TRANSMITTER.
10. PIPING SHALL BE PROVIDED WITH STRAIGHT LENGTH OF 5D UPSTREAM AND 3D DOWNSTREAM.
11. AMMETER SHALL BE PROVIDED IN LCS FOR MOTORS ABOVE 30 KW.
12. DELETED.
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14. CLARIFIED WATER BOOSTER PUMP IS DESIGNED TO EMPTY THE CLARIFIED WATER STORAGE TANK IN 12 HOURS.
15. CLEANOUT DOOR SHALL BE SUITABLE FOR WHEEL BARRROW ACCESS FOR SEDIMENTS/SLUDGE CLEANING PROCESS.
16. GUIDED WAVE RADAR TYPE LEVEL TRANSMITTER.
17. CLARIFIED WATER STORAGE TANK IS DESIGNED FOR 24 hours STORAGE. WATER INLET FLOWRATE AT 80% TANK VOLUME.
18. ALL INSTRUMENTS, VALVES, LINE NUMBERS SHALL BE PREFIXED BY UN.
19. TANK AND ITS ASSOCIATED INSTRUMENTS, INTERNALS DESIGN BY EPCO. SUPPLIED BY MPC-10 CONTRACTOR.
20. CATHODIC PROTECTION ARRANGEMENTS SHALL BE PROVIDED BY MPC-7



B	23 FEB 18	ISSUED FOR BID	MG	PSN/TKY	MSB/MS	
A	08 DEC 17	ISSUED FOR REVIEW	MG	PSN/TKY	MSB/MS	
REV	DATE	DESCRIPTION	BY	CHK.	APPR	

COMPANY:  ऑयल इंडिया लिमिटेड Oil India Limited		PROJECT : CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN	
EPCM CONSULTANT:  KAVIN™		THIS DRAWING AND ALL DESIGN DETAILS AND DATA SHOWN HEREON, IS THE SOLE PROPERTY OF OIL INDIA LTD AND SHALL NOT BE REPRODUCED IN ANY MANNER OR USED FOR ANY PURPOSE WHATSOEVER, EXCEPT BY WRITTEN PERMISSION OF OIL INDIA LTD.	
		TITLE : PIPING AND INSTRUMENTATION DIAGRAM CLARIFIED WATER STORAGE TANK & CLARIFIED WATER BOOSTER PUMPS	
		PROJECT NO.: KIP-17039	PROJECT SITE: NADUA
		DRAWING NO.: 17039-ND-P-DW-0206-02	REV: B SHEET: 1 OF 1 SCALE: NTS

MPC-3

B	23 FEB 18	ISSUED FOR BID	MG	PSN/TKV	MSB/MSR
A	11 DEC 17	ISSUED FOR REVIEW	MG	PSN/TKV	MSB/MSR
REV	DATE	DESCRIPTION	BY	CHK.	APPR.



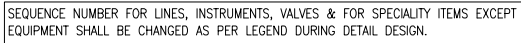
ऑयल इंडिया लिमिटेड
Oil India Limited



KAVINTM

PROJECT :					CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJJAN				
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TITLE :		PIPING AND INSTRUMENTATION DIAGRAM CLARIFIED WATER DISPOSAL PUMPS							
PROJECT NO.: KIP-17039					PROJECT SITE:		EAST KHAGORIJJAN		
DRAWING NO.:		17039-EK-P-DW-0206-03			REV: B		SHEET : 1 OF 1		SCALE : NTS

MPC-3



INSTRUMENT AIR SUPPLY
17039-ND-P-DW-0206-02

2nd-IA-63-6238-AG01

INSTRUMENT AIR SUPPLY
17039-ND-P-DW-0206-04

HOLD:

1. ECCENTRIC REDUCER WITH FLAT TOP.
2. DELETED.
3. REMOVABLE SPOOL PIECE FOR MAINTENANCE PURPOSE.
4. DUTY INCLUDES 10% MARGIN WITH 75% ADIABATIC EFFICIENCY.
5. CLARIFIED WATER INJECTION PUMPS ARE DESIGNED TO EMPTY THE CLARIFIED WATER STORAGE TANK IN 12 HOURS.
6. PIPING TO BE SYMMETRICAL TO ENSURE EQUAL FLOW TO ALL PUMPS.
7. PSV INLET PIPING SHALL BE SELF DRAINING.
8. PIPING SHALL BE PROVIDED WITH HIGH POINT VENTS AND LOW POINT DRAINS.
9. GAS ENGINE CONTROL LOGIC WILL BE CONFIRMED DURING DETAIL ENGINEERING.
10. ALL INSTRUMENTS, VALVES, LINE NUMBERS SHALL BE PREFIXED BY UNIT NAME "ND".
11. PUMP WARM-UP BY "PASS LINE"

1. PSV SIZES & ITS ASSOCIATED PIPING SIZE.
2. CLARIFIED WATER INJECTION PUMPS SUCTION AND DISCHARGE NOZZLE SIZE.
3. DELETED.

B	23 FEB 18	ISSUED FOR BID	MG	PSN/TKV	MSB/MSR
A	08 DEC 17	ISSUED FOR REVIEW	MG	PSN/TKV	MSB/MSR
REV	DATE	DESCRIPTION	BY	CHK.	APPR.



ऑयल इंडिया लिमिटेड
Oil India Limited

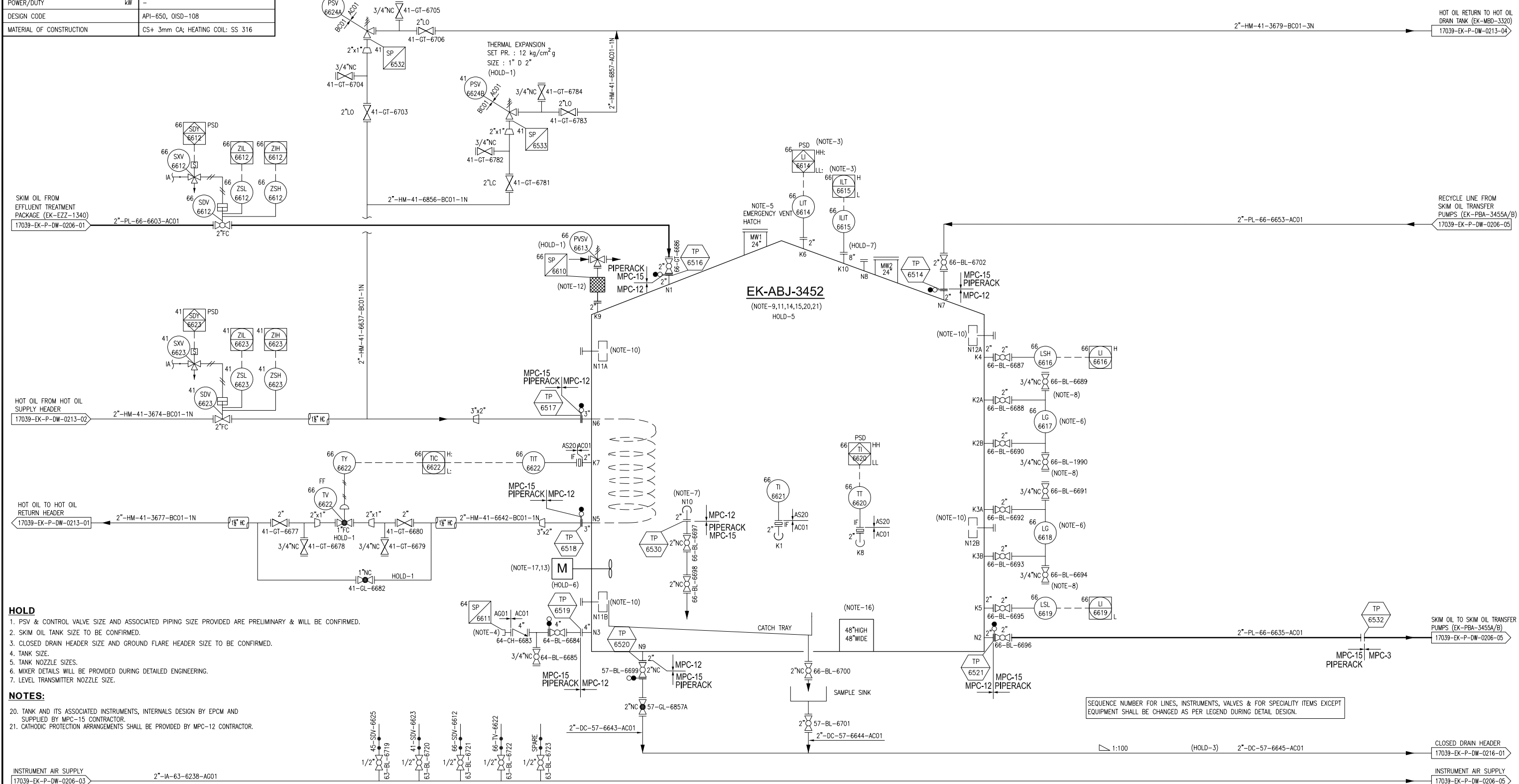


KAVINTM

PROJECT :					CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN				
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TITLE :		PIPING AND INSTRUMENTATION DIAGRAM CLARIFIED WATER DISPOSAL PUMPS							
PROJECT NO.: KIP-17039				PROJECT SITE:		NADUA			
DRAWING NO.:		17039-ND-P-DW-0206-03		REV: B		SHEET : 1 OF 1		SCALE : NTS	

TAG NUMBER		SKIM OIL TANK
DESCRIPTION		SKIM OIL TANK
TYPE		VERTICAL CONE ROOF, ATMOSPHERIC
SERVICE		SKIM OIL
PRESSURE	DESIGN kg/cm ² g	FW + 0.07 kg/cm ²
	OPERATING kg/cm ² g	ATM
TEMPERATURE	DESIGN °C	90
	OPERATING °C	55
DESIGN CAPACITY		KLS 150
DIMENSION		mm 5500 (1/D) x 8000 (H) (HOLD-4) (NOTE-18)
POWER/DUTY		kW -
DESIGN CODE		API-650, OISD-108
MATERIAL OF CONSTRUCTION		CS + 3mm CA; HEATING COIL: SS 316

THERMAL EXPANSION
SET PR. : 12 kg/cm²g
SIZE : 1" D 2"
(HOLD-1) 41



- ## HOLD
1. PSV & CONTROL VALVE SIZE AND ASSOCIATED PIPING SIZE PROVIDED ARE PRELIMINARY & WILL BE CONFIRMED.
 2. SKIM OIL TANK SIZE TO BE CONFIRMED.
 3. CLOSED DRAIN HEADER SIZE AND GROUND FLARE HEADER SIZE TO BE CONFIRMED.
 4. TANK SIZE.
 5. TANK NOZZLE SIZES.
 6. MIXER DETAILS WILL BE PROVIDED DURING DETAILED ENGINEERING.
 7. LEVEL TRANSMITTER NOZZLE SIZE.

NOTES:

20. TANK AND ITS ASSOCIATED INSTRUMENTS, INTERNALS DESIGN BY EPCM AND SUPPLIED BY MPC-15 CONTRACTOR.
21. CATHODIC PROTECTION ARRANGEMENTS SHALL BE PROVIDED BY MPC-12 CONTRACTOR

INSTRUMENT AIR SUPPLY
17039-EK-P-DW-0206-03 2"-IA-63-6238-AG01

- ## NOTES:
1. WHEREVER DISSIMILAR MATERIALS ARE TO BE CONNECTED BY MEANS AT GASKETED FLANGE JOINTS, INSULATION GASKET SHALL BE USED.
 2. PIPING SHALL BE PROVIDED WITH HIGH POINT VENTS AND LOW POINT DRAINS. THESE ARE NOT SHOWN ON P&IDs
 3. RADAR TYPE LEVEL TRANSMITTER.
 4. NITROGEN PURGE CONNECTION.
 5. MANHOLE WITH EMERGENCY VENT HATCH.
 6. MAGNETIC TYPE LEVEL GAUGE.
 7. SAMPLE CONNECTION.
 8. ALL LEVEL INSTRUMENTS VENT AND DRAIN SHALL BE ROUTED TO FLARE HEADER CLOSED DRAIN HEADER RESPECTIVELY.
 9. TANKS SHALL BE PROVIDED WITH PROPER INTERNAL COATING FOR THERMAL PROTECTION AGAINST CORROSION AND EROSION PREVENTION.
 10. TANKS MUST HAVE SACRIFICIAL ANODE TYPE CATHODIC PROTECTION SYSTEM.
 11. PAINTING OF TANKS SHOULD BE OLIVE GREEN WITH CAMOUFLAGE PATTERN.

12. BIDIRECTIONAL FLAME ARRESTER.
13. SIDE ENTRY MIXERS SHALL REMAIN SUBMERGED BELOW THE LOW LIQUID LEVEL DURING OPERATION.
14. LADDER RUNGS TO BE PROVIDED.
15. BUND WALL PROVIDED AROUND THE SKIM OIL TANK TO CONTAIN THE VOLUME IN CASE OF FIRE.
16. CLEAN OUT DOOR SHALL BE SUITABLE FOR WHEEL BARROW ACCESS FOR FACILITATING SEDIMENTS / SLUDGE CLEANING PROCESS.
17. SIDE ENTRY MIXERS SHALL BE PROVIDED TO MAINTAIN UNIFORM TEMPERATURE OF THE CRUDE OIL IN STORAGE TANK AND TO AVOID SLUDGE AT BOTTOM OF THE TANK.
18. SKIM OIL TANK IS DESIGNED FOR 24 hours STORAGE OF 150 KL CAPACITY AT 80% TANK VOLUME.
19. ALL INSTRUMENTS, VALVES, LINE NUMBERS SHALL BE PREFIXED BY UNIT NAME 'EK'.

B	23 FEB 18	ISSUED FOR BID	MG	PSN/TKV	MSB/MSR
A	11 DEC 17	ISSUED FOR REVIEW	MG	PSN/TKV	MSB/MSR
REV	DATE	DESCRIPTION	BY	CHK.	APPR.

COMPANY:



EPCM CONSULTANT :



PROJECT :	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN

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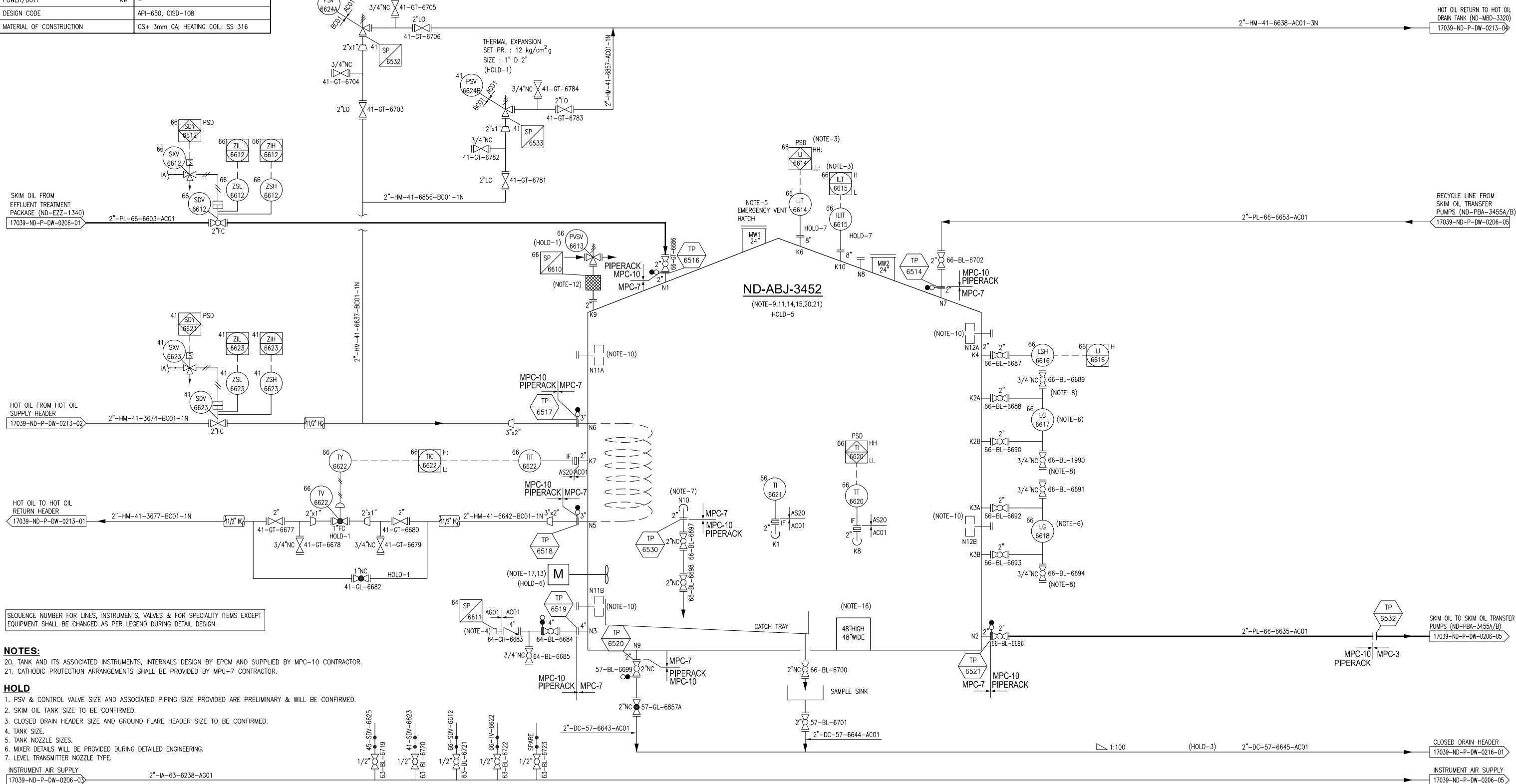
TITLE :	PIPING AND INSTRUMENTATION DIAGRAM
	SKIM OIL TANK

PROJECT NO.: KIP-17039		PROJECT SITE:		EAST KHAGORIJAN	
DRAWING NO.:	17039-EK-P-DW-0206-04	REV: B	SHEET : 1 OF 1		SCALE : NTS

TAG NUMBER			ND-ABJ-3452
DESCRIPTION			SKIM OIL TANK
TYPE			VERTICAL CONE ROOF, ATMOSPHERIC
SERVICE			SKIM OIL
PRESSURE	DESIGN	kg/cm ² g	FOW + 0.07 kg/cm ²
	OPERATING	kg/cm ² g	ATM
TEMPERATURE	DESIGN	°C	90
	OPERATING	°C	55
DESIGN CAPACITY		KLS	150
DIMENSION		mm	5500 (I/D) x 8000 (H) (HOLD-4) (NOTE-18)
POWER/DUTY		kW	-
DESIGN CODE			API-650, OISD-108
MATERIAL OF CONSTRUCTION			CS+ 3mm CA; HEATING COIL: SS 316

THERMAL EXPANSION
SET PR. : 12 kg/cm² g
SIZE : 1" D 2"
(HOLD-1)

MPC-3



NOTES:

20. TANK AND ITS ASSOCIATED INSTRUMENTS, INTERNALS DESIGN BY EPCM AND SUPPLIED BY MPC-10 CONTRACTOR.
21. CATHODIC PROTECTION ARRANGEMENTS SHALL BE PROVIDED BY MPC-7 CONTRACTOR.

HOLD

1. PSV & CONTROL VALVE SIZE AND ASSOCIATED PIPING SIZE PROVIDED ARE PRELIMINARY & WILL BE CONFIRMED.
2. SKIM OIL TANK SIZE TO BE CONFIRMED.
3. CLOSED DRAIN HEADER SIZE AND GROUND FLARE HEADER SIZE TO BE CONFIRMED.
4. TANK SIZE.
5. TANK NOZZLE SIZES.
6. MIXER DETAILS WILL BE PROVIDED DURING DETAILED ENGINEERING.
7. LEVEL TRANSMITTER NOZZLE TYPE.

INSTRUMENT AIR SUPPLY
17039-ND-P-DW-0206-03 2"-IA-63-6238-AG01

NOTES:

1. WHEREVER DISSIMILAR MATERIALS ARE TO BE CONNECTED BY MEANS AT GASKETED FLANGE JOINTS, INSULATION GASKET SHALL BE USED.
2. PIPING SHALL BE PROVIDED WITH HIGH POINT VENTS AND LOW POINT DRAINS. THESE ARE NOT SHOWN ON P&IDs.
3. RADAR TYPE LEVEL TRANSMITTER.
4. NITROGEN PURGE CONNECTION.
5. MANHOLE WITH EMERGENCY VENT HATCH.
6. MAGNETIC TYPE LEVEL GAUGE.
7. SAMPLE CONNECTION.
8. ALL LEVEL INSTRUMENTS VENT AND DRAIN SHALL BE ROUTED TO FLARE HEADER CLOSED DRAIN HEADER RESPECTIVELY.
9. TANKS SHALL BE PROVIDED WITH PROPER INTERNAL COATING FOR THERMAL RESISTANCE AND CORROSION PREVENTION.
10. TANKS MUST HAVE SACRIFICIAL ANODE TYPE CATHODIC PROTECTION SYSTEM.
11. PAINTING OF TANKS SHOULD BE OLIVE GREEN WITH CAMOUFLAGE PATTERN.

12. BIDIRECTIONAL FLAME ARRESTER.
13. SIDE ENTRY MIXERS SHALL REMAIN SUBMERGED BELOW THE LOW LIQUID LEVEL DURING OPERATION.
14. LADDER RUNGS TO BE PROVIDED.
15. BUND WALL PROVIDED AROUND THE SKIM OIL TANK TO CONTAIN THE VOLUME IN CASE OF FIRE.
16. CLEAN OUT DOOR SHALL BE SUITABLE FOR WHEEL BARROW ACCESS FOR FACILITATING SEDIMENTS / SLUDGE CLEANING PROCESS.
17. SIDE ENTRY MIXERS SHALL BE PROVIDED TO MAINTAIN UNIFORM TEMPERATURE OF THE CRUDE OIL IN STORAGE TANK AND TO AVOID SLUDGE AT BOTTOM OF THE TANK.
18. SKIM OIL TANK IS DESIGNED FOR 24 hours STORAGE OF 150 KL CAPACITY AT 80% TANK VOLUME.
19. ALL INSTRUMENTS, VALVES, LINE NUMBERS SHALL BE PREFIXED BY UNIT NAME 'ND'.

REV	DATE	DESCRIPTION	BY	CHK	APPR.
B	23 FEB 18	ISSUED FOR BID	MG	PSN/TKV/MSB/MSR	
A	08 DEC 17	ISSUED FOR REVIEW	MG	PSN/TKV/MSB/MSR	

COMPANY:



EPCM CONSULTANT:



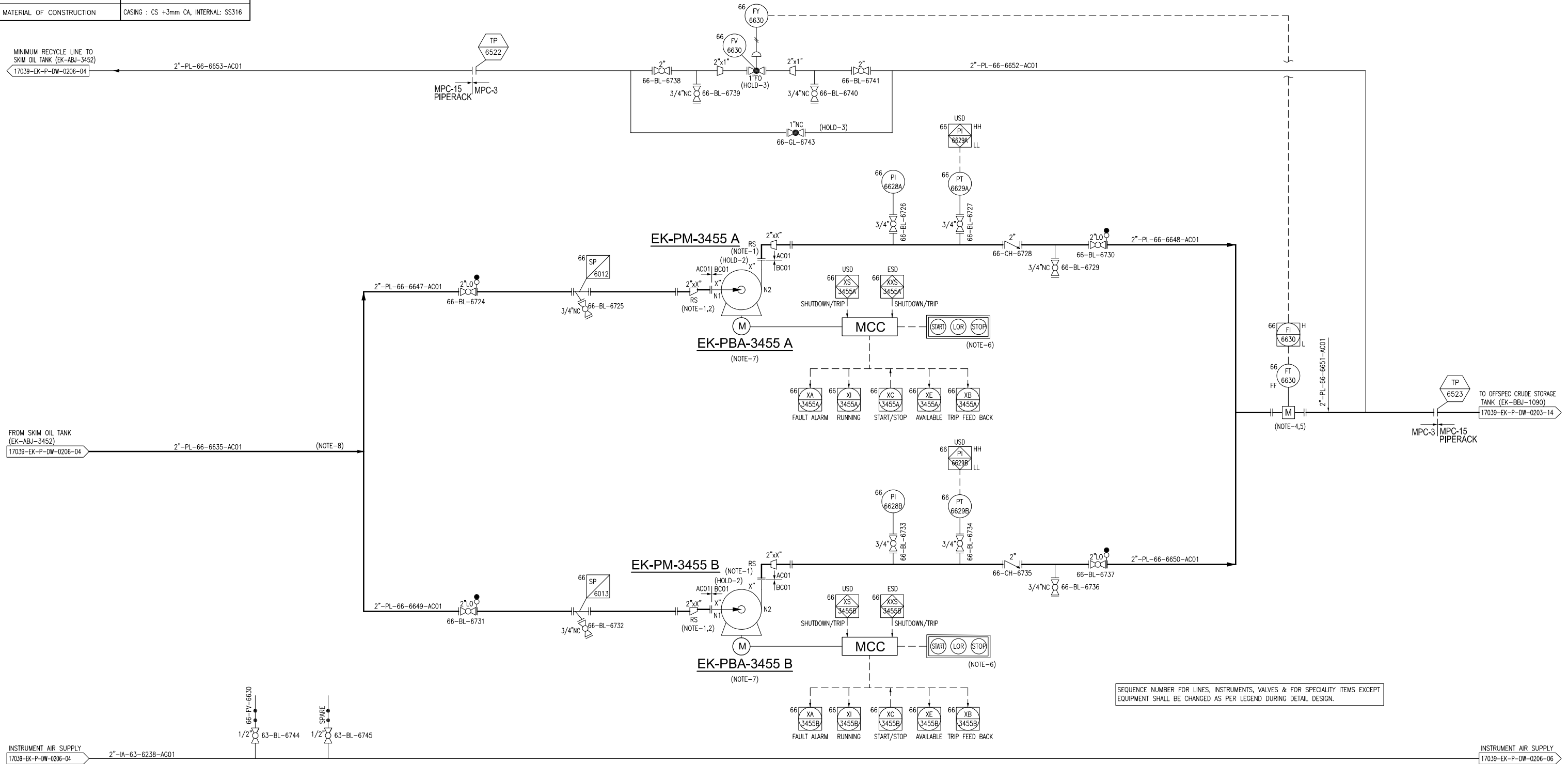
PROJECT : CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN

THIS DRAWING AND ALL DESIGN DETAILS AND DATA SHOWN HEREON, IS THE SOLE PROPERTY OF OIL INDIA LTD AND SHALL NOT BE REPRODUCED IN ANY MANNER OR USED FOR ANY PURPOSE WHATSOEVER, EXCEPT BY WRITTEN PERMISSION OF OIL INDIA LTD.

TITLE : PIPING AND INSTRUMENTATION DIAGRAM
SKIM OIL TANK

PROJECT NO.: KIP-17039	PROJECT SITE: NADUA
DRAWING NO.: 17039-ND-P-DW-0206-04	REV: B SHEET : 1 OF 1 SCALE : NTS

TAG NUMBER	EK-PBA-3455 A/B
DESCRIPTION	SKIM OIL TRANSFER PUMPS (2x100%)
TYPE	CENTRIFUGAL
SERVICE	SKIM OIL
DESIGN PRESSURE	kg/cm ² g 10
DESIGN TEMPERATURE	°C 90
OPERATING TEMPERATURE	°C 55
DISCHARGE PRESSURE	kg/cm ² g 5
DIFFERENTIAL PRESSURE	kg/cm ² 5
DESIGN CAPACITY	KLPD 150 (NOTE-9)
ABSORBED POWER	kW 1.25
MOTOR DUTY	kW (HOLD-1)
DESIGN CODE	API-610
MATERIAL OF CONSTRUCTION	CASING : CS +3mm CA, INTERNAL: SS316



- NOTES:**
1. REMOVABLE SPOOL PIECE IS FOR MAINTENANCE PURPOSE
 2. ECCENTRIC REDUCER WITH FLAT TOP.
 3. PIPING SHALL BE PROVIDED WITH HIGH POINT VENTS AND LOW POINT DRAINS.
 4. MAGNETIC TYPE FLOW TRANSMITTER.
 5. PIPING SHALL BE PROVIDED WITH STRAIGHT LENGTH OF 5D UPSTREAM AND 3D DOWNSTREAM.
 6. AMMETER SHALL BE PROVIDED IN LCS FOR MOTORS ABOVE 30 KW.
 7. STAND BY PUMP SHALL START AUTOMATICALLY IF THE DUTY PUMP TRIPS.
 8. PIPING TO BE SYMMETRICAL TO ENSURE EQUAL FLOW TO ALL PUMPS.
 9. DUTY INCLUDE 10% MARGIN WITH 75% ADIABATIC EFFICIENCY.
 10. SKIM OIL TRANSFER PUMP IS DESIGNED TO EMPTY THE SKIM OIL TANK IN 24 hours.

11. ALL INSTRUMENTS, VALVES, LINE NUMBERS SHALL BE PREFIXED BY UNITNAME 'EK'.
- HOLD:**
1. PUMP MOTOR DUTY.
 2. PUMP SUCTION AND DISCHARGE NOZZLE SIZE.
 3. CONTROL VALVE SIZE AND ITS ASSOCIATED PIPING SIZE.

B	23 FEB 18	ISSUED FOR BID	MG	PSN/TKV/MSB/MSR		
A	11 DEC 17	ISSUED FOR REVIEW	MG	PSN/TKV/MSB/MSR		
REV	DATE	DESCRIPTION	BY	CHK.	APPR.	

COMPANY:

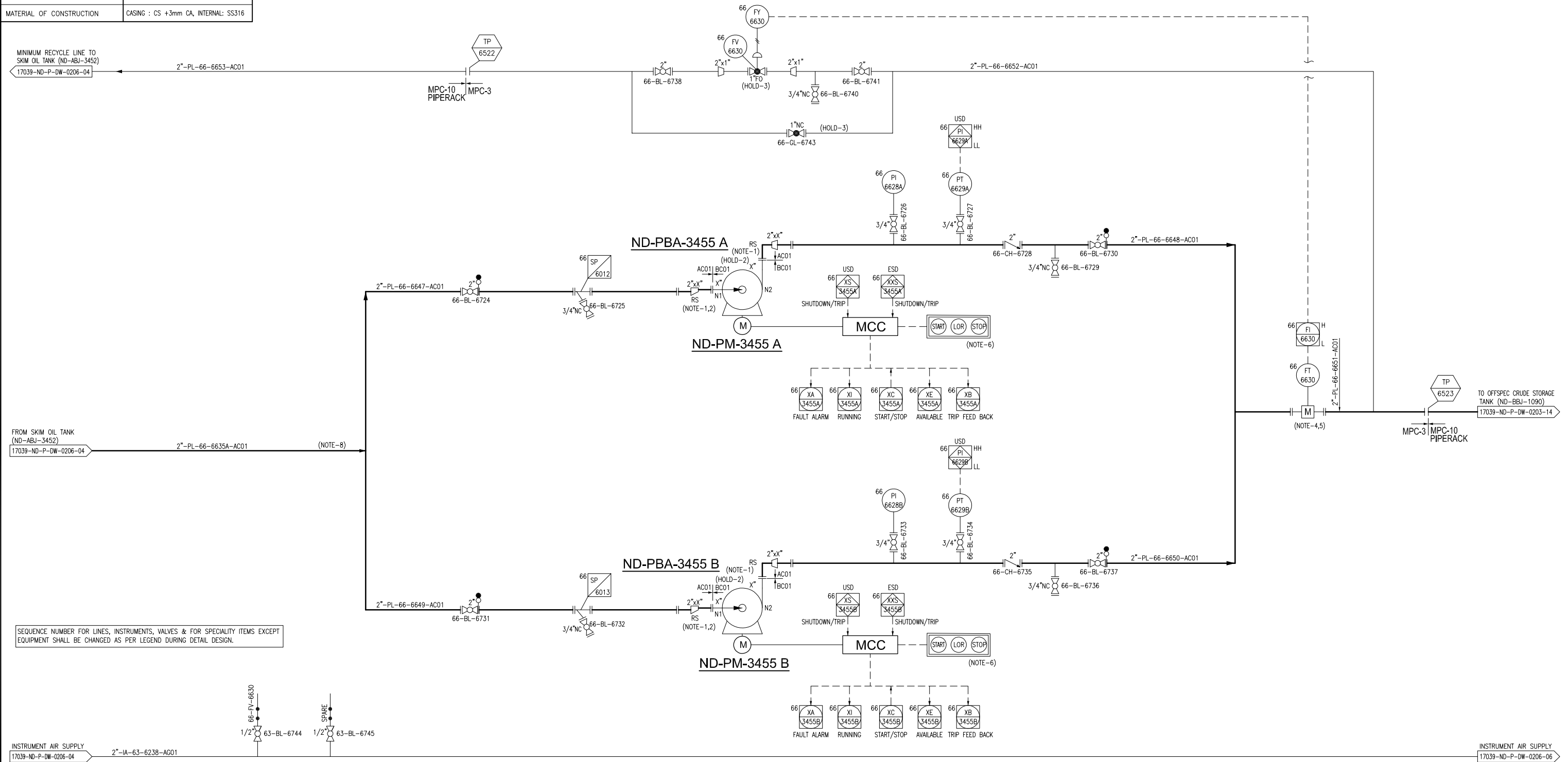


EPCM CONSULTANT :



PROJECT :	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJJAN		
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TITLE :	PIPING AND INSTRUMENTATION DIAGRAM SKIM OIL TRANSFER PUMP		
PROJECT NO.:	KIP-17039	PROJECT SITE:	EAST KHAGORIJJAN
DRAWING NO.:	17039-EK-P-DW-0206-05	REV: B	SHEET : 1 OF 1
			SCALE : NTS

TAG NUMBER	ND-PBA-3455 A/B
DESCRIPTION	SKIM OIL TRANSFER PUMPS (2x100%)
TYPE	CENTRIFUGAL
SERVICE	SKIM OIL
DESIGN PRESSURE	kg/cm ² g 10
DESIGN TEMPERATURE	°C 90
OPERATING TEMPERATURE	°C 55
DISCHARGE PRESSURE	kg/cm ² g 5
DIFFERENTIAL PRESSURE	kg/cm ² 5
DESIGN CAPACITY	KLPD 150 (NOTE-10)
ABSORBED POWER	kW 1.25 (NOTE-9)
MOTOR DUTY	kW (HOLD-1)
DESIGN CODE	API-610
MATERIAL OF CONSTRUCTION	CASING : CS +3mm CA, INTERNAL: SS316



NOTES:			
1.	REMOVABLE SPOOL PIECE IS FOR MAINTENANCE PURPOSE		
2.	ECCENTRIC REDUCER WITH FLAT TOP.		
3.	PIPING SHALL BE PROVIDED WITH HIGH POINT VENTS AND LOW POINT DRAINS.		
4.	MAGNETIC TYPE FLOW TRANSMITTER.		
5.	PIPING SHALL BE PROVIDED WITH STRAIGHT LENGTH OF 5D UPSTREAM AND 3D DOWNSTREAM.		
6.	AMMETER SHALL BE PROVIDED IN LCS FOR MOTORS ABOVE 30 KW.		
7.	DELETED.		
8.	PIPING TO BE SYMMETRICAL TO ENSURE EQUAL FLOW TO ALL PUMPS.		
9.	DUTY INCLUDE 10% MARGIN WITH 75% ADIABATIC EFFICIENCY.		
10.	SKIM OIL TRANSFER PUMP IS DESIGNED TO EMPTY THE SKIM OIL TANK IN 24 hours.		

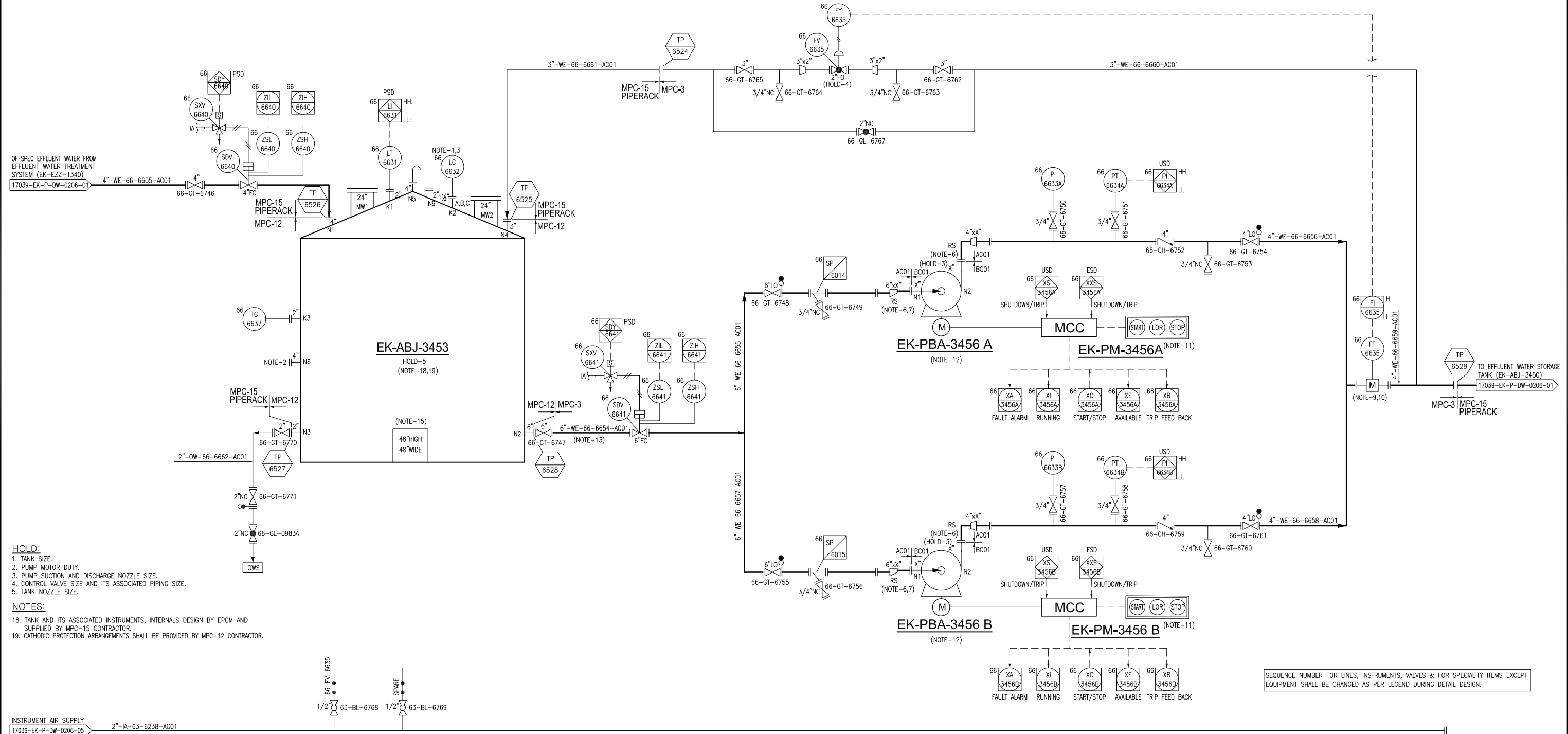
11. ALL INSTRUMENTS, VALVES, LINE NUMBERS SHALL BE PREFIXED BY UNIT NAME 'ND'			
HOLD:			
1.	PUMP MOTOR DUTY.		
2.	PUMP SUCTION AND DISCHARGE NOZZLE SIZE.		
3.	CONTROL VALVE SIZE AND ITS ASSOCIATED PIPING SIZE.		

REV	DATE	DESCRIPTION	BY	CHK	APPR.
B	23 FEB 18	ISSUED FOR BID	MG	PSN/TKV	MSB/MSR
A	08 DEC 17	ISSUED FOR REVIEW	MG	PSN/TKV	MSB/MSR

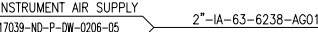
COMPANY:		
EPCM CONSULTANT :		
		

PROJECT : CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN			
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TITLE : PIPING AND INSTRUMENTATION DIAGRAM SKIM OIL TRANSFER PUMP			
PROJECT NO.: KIP-17039	PROJECT SITE:	NADUA	
DRAWING NO.: 17039-ND-P-DW-0206-05	REV: B	SHEET : 1 OF 1	SCALE : NTS

TAG NUMBER		EK-ABJ-3453	TAG NUMBER		EK-P8A-3456 A/B
DESCRIPTION		OFF-SPEC EFFLUENT WATER STORAGE TANK	DESCRIPTION		OFF-SPEC EFFLUENT WATER TRANSFER PUMPS (2x100%)
TYPE		VERTICAL CONE ROOF	TYPE		CENTRIFUGAL
SERVICE		OFF-SPEC EFFLUENT WATER	SERVICE		OFF-SPEC EFFLUENT WATER
PRESSURE	DESIGN	kg/cm ² g	DESIGN PRESSURE	kg/cm ² g	10
	OPERATING	kg/cm ² g	DESIGN TEMPERATURE	°C	85
TEMPERATURE	DESIGN	°C	OPERATING TEMPERATURE	°C	51
	OPERATING	°C	DISCHARGE PRESSURE	kg/cm ² g	5
DESIGN CAPACITY		KLPD	DIFFERENTIAL PRESSURE	kg/cm ²	5
DIMENSION		mm	DESIGN CAPACITY	KLPD	1108 (NOTE-5)
DESIGN CODE		ROARK'S FORMULA, API-650	ABSORBED POWER	kW	9.23 (NOTE-14)
MATERIAL OF CONSTRUCTION		CS +3mm CA	MOTOR DUTY	kW	(HOLD-2)
			DESIGN CODE		API-610
			MATERIAL OF CONSTRUCTION		CASING : CS +3mm CA, INTERNAL: SS316

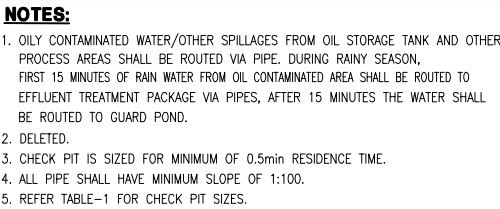


NOTES: 1. FLOAT AND TAPE TYPE LEVEL GAUGE. 2. SPARE NOZZLE. 3. FOR FLOAT AND TAPE TYPE LEVEL GAUGE 3 NOS. OF 1½" NOZZLE SHALL BE PROVIDED. 4. PLASTIC BALLS SHALL BE FLOATED ON THE LIQUID SURFACE TO PREVENT OXYGEN INGRESS. 5. OFF-SPEC EFFLUENT WATER TRANSFER PUMP IS DESIGNED TO EMPTY THE OFF-SPEC EFFLUENT WATER STORAGE TANK IN 12 HOURS. 6. REMOVABLE SPOOL PIECE IS FOR MAINTENANCE PURPOSE. 7. ECCENTRIC REDUCER WITH FLAT TOP. 8. PIPING SHALL BE PROVIDED WITH HIGH POINT VENTS AND LOW POINT DRAINS. 9. MAGNETIC TYPE FLOW TRANSMITTER.		10. PIPING SHALL BE PROVIDED WITH STRAIGHT LENGTH OF 5D UPSTREAM AND 3D DOWNSTREAM. 11. AMMETER SHALL BE PROVIDED IN LCS FOR MOTORS ABOVE 5.5KW. 12. STAND BY PUMP SHALL START AUTOMATICALLY IF THE DUTY PUMP TRIPS. 13. PIPING TO BE SYMMETRICAL TO ENSURE EQUAL FLOW TO ALL PUMPS. 14. DUTY INCLUDES 10% MARGIN FLOW RATE. 15. CLEANOUT DOOR SHALL BE SUITABLE FOR WHEEL BARROW ACCESS FOR FACILITATING SEDIMENTS/SLUDGE CLEANING PROCESS 16. OFF-SPEC EFFLUENT WATER STORAGE TANK IS DESIGNED FOR 12 hours STORAGE OF OFF-SPEC EFFLUENT WATER INLET FLOWRATE AT 80% TANK VOLUME. 17. ALL INSTRUMENTS, VALVES, LINE NUMBERS SHALL BE PREFIXED BY UNIT NAME 'EK'.		COMPANY: Oil India Limited		PROJECT : CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN THIS DRAWING AND ALL DESIGN DETAILS AND DATA SHOWN HEREON, IS THE SOLE PROPERTY OF OIL INDIA LTD AND SHALL NOT BE REPRODUCED IN ANY MANNER OR USED FOR ANY PURPOSE WHATSOEVER, EXCEPT BY WRITTEN PERMISSION OF OIL INDIA LTD.	
				EPCM CONSULTANT : KAVIN ™		TITLE : PIPING AND INSTRUMENTATION DIAGRAM OFFSPEC EFFLUENT WATER STORAGE TANK & OFFSPEC EFFLUENT WATER TRANSFER PUMPS	
						PROJECT NO.: KIP-17039	PROJECT SITE: EAST KHAGORIJAN
						DRAWING NO.: 17039-EK-P-DW-0206-06	REV: B SHEET : 1 OF 1 SCALE : NTS

MPC-3Page 168 of 379

MPC-14

CHECK PIT TAG NO.	DIMENSION mm (L x W x D) (HOLD-2)
EK-ZSU-003, 004, 005, 006, 007, 008, 010, 020, 024	100 x 700 x 1000
EK-ZSU-002, 001, 009, 018, 021, 022, 023, 019	200 x 700 x 1000
EK-ZSU-011, 015, 016, 017	300 x 700 x 1000
EK-ZSU-012, 013, 014	700 x 700 x 1000



B	23 FEB 18	ISSUED FOR BID	MG	PSN/TKV	MSB/MSR
A	13 DEC 17	ISSUED FOR REVIEW	MG	PSN/TKV	MSB/MSR
REV	DATE	DESCRIPTION	BY	CHK.	APPR.



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Oil India Limited



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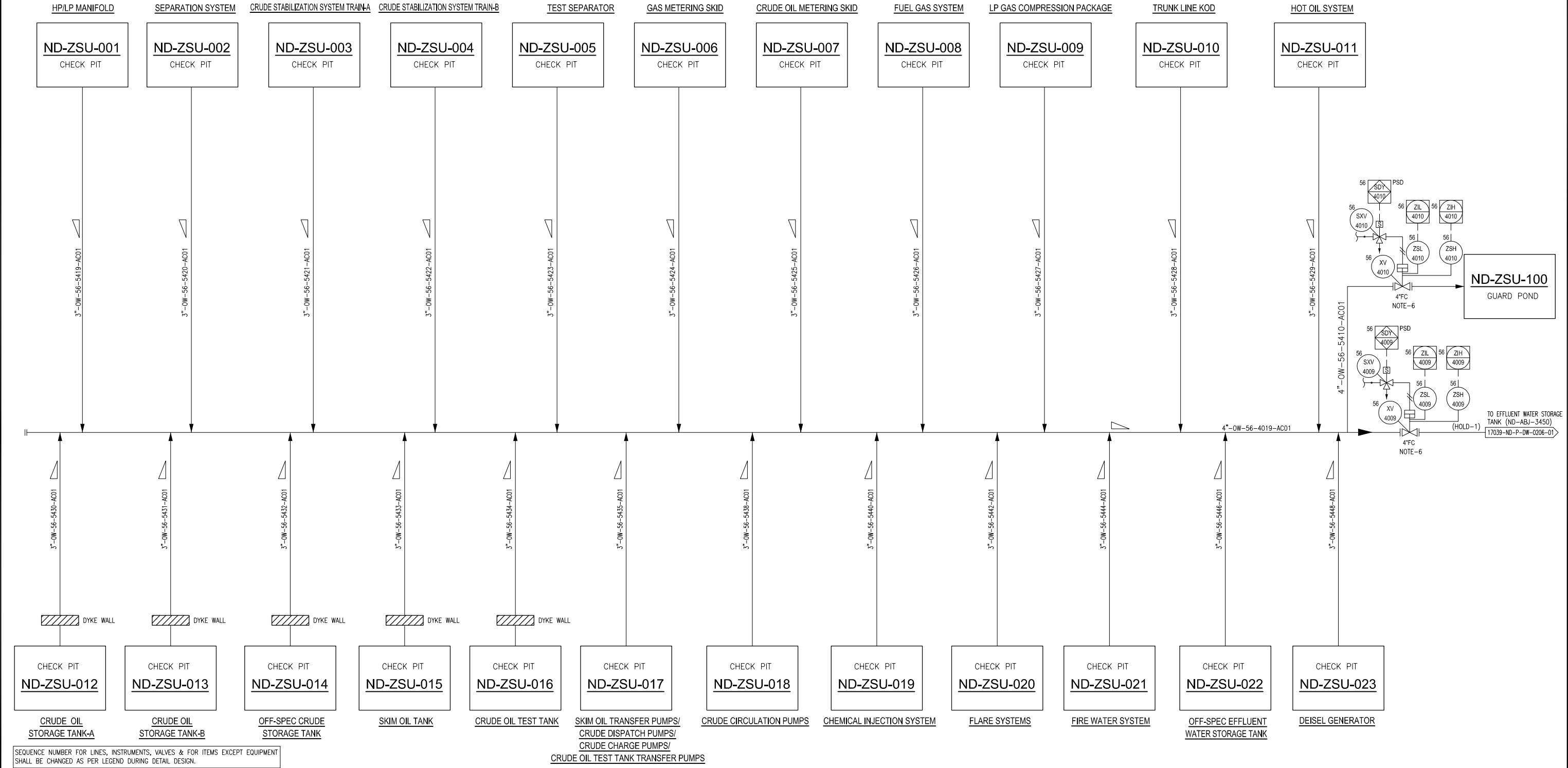
PROJECT :				CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN			
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TITLE :		PIPING AND INSTRUMENTATION DIAGRAM OILY WATER COLLECTION SYSTEM					
PROJECT NO. : KIP-17039				PROJECT SITE:		EAST KHAGORIJAN	
DRAWING NO. :		17039-EK-P-DW-0207-01		REV: B	SHEET : 1 OF 1	SCALE : NTS	

TAG NUMBER		ND-ZSU-001 to 023	ND-ZSU-100
DESCRIPTION		CHECK PIT	GUARD POND
TYPE		UNDER GROUND PIT	UNDER GROUND PIT
SERVICE		OILY WATER / STORM WATER	STORM WATER
PRESSURE	DESIGN kg/cm ² g	FOW	FOW
	OPERATING kg/cm ² g	ATM + LIQUID HEAD	ATM + LIQUID HEAD
TEMPERATURE	DESIGN °C	80	80
	OPERATING °C	AMB	AMB
DESIGN CAPACITY		NOTE-3	-
DIMENSION		NOTE-5	26000 (L) x 25000 (W) x 4000 (D) (HOLD-3)
DESIGN CODE		-	-
MATERIAL OF CONSTRUCTION		RCC WITH EPOXY INNER	RCC WITH EPOXY INNER

MPC-9

TABLE-1 CHECK PIT SIZES:

CHECK PIT TAG NO.	DIMENSION mm (L x W x D) (HOLD-2)
ND-ZSU-003, 004, 005, 006, 007, 008, 010, 018, 019, 023	100 x 700 x 1000
ND-ZSU-002, 009, 020, 021	200 x 700 x 1000
ND-ZSU-001, 011, 015, 016	300 x 700 x 1000
ND-ZSU-017	400 x 700 x 1000
ND-ZSU-012, 013, 014	700 x 700 x 1000



- NOTES:**
- OILY CONTAMINATED WATER/OTHER SPILLAGES FROM OIL STORAGE TANK AND OTHER PROCESS AREAS SHALL BE ROUTED VIA PIPE. DURING RAINY SEASON, FIRST 15 MINUTES OF RAIN WATER FROM OIL CONTAMINATED AREA SHALL BE ROUTED TO EFFLUENT TREATMENT PACKAGE VIA PIPES, AFTER 15 MINUTES THE WATER SHALL BE ROUTED TO GUARD POND.
 - DELETED.
 - CHECK PIT IS SIZED FOR MINIMUM OF 0.5min RESIDENCE TIME.
 - ALL PIPE SHALL HAVE MINIMUM SLOPE OF 1:100.
 - REFER TABLE-1 FOR CHECK PIT SIZES.

6. OILY WATER FROM OILY WATER COLLECTION PIT SHALL BE ROUTED TO EFFLUENT WATER STORAGE TANK FOR FIRST 15 MINUTES VIA XV-4009 (OPERATED MANUALLY FROM DCS) AND EXCESS RAIN WATER AFTER 15 MINUTES SHALL BE DIVERTED TO GUARD POND VIA XV-4010 (OPERATED MANUALLY FROM DCS).
- HOLD:**
- LINE SIZE.
 - CHECK PIT SIZE.
 - GUARD POND SIZE.

B	06 FEB 18	ISSUED FOR BID	MG	PSN/TKV/MSB/MSR		
A	13 DEC 17	ISSUED FOR REVIEW	MG	PSN/TKV/MSB/MSR		
REV	DATE	DESCRIPTION	BY	CHK.	APPR.	

COMPANY:



EPCM CONSULTANT :



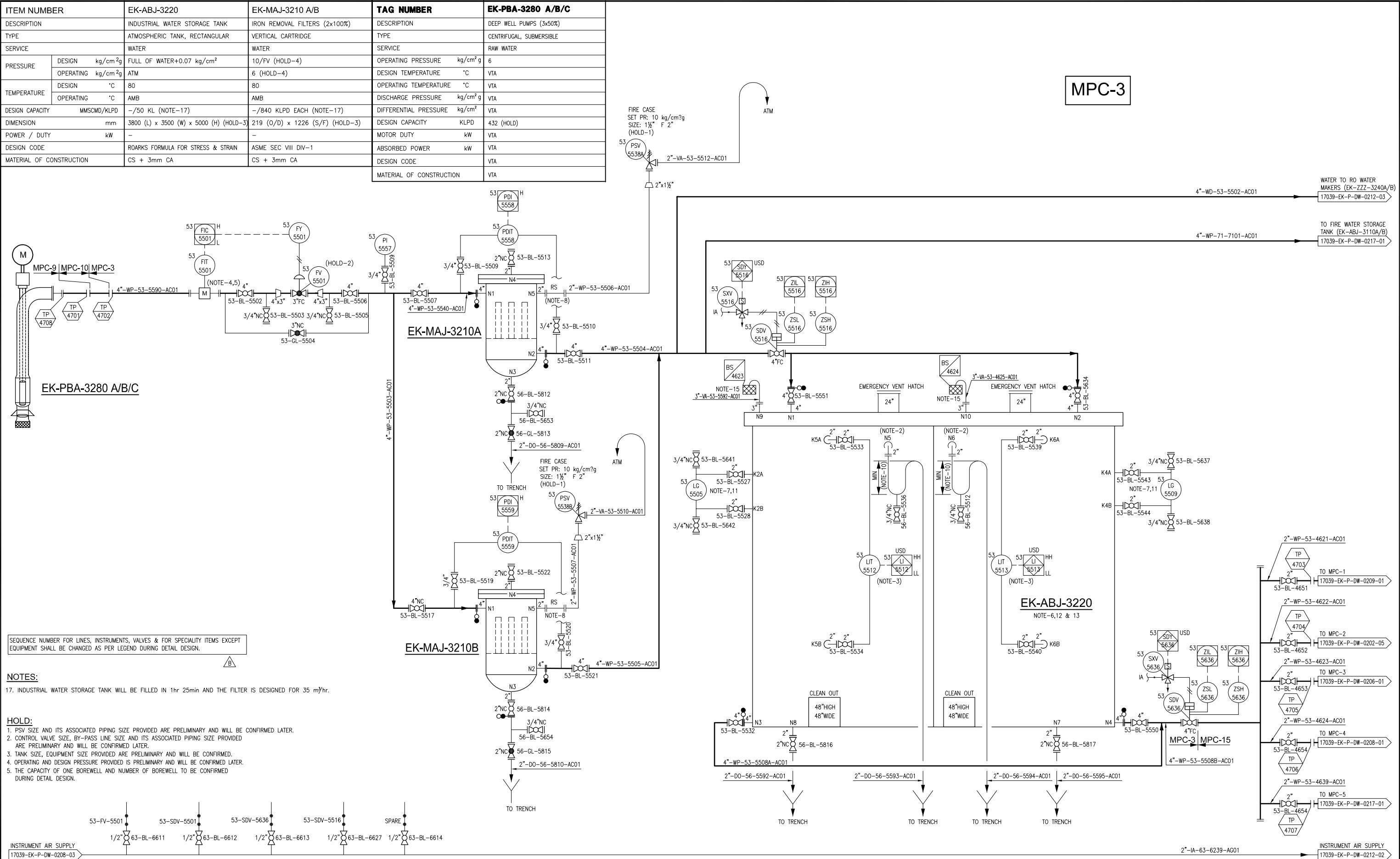
PROJECT : CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN

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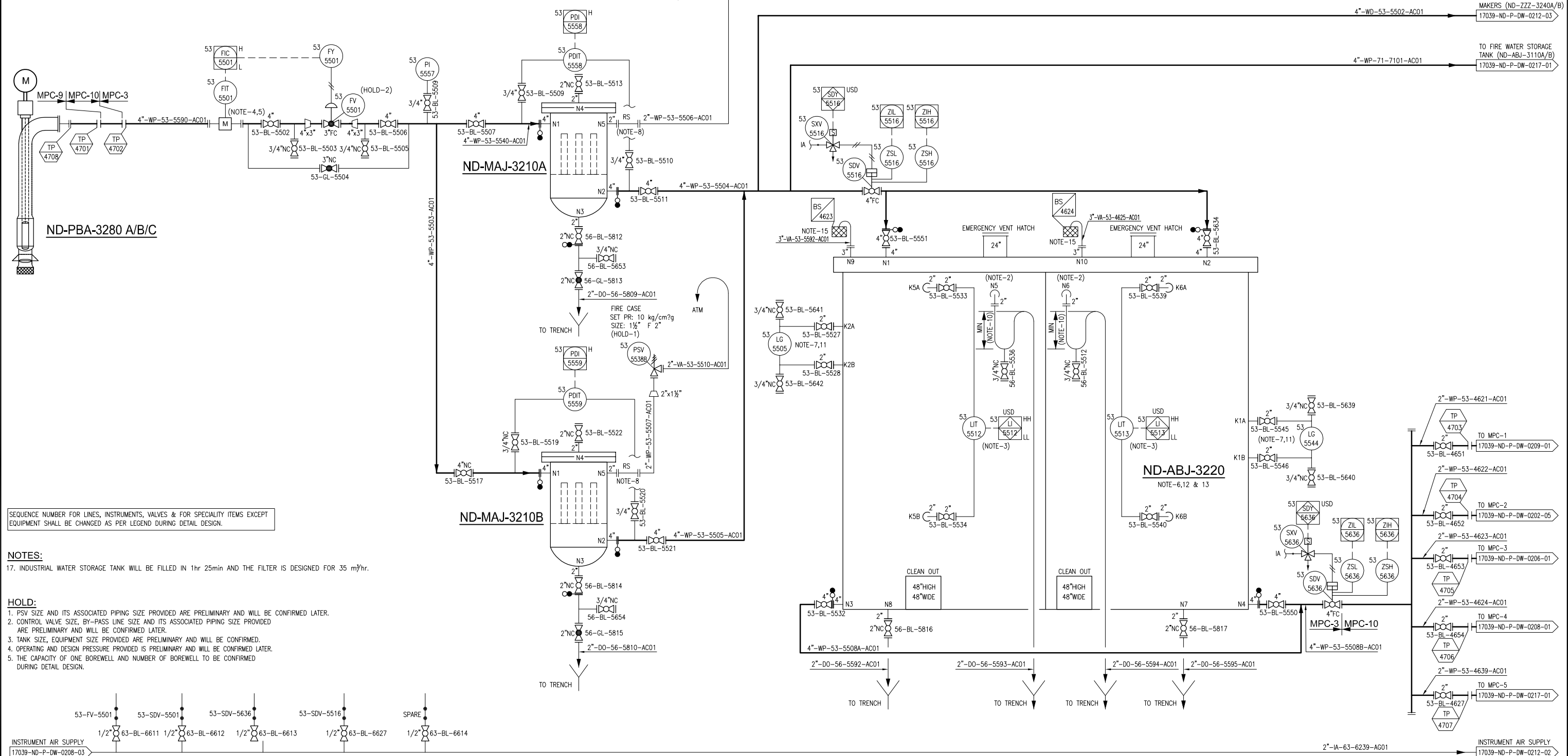
TITLE : PIPING AND INSTRUMENTATION DIAGRAM
OILY WATER COLLECTION SYSTEM

PROJECT NO.: KIP-17039	PROJECT SITE:	NADUA
DRAWING NO.: 17039-ND-P-DW-0207-01	REV: B	SHEET : 1 OF 1
		SCALE : NTS

ITEM NUMBER		EK-ABJ-3220	EK-MAJ-3210 A/B	TAG NUMBER	EK-PBA-3280 A/B/C
DESCRIPTION		INDUSTRIAL WATER STORAGE TANK	IRON REMOVAL FILTERS (2x100%)	DESCRIPTION	DEEP WELL PUMPS (3x50%)
TYPE		ATMOSPHERIC TANK, RECTANGULAR	VERTICAL CARTRIDGE	TYPE	CENTRIFUGAL, SUBMERSIBLE
SERVICE		WATER	WATER	SERVICE	RAW WATER
PRESSURE	DESIGN kg/cm ² g	FULL OF WATER+0.07 kg/cm ²	10/FV (HOLD-4)	OPERATING PRESSURE kg/cm ² g	6
	OPERATING kg/cm ² g	ATM	6 (HOLD-4)	DESIGN TEMPERATURE °C	VTA
TEMPERATURE	DESIGN °C	80	80	OPERATING TEMPERATURE °C	VTA
	OPERATING °C	AMB	AMB	DISCHARGE PRESSURE kg/cm ² g	VTA
DESIGN CAPACITY MMSCMD/KLPD		-/50 KL (NOTE-17)	-/840 KLPD EACH (NOTE-17)	DIFFERENTIAL PRESSURE kg/cm ²	VTA
DIMENSION mm		3800 (L) x 3500 (W) x 5000 (H) (HOLD-3)	219 (O/D) x 1226 (S/F) (HOLD-3)	DESIGN CAPACITY KLPD	432 (HOLD)
POWER / DUTY kW		-	-	MOTOR DUTY kW	VTA
DESIGN CODE		ROARKS FORMULA FOR STRESS & STRAIN	ASME SEC VIII DIV-1	ABSORBED POWER kW	VTA
MATERIAL OF CONSTRUCTION		CS + 3mm CA	CS + 3mm CA	DESIGN CODE	VTA
				MATERIAL OF CONSTRUCTION	VTA

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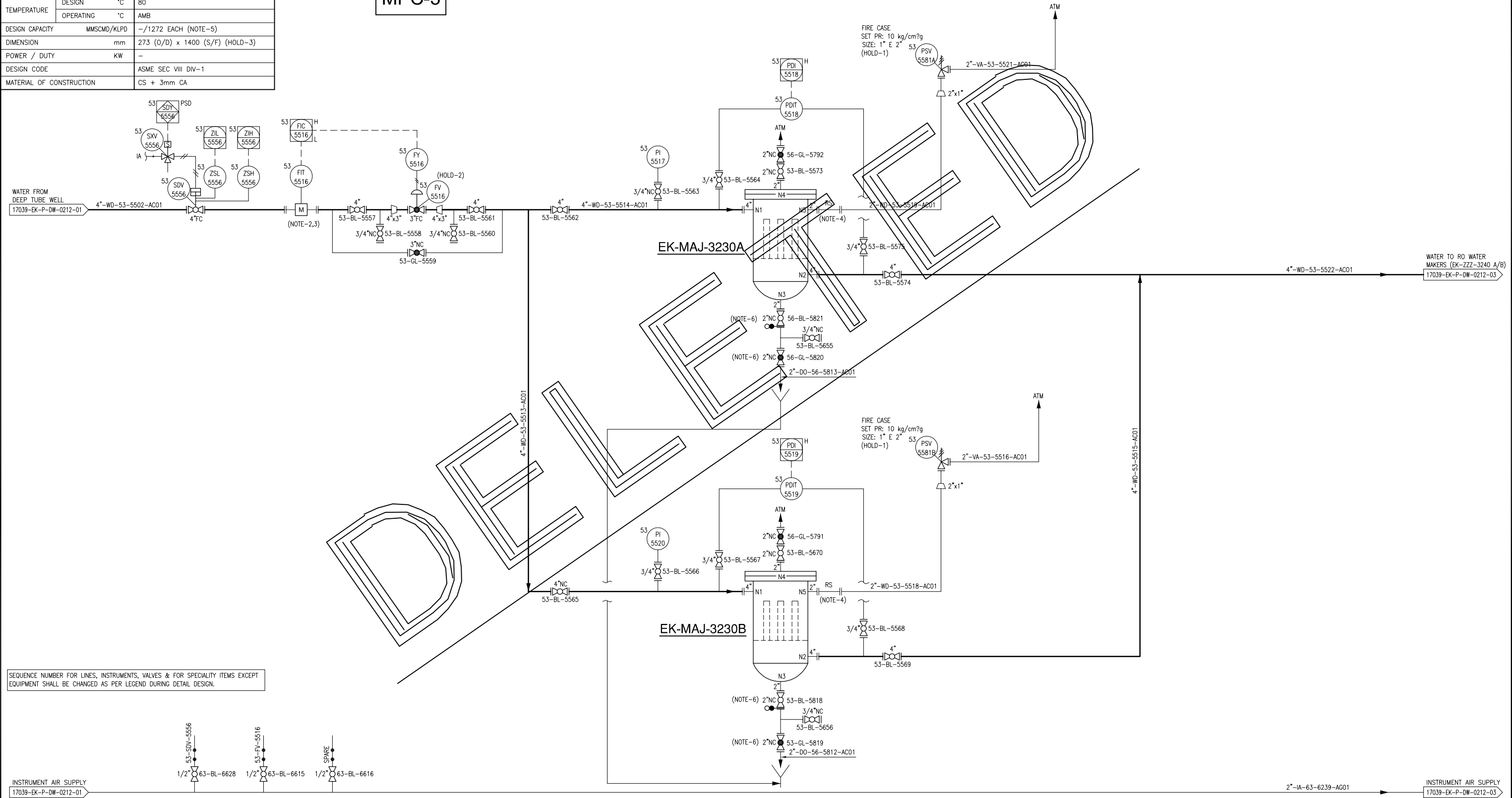
ITEM NUMBER		ND-ABJ-3220	ND-MAJ-3210 A/B	TAG NUMBER	ND-PBA-3280 A/B/C
DESCRIPTION		INDUSTRIAL WATER STORAGE TANK	IRON REMOVAL FILTERS (2x100%)	DESCRIPTION	DEEP WELL PUMPS (3x50%)
TYPE		ATMOSPHERIC TANK, RECTANGULAR	VERTICAL CARTRIDGE	TYPE	CENTRIFUGAL, SUBMERSIBLE
SERVICE		WATER	WATER	SERVICE	RAW WATER
PRESSURE	DESIGN kg/cm ² g	FULL OF WATER+0.07 kg/cm ²	10/FV (HOLD-4)	OPERATING PRESSURE kg/cm ² g	6
	OPERATING kg/cm ² g	ATM	6 (HOLD-4)	DESIGN TEMPERATURE °C	VIA
TEMPERATURE	DESIGN °C	80	80	OPERATING TEMPERATURE °C	VIA
	OPERATING °C	AMB	AMB	DISCHARGE PRESSURE kg/cm ² g	VIA
DESIGN CAPACITY MMSCMD/KLPD		~ /50 KL (NOTE-17)	~ /840 KLPD EACH (NOTE-17)	DIFFERENTIAL PRESSURE kg/cm ²	VIA
DIMENSION mm		3800 (L) x 3500 (W) x 5000 (H) (HOLD-3)	219 (O/D) x 1226 (S/F) (HOLD-3)	DESIGN CAPACITY KLPD	432 (HOLD)
POWER / DUTY kW		—	—	MOTOR DUTY kW	VIA
DESIGN CODE		ROARKS FORMULA FOR STRESS & STRAIN	ASME SEC VIII DIV-1	ABSORBED POWER kW	VIA
MATERIAL OF CONSTRUCTION		CS + 3mm CA	CS + 3mm CA	DESIGN CODE	VIA
				MATERIAL OF CONSTRUCTION	VIA



- NOTES:**
17. INDUSTRIAL WATER STORAGE TANK WILL BE FILLED IN 1hr 25min AND THE FILTER IS DESIGNED FOR 35 m³/hr.
- HOLD:**
1. PSV SIZE AND ITS ASSOCIATED PIPING SIZE PROVIDED ARE PRELIMINARY AND WILL BE CONFIRMED LATER.
2. CONTROL VALVE SIZE, BY-PASS LINE SIZE AND ITS ASSOCIATED PIPING SIZE PROVIDED ARE PRELIMINARY AND WILL BE CONFIRMED LATER.
3. TANK SIZE, EQUIPMENT SIZE PROVIDED ARE PRELIMINARY AND WILL BE CONFIRMED.
4. OPERATING AND DESIGN PRESSURE PROVIDED IS PRELIMINARY AND WILL BE CONFIRMED LATER.
5. THE CAPACITY OF ONE BOREWELL AND NUMBER OF BOREWELL TO BE CONFIRMED DURING DETAIL DESIGN.

NOTES:		10. LIQUID/WATER SEAL LENGTH IS 500mm (MINIMUM).				COMPANY:		PROJECT :	
1. PIPING SHALL BE PROVIDED WITH HIGH POINT VENTS AND LOW POINT DRAINS THESE ARE NOT SHOWN ON P&ID.		11. ALL LEVEL INSTRUMENTS DRAIN SHALL BE ROUTED TO OPEN DRAIN.				Oil India Limited		CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN	
2. SYPHON BREAKING HOLE TO BE PROVIDED ON OVERFLOW LINE.		12. INDUSTRIAL WATER DISTRIBUTION SHALL BE GRAVITY FLOW. HENCE THE STORAGE TANK (ABJ-3220) SHALL BE LOCATED AT THE ELEVATION ABOVE ALL THE USERS.						THIS DRAWING AND ALL DESIGN DETAILS AND DATA SHOWN HEREON, IS THE SOLE PROPERTY OF OIL INDIA LTD AND SHALL NOT BE REPRODUCED IN ANY MANNER OR USED FOR ANY PURPOSE WHATSOEVER, EXCEPT BY WRITTEN PERMISSION OF OIL INDIA LTD.	
3. DP TYPE LEVEL TRANSMITTER.		13. INDUSTRIAL WATER STORAGE TANK IS TWO INTERCONNECTED COMPARTMENTS OF EQUAL CAPACITY TO FACILITATE CLEANING AND REPAIRS.						TITLE :	
4. MAGNETIC TYPE FLOW TRANSMITTER.		14. ALL INSTRUMENTS, VALVES, PSV, EQUIPMENT TAG NO'S WILL BE PREFIXED BY UNIT 'ND'.				EPCM CONSULTANT :		PIPING AND INSTRUMENTATION DIAGRAM	
5. PIPING SHALL BE PROVIDED WITH STRAIGHT LENGTH OF 5D UPSTREAM AND 3D DOWNSTREAM OF 53-FIT-5501.		15. OUTLET PROVIDED WITH BUG SCREEN.				KAVIN™		INDUSTRIAL WATER SYSTEM	
6. MINIMUM RAW WATER REQUIRED FOR CONTINUOUS OPERATION IS 36 m ³ /hr FROM BORE WELL. MINIMUM 2 BORE WELL SHALL BE REQUIRED. THE FIRE WATER TANKS WILL BE FILLED IN APPROXIMATELY (24 hrs).		16. MINIMUM RAW WATER REQUIRED FOR CONTINUOUS OPERATION IS 36 m ³ /hr FROM BORE WELL. MINIMUM 2 BORE WELL SHALL BE REQUIRED. THE FIRE WATER TANKS WILL BE FILLED IN APPROXIMATELY (24 hrs).						PROJECT NO.: KIP-17039	
7. MAGNETIC LEVEL GAUGE.		17. THE GIVEN SCHEME IS PRELIMINARY, BASED ON THE WATER QUALITY THE RAW WATER SYSTEM SCHEME SHALL BE OPTIMIZED.						PROJECT SITE: NADUA	
8. REMOVABLE SPOOL PIECE FOR MAINTENANCE PURPOSE.								DRAWING NO.: 17039-ND-P-DW-0212-01	
9. SPARE NOZZLE.								REV: B	
								SHEET : 1 OF 1	
								SCALE : NTS	

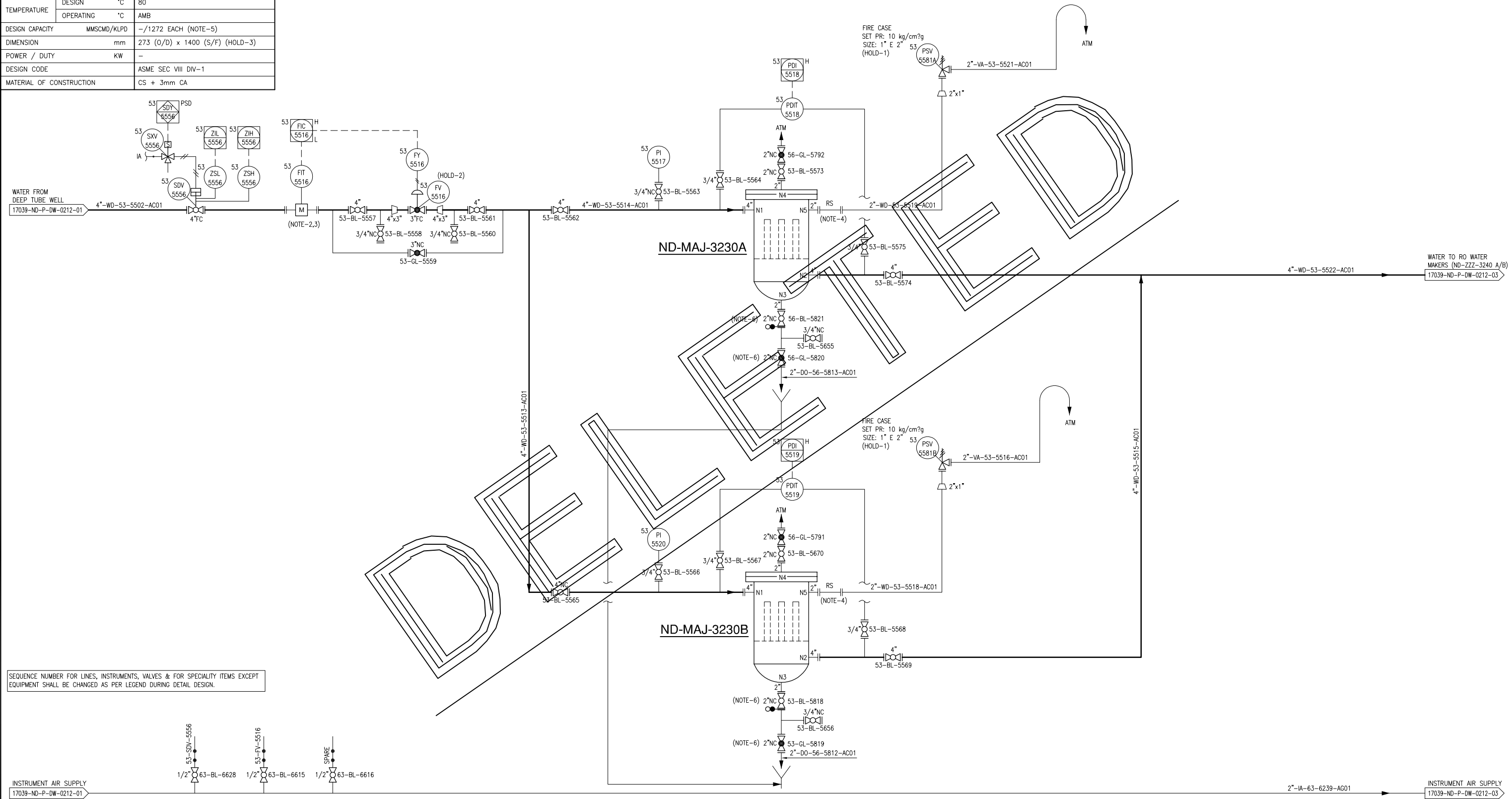
ITEM NUMBER		EK-MAJ-3230 A/B	
DESCRIPTION		POTABLE WATER FILTERS (2x100%)	
TYPE		VERTICAL CARTRIDGE	
SERVICE		POTABLE WATER	
PRESSURE	DESIGN	kg/cm ² g	10/FV (HOLD-4)
	OPERATING	kg/cm ² g	5.8 (HOLD-4)
TEMPERATURE	DESIGN	°C	80
	OPERATING	°C	AMB
DESIGN CAPACITY		MMSCMD/KLPD	~1272 EACH (NOTE-5)
DIMENSION		mm	273 (O/D) x 1400 (S/F) (HOLD-3)
POWER / DUTY		KW	—
DESIGN CODE		ASME SEC VIII DIV-1	
MATERIAL OF CONSTRUCTION		CS + 3mm CA	



NOTES: 1. HIGH POINT VENTS AND LOW POINT DRAINS ARE NOT SHOWN ON P&ID. THESE WILL BE SHOWN ON PIPING ISOMETRICS. 2. PIPING SHALL BE PROVIDED WITH STRAIGHT LENGTH OF 5D UPSTREAM AND 3D DOWNSTREAM OF 53-FT-5516. 3. MAGNETIC TYPE FLOW TRANSMITTER. 4. REMOVABLE SPOOL PIECE FOR MAINTENANCE PURPOSE. 5. POTABLE WATER SYSTEM SHALL BE DESIGNED FOR THE CAPACITY OF 100 US GALLON/ PERSON/ DAY FOR 80 PERSONS. 6. FILTERS SHALL BE COMPLETELY DEPRESSURIZED PRIOR TO OPENING THESE VALVES IN ORDER TO AVOID OVERPRESSURE IN DOWN STREAM SYSTEM. 7. ALL INSTRUMENTS, VALVES, PSV, EQUIPMENT TAG NO'S WILL BE PREFIXED BY UNIT 'EK'.		HOLD: 1. PSV SIZE AND ITS ASSOCIATED PIPING SIZE PROVIDED ARE PRELIMINARY AND WILL BE CONFIRMED LATER. 2. CONTROL VALVE SIZE, BY-PASS LINE SIZE AND ITS ASSOCIATED LINE SIZE PROVIDED ARE PRELIMINARY AND WILL BE CONFIRMED LATER. 3. EQUIPMENT SIZE PROVIDED IS PRELIMINARY AND WILL BE CONFIRMED. 4. OPERATING AND DESIGN PRESSURE PROVIDED IS PRELIMINARY AND WILL BE CONFIRMED LATER.		<table><tr><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>B</td><td>23 FEB 18</td><td>ISSUED FOR BID</td><td>MG</td><td>PSN/TKV</td><td>MSB/MSR</td></tr><tr><td>A</td><td>12 DEC 17</td><td>ISSUED FOR REVIEW</td><td>MG</td><td>PSN/TKV</td><td>MSB/MSR</td></tr><tr><td>REV</td><td>DATE</td><td>DESCRIPTION</td><td>BY</td><td>CHK.</td><td>APPR.</td></tr></table>																																												B	23 FEB 18	ISSUED FOR BID	MG	PSN/TKV	MSB/MSR	A	12 DEC 17	ISSUED FOR REVIEW	MG	PSN/TKV	MSB/MSR	REV	DATE	DESCRIPTION	BY	CHK.	APPR.	COMPANY:  अॉयल इंडिया लिमिटेड Oil India Limited EPCM CONSULTANT:  KAVINTM		PROJECT : CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN THIS DRAWING AND ALL DESIGN DETAILS AND DATA SHOWN HEREON, IS THE SOLE PROPERTY OF OIL INDIA LTD AND SHALL NOT BE REPRODUCED IN ANY MANNER OR USED FOR ANY PURPOSE WHATSOEVER, EXCEPT BY WRITTEN PERMISSION OF OIL INDIA LTD. TITLE : PIPING AND INSTRUMENTATION DIAGRAM POTABLE WATER FILTERS PROJECT NO.: KIP-17039PROJECT SITE: EAST KHAGORIJAN DRAWING NO.: 17039-EK-P-DW-0212-02REV: B SHEET : 1 OF 1SCALE : NTS			
B	23 FEB 18	ISSUED FOR BID	MG	PSN/TKV	MSB/MSR																																																																		
A	12 DEC 17	ISSUED FOR REVIEW	MG	PSN/TKV	MSB/MSR																																																																		
REV	DATE	DESCRIPTION	BY	CHK.	APPR.																																																																		

ITEM NUMBER		ND-MAJ-3230 A/B	
DESCRIPTION		POTABLE WATER FILTERS (2x100%)	
TYPE		VERTICAL CARTRIDGE	
SERVICE		POTABLE WATER	
PRESSURE	DESIGN	kg/cm ² g	10/FV (HOLD-4)
	OPERATING	kg/cm ² g	5.8 (HOLD-4)
TEMPERATURE	DESIGN	°C	80
	OPERATING	°C	AMB
DESIGN CAPACITY		MMSCMD/KLPD	~1272 EACH (NOTE-5)
DIMENSION		mm	273 (O/D) x 1400 (S/F) (HOLD-3)
POWER / DUTY		KW	—
DESIGN CODE		ASME SEC VIII DIV-1	
MATERIAL OF CONSTRUCTION		CS + 3mm CA	

MPC-3

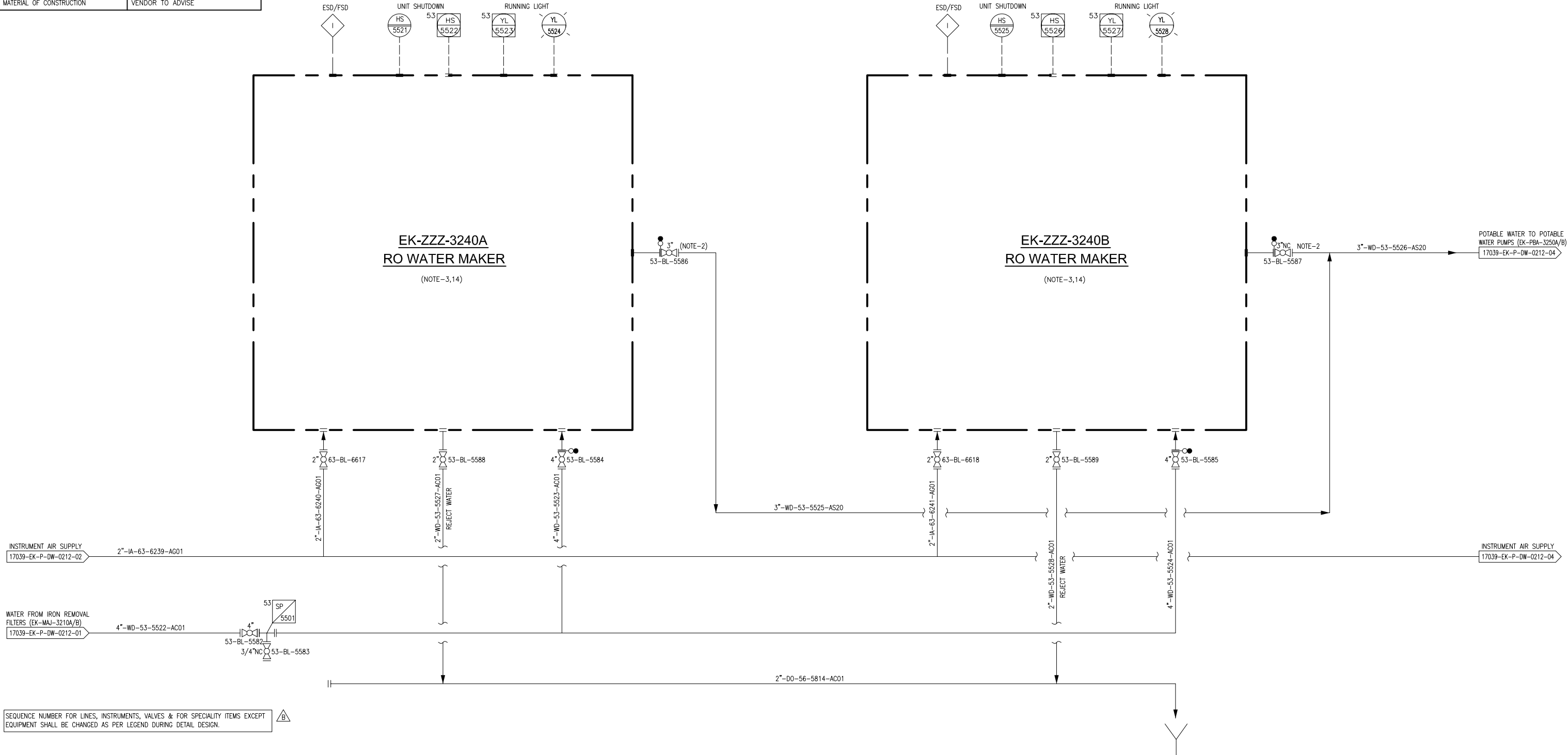


SEQUENCE NUMBER FOR LINES, INSTRUMENTS, VALVES & FOR SPECIALITY ITEMS EXCEPT EQUIPMENT SHALL BE CHANGED AS PER LEGEND DURING DETAIL DESIGN.

NOTES: 1. HIGH POINT VENTS AND LOW POINT DRAINS ARE NOT SHOWN ON P&ID. THESE WILL BE SHOWN ON PIPING ISOMETRICS. 2. PIPING SHALL BE PROVIDED WITH STRAIGHT LENGTH OF 5D UPSTREAM AND 3D DOWNSTREAM OF 53-FT-5516. 3. MAGNETIC TYPE FLOW TRANSMITTER. 4. REMOVABLE SPOOL PIECE FOR MAINTENANCE PURPOSE. 5. POTABLE WATER SYSTEM SHALL BE DESIGNED FOR THE CAPACITY OF 100 US GALLON/ PERSON/ DAY FOR 50 PERSONS. 6. FILTERS SHALL BE COMPLETELY DEPRESSURIZED PRIOR TO OPENING THESE VALVES IN ORDER TO AVOID OVERPRESSURE IN DOWN STREAM SYSTEM. 7. ALL INSTRUMENTS, VALVES, PSV, EQUIPMENT TAG NO'S WILL BE PREFIXED BY UNIT 'ND'.	HOLD: 1. PSV SIZE AND ITS ASSOCIATED PIPING SIZE PROVIDED ARE PRELIMINARY AND WILL BE CONFIRMED LATER. 2. CONTROL VALVE SIZE, BY-PASS LINE SIZE AND ITS ASSOCIATED LINE SIZE PROVIDED ARE PRELIMINARY AND WILL BE CONFIRMED LATER. 3. EQUIPMENT SIZE PROVIDED IS PRELIMINARY AND WILL BE CONFIRMED. 4. OPERATING AND DESIGN PRESSURE PROVIDED IS PRELIMINARY AND WILL BE CONFIRMED LATER.							COMPANY: 	PROJECT : CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJJAN THIS DRAWING AND ALL DESIGN DETAILS AND DATA SHOWN HEREON, IS THE SOLE PROPERTY OF OIL INDIA LTD AND SHALL NOT BE REPRODUCED IN ANY MANNER OR USED FOR ANY PURPOSE WHATSOEVER, EXCEPT BY WRITTEN PERMISSION OF OIL INDIA LTD.		
											EPCM CONSULTANT : 
B	12 FEB 18	ISSUED FOR BID	MG	PSN/TKV	MSB/MSR			TITLE : PIPING AND INSTRUMENTATION DIAGRAM POTABLE WATER FILTERS			
A	12 DEC 17	ISSUED FOR REVIEW	MG	PSN/TKV	MSB/MSR						
REV	DATE	DESCRIPTION	BY	CHK	APPR.						
								PROJECT NO.: KIP-17039	PROJECT SITE: NADUA		
DRAWING NO.: 17039-ND-P-DW-0212-02								REV: B	SHEET : 1 OF 1	SCALE : NTS	

TAG NUMBER		EK-ZZZ-3240 A/B	
DESCRIPTION		RO WATER MAKERS (2x100%)	
TYPE		REVERSE OSMOSIS	
SERVICE		WATER	
PRESSURE	DESIGN	kg/cm ² g	10/FV (HOLD-3)
	OPERATING	kg/cm ² g	5.8 (HOLD-3)
TEMPERATURE	DESIGN	°C	80
	OPERATING	°C	AMB
DESIGN CAPACITY (MMSCMD/KLPD)		~ /840 (NOTE-5)	
DIMENSION		mm	—
POWER/DUTY		kW	—
DESIGN CODE		—	
MATERIAL OF CONSTRUCTION		VENDOR TO ADVISE	

MPC-3



NOTES:

1. PIPING SHALL BE PROVIDED WITH HIGH POINT VENT AND LOW POINT DRAINS. THESE ARE NOT SHOWN ON P&IDs.
2. VALVE SHALL BE LOCATED AS CLOSE AS POSSIBLE TO RO WATER MAKER UNIT.
3. RO WATER MAKERS TO MEET "BIS 10500" STANDARD SPECIFICATIONS FOR POTABLE WATER.
4. RO WATER MAKER EFFICIENCY IS CONSIDERED AS 25%. HENCE THE OUTLET FROM RO WATER TO POTABLE WATER STORAGE TANK IS 210 KLPD.
5. RO WATER MAKER CAPACITY IS CONSIDERED AS 840 KLPD.
6. ALL INSTRUMENTS, VALVES, PSV, EQUIPMENT TAG NO'S WILL BE PREFIXED BY UNIT 'EK'.
7. WHEREVER DISSIMILAR MATERIALS ARE TO BE CONNECTED BY MEANS OF GASKETED FLANGE, INSULATING GASKET SHALL BE USED.

HOLD:

1. RO WATER MAKER DESIGN DETAILS WILL BE PROVIDED BASED ON VENDOR INFORMATION.
2. RO WATER MAKER EFFICIENCY WILL BE CONFIRMED BASED ON VENDOR INFORMATION DURING DETAIL ENGINEERING.
3. OPERATING AND DESIGN PRESSURE PROVIDED IS PRELIMINARY AND WILL BE CONFIRMED LATER.

B	23 FEB 18	ISSUED FOR BID	MC	PSN/TKV	MSB/MSR	
A	12 DEC 17	ISSUED FOR REVIEW	MC	PSN/TKV	MSB/MSR	
REV	DATE	DESCRIPTION	BY	CHK.	APPR.	

COMPANY:

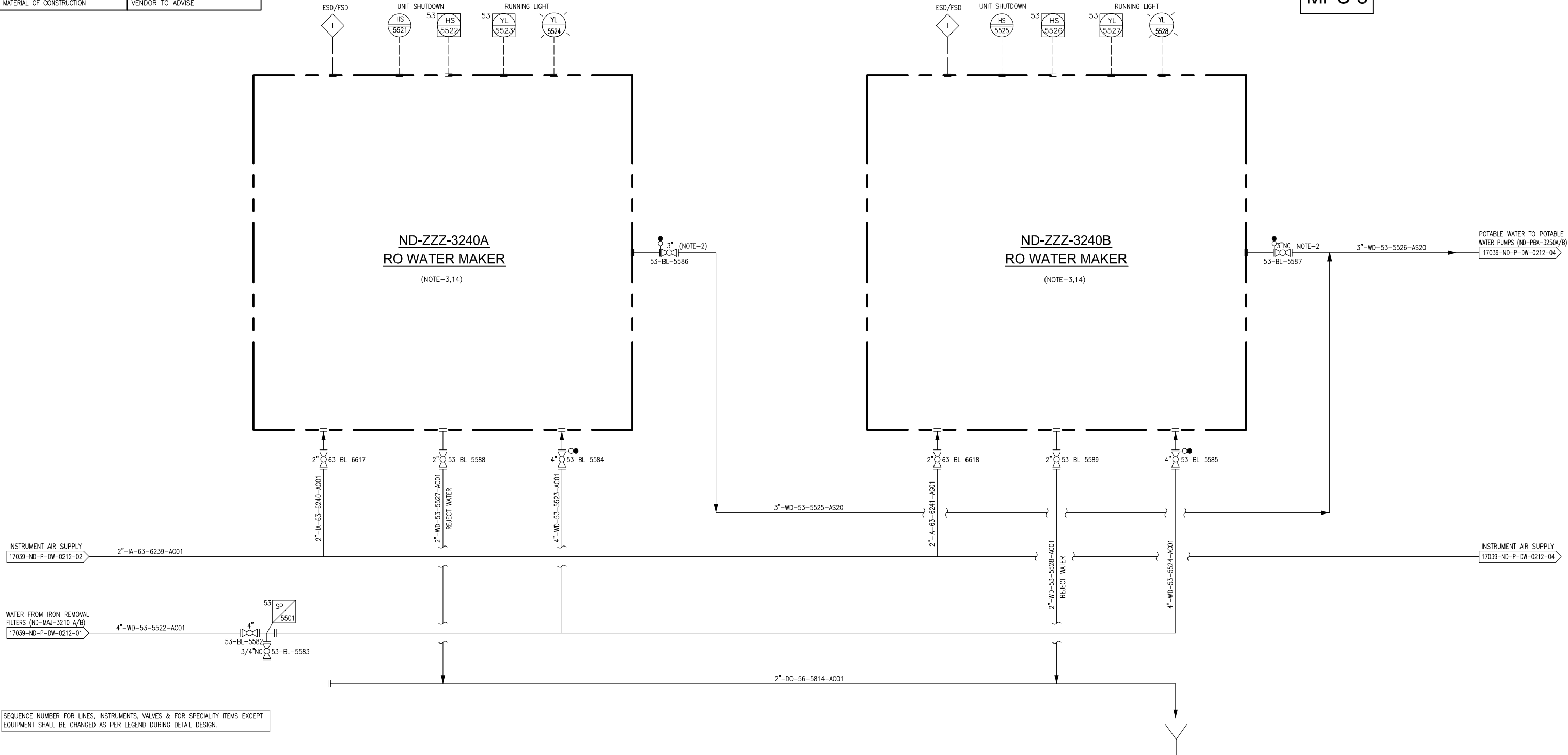


EPCM CONSULTANT :



PROJECT : CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJJAN			
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TITLE : PIPING AND INSTRUMENTATION DIAGRAM RO WATER MAKERS			
PROJECT NO.: KIP-17039	PROJECT SITE:	EAST KHAGORIJJAN	
DRAWING NO.: 17039-EK-P-DW-0212-03	REV: B	SHEET : 1 OF 1	SCALE : NTS

TAG NUMBER		ND-ZZZ-3240 A/B	
DESCRIPTION		RO WATER MAKERS (2x100%)	
TYPE		REVERSE OSMOSIS	
SERVICE		WATER	
PRESSURE	DESIGN	kg/cm ² g	10/FV (HOLD-3)
	OPERATING	kg/cm ² g	5.8 (HOLD-3)
TEMPERATURE	DESIGN	°C	80
	OPERATING	°C	AMB
DESIGN CAPACITY (MMSCMD/KLPD)		~ /840 (NOTE-5)	
DIMENSION		mm	-
POWER/DUTY		kW	-
DESIGN CODE		-	
MATERIAL OF CONSTRUCTION		VENDOR TO ADVISE	



NOTES:

1. PIPING SHALL BE PROVIDED WITH HIGH POINT VENT AND LOW POINT DRAINS, THESE ARE NOT SHOWN ON P&IDs.
2. VALVE SHALL BE LOCATED AS CLOSE AS POSSIBLE TO RO WATER MAKER UNIT.
3. RO WATER MAKERS TO MEET "BIS 10500" STANDARD SPECIFICATIONS FOR POTABLE WATER.
4. RO WATER MAKER EFFICIENCY IS CONSIDERED AS 25%. HENCE THE OUTLET FROM RO WATER TO POTABLE WATER STORAGE TANK IS 210 KLPD.
5. RO WATER MAKER CAPACITY IS CONSIDERED AS 840 KLPD.
6. ALL INSTRUMENTS, VALVES, PSV, EQUIPMENT TAG NO'S WILL BE PREFIXED BY UNIT 'ND'.
7. WHEREVER DISSIMILAR MATERIALS ARE TO BE CONNECTED BY MEANS OF GASKETED FLANGE, INSULATING GASKET SHALL BE USED.

HOLD:

1. RO WATER MAKER DESIGN DETAILS WILL BE PROVIDED BASED ON VENDOR INFORMATION.
2. RO WATER MAKER EFFICIENCY WILL BE CONFIRMED BASED ON VENDOR INFORMATION DURING DETAIL ENGINEERING.
3. OPERATING AND DESIGN PRESSURE PROVIDED IS PRELIMINARY AND WILL BE CONFIRMED LATER.

B	12 FEB 18	ISSUED FOR BID	MC	PSN/TKV	MSB/MSR	
A	12 DEC 17	ISSUED FOR REVIEW	MC	PSN/TKV	MSB/MSR	
REV	DATE	DESCRIPTION	BY	CHK.	APPR.	

COMPANY:



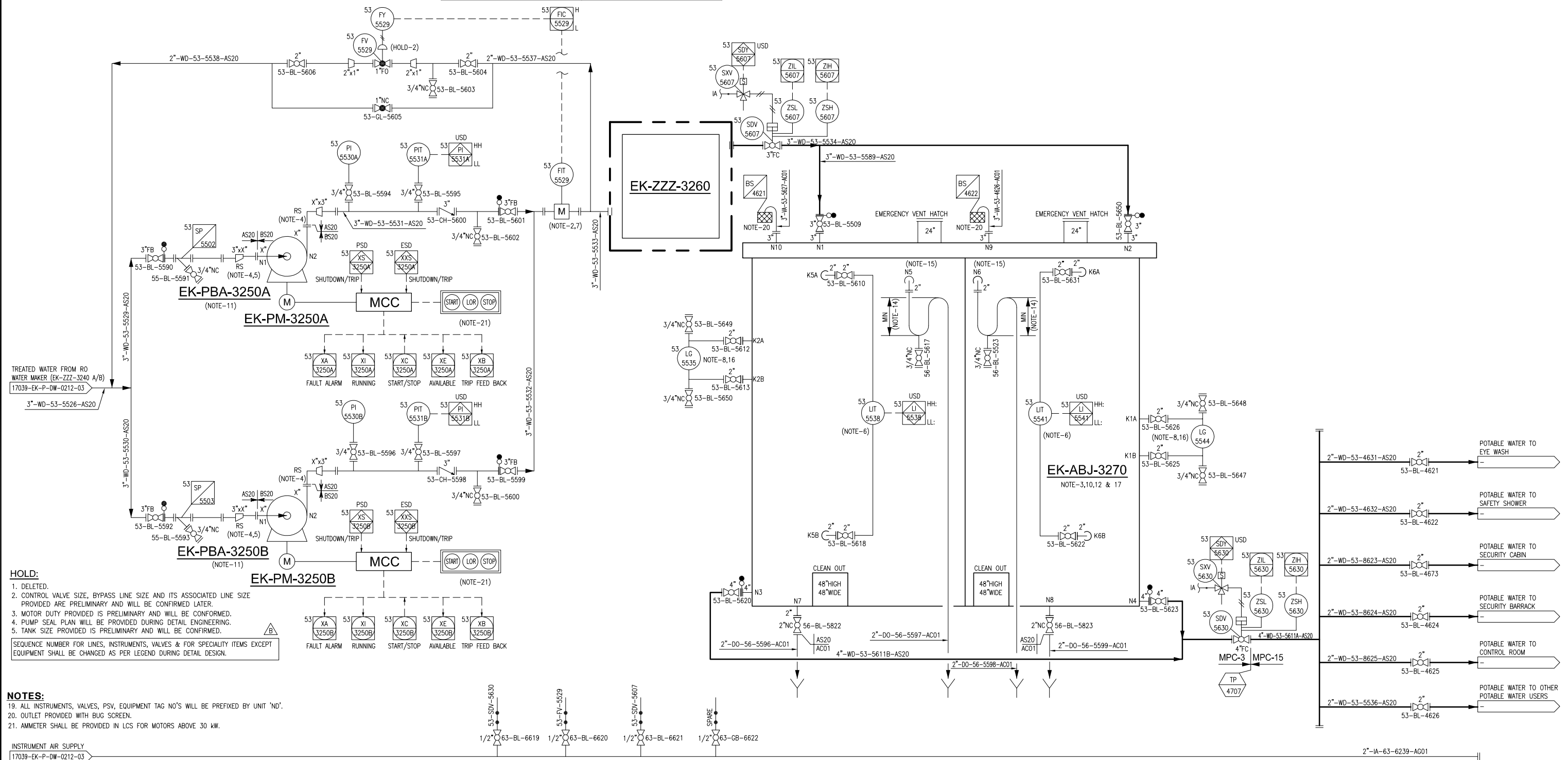
EPCM CONSULTANT :



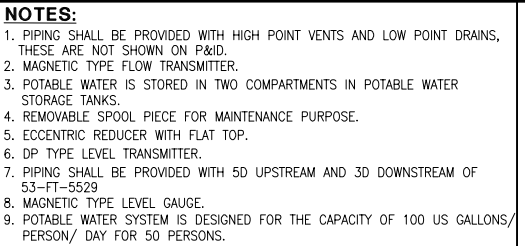
PROJECT : CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJJAN			
THIS DRAWING AND ALL DESIGN DETAILS AND DATA SHOWN HEREON, IS THE SOLE PROPERTY OF OIL INDIA LTD AND SHALL NOT BE REPRODUCED IN ANY MANNER OR USED FOR ANY PURPOSE WHATSOEVER, EXCEPT BY WRITTEN PERMISSION OF OIL INDIA LTD.			
TITLE : PIPING AND INSTRUMENTATION DIAGRAM RO WATER MAKERS			
PROJECT NO.: KIP-17039		PROJECT SITE:	NADUA
DRAWING NO.:	17039-ND-P-DW-0212-03	REV: B	SHEET : 1 OF 1 SCALE : NTS

TAG NUMBER		EK-ABJ-3270	EK-ZZZ-3260	TAG NUMBER	EK-PBA-3250 A/B
DESCRIPTION		POTABLE WATER STORAGE TANK	UV STERILIZER UNIT	DESCRIPTION	POTABLE WATER PUMPS (2x100%)
TYPE		ATMOSPHERIC TANK, RECTANGULAR	MEMBRANE	TYPE	CENTRIFUGAL
SERVICE		POTABLE WATER	POTABLE WATER	SERVICE	POTABLE WATER
PRESSURE	DESIGN	kg/cm² g	FULL OF WATER+0.07 kg/cm²	DESIGN PRESSURE	kg/cm² g
	OPERATING	kg/cm² g	ATM	DESIGN TEMPERATURE	°C
TEMPERATURE	DESIGN	°C	80	OPERATING TEMPERATURE	°C
	OPERATING	°C	AMB	DISCHARGE PRESSURE	kg/cm²
DESIGN CAPACITY (MMSCMD/KLPD)		~ /66KL	~ /210	DIFFERENTIAL PRESSURE	4
DIMENSION		mm	4800 (W) x 3500 (W) x 5000 (H) (HOLD-5)	DESIGN CAPACITY	KLPD
POWER/DUTY		kW	—	ABSORBED POWER	kW
DESIGN CODE		ROARKS FORMULA FOR STRESS & STRAIN	—	MOTOR DUTY	kW
MATERIAL OF CONSTRUCTION		SS 316L	VENDOR TO ADVISE	DESIGN CODE	API-610
				MATERIAL OF CONSTRUCTION	SS 316

MPC-3



NOTES: 1. PIPING SHALL BE PROVIDED WITH HIGH POINT VENTS AND LOW POINT DRAINS, THESE ARE NOT SHOWN ON P&ID. 2. MAGNETIC TYPE FLOW TRANSMITTER. 3. POTABLE WATER IS STORED IN TWO COMPARTMENTS IN POTABLE WATER STORAGE TANKS. 4. REMOVABLE SPOOL PIECE FOR MAINTENANCE PURPOSE. 5. ECCENTRIC REDUCER WITH FLAT TOP. 6. DP TYPE LEVEL TRANSMITTER. 7. PIPING SHALL BE PROVIDED WITH 5D UPSTREAM AND 3D DOWNSTREAM OF 53-TT-5529. 8. MAGNETIC TYPE LEVEL GAUGE. 9. POTABLE WATER SYSTEM IS DESIGNED FOR THE CAPACITY OF 100 US GALLONS/ PERSON/ DAY FOR 50 PERSONS.		10. POTABLE WATER DISTRIBUTION SHALL BE GRAVITY FLOW. HENCE THE POTABLE WATER STORAGE TANK (ABJ-3270) SHALL BE LOCATED AT THE ELEVATION ABOVE ALL THE USERS. MINIMUM SUPPLY PRESSURE AT THE LAST CONSUMER OF THE UNIT SHALL BE 1 Kg/cm ² g. 11. STANDBY PUMP SHALL START AUTOMATICALLY IF THE DUTY PUMP TRIPS. 12. POTABLE WATER STORAGE TANK (ABJ-3270) IS DESIGNED FOR 3.5 DAYS STORAGE CAPACITY. 13. PUMP DUTY INCLUDES 10% MARGIN WITH 75% ADIABATIC EFFICIENCY. 14. LIQUID/WATER SEAL LENGTH IS 500mm (MINIMUM). 15. SYPHON BREAKING HOLE TO BE PROVIDED ON OVER FLOW LINE. 16. ALL LEVEL INSTRUMENTS VENT & DRAIN SHALL BE ROUTED TO FLARE HEADER AND OPEN DRAIN HEADER RESPECTIVELY. 17. POTABLE WATER STORAGE TANK IS TWO INTERCONNECTED COMPARTMENTS OF EQUAL CAPACITY TO FACILITATE CLEANING AND REPAIRS.		COMPANY:  EPCM CONSULTANT: 		PROJECT : CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN THIS DRAWING AND ALL DESIGN DETAILS AND DATA SHOWN HEREON, IS THE SOLE PROPERTY OF OIL INDIA LTD AND SHALL NOT BE REPRODUCED IN ANY MANNER OR USED FOR ANY PURPOSE WHATSOEVER, EXCEPT BY WRITTEN PERMISSION OF OIL INDIA LTD. TITLE : PIPING AND INSTRUMENTATION DIAGRAM POTABLE WATER STORAGE TANK PROJECT NO.: KIP-17039 DRAWING NO.: 17039-EK-P-DW-0212-04		PROJECT SITE: EAST KHAGORIJAN REV: B SHEET : 1 OF 1 SCALE : NTS	

MPC-3

10. POTABLE WATER DISTRIBUTION SHALL BE GRAVITY FLOW. HENCE THE POTABLE WATER STORAGE TANK (ABJ-3270) SHALL BE LOCATED AT THE ELEVATION ABOVE ALL THE USERS. MINIMUM SUPPLY PRESSURE AT THE LAST CONSUMER OF THE UNIT SHALL BE 1 kg/cm²g.
11. STANDBY PUMP SHALL START AUTOMATICALLY IF THE DUTY PUMP TRIPS.
12. POTABLE WATER STORAGE TANK (ABJ-3270) IS DESIGNED FOR 3.5 DAYS STORAGE CAPACITY.
13. PUMP DUTY INCLUDES 10% MARGIN WITH 75% ADIABATIC EFFICIENCY.
14. LIQUID/WATER SEAL LENGTH IS 500mm (MINIMUM)
15. SYPHON BREAKING HOLE TO BE PROVIDED ON OVER FLOW LINE.
16. ALL LEVEL INSTRUMENTS VENT & DRAIN SHALL BE ROUTED TO FLARE HEADER AND OPEN DRAIN HEADER RESPECTIVELY.
17. POTABLE WATER STORAGE TANK IS TWO INTERCONNECTED COMPARTMENTS OF EQUAL CAPACITY TO FACILITATE CLEANING AND REPAIRS.

B	12 FEB 18	ISSUED FOR BID	MG	PSN/TKV	MSB/MSR
A	12 DEC 17	ISSUED FOR REVIEW	MG	PSN/TKV	MSB/MSR
REV	DATE	DESCRIPTION	BY	CHK.	APPR.



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Oil India Limited

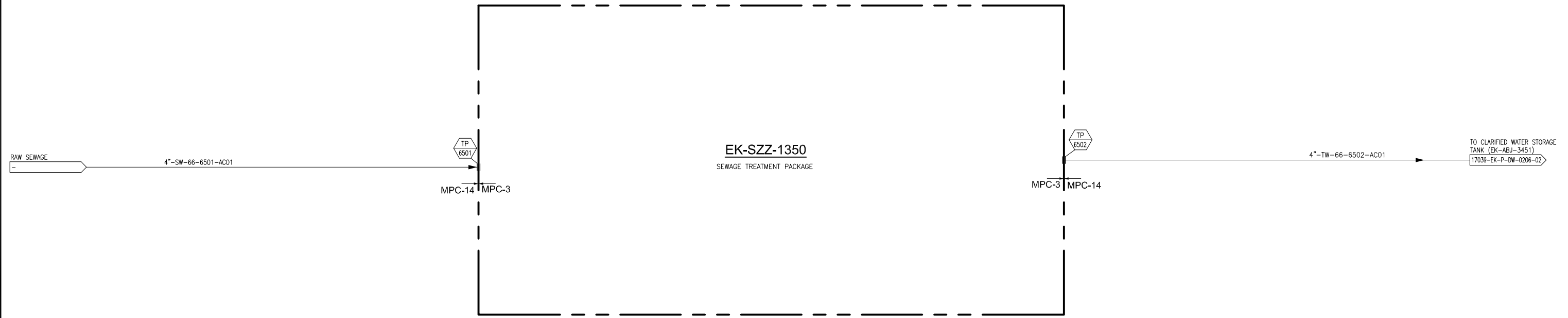


KAVINTM

PROJECT :				CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN			
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TITLE :		PIPING AND INSTRUMENTATION DIAGRAM POTABLE WATER STORAGE TANK					
PROJECT NO. : KIP-17039				PROJECT SITE :		NADUA	
DRAWING NO. :		17039-ND-P-DW-0212-04		REV. : B	SHEET : 1 OF 1		SCALE : NTS

TAG NUMBER		EK-SZZ-1350
DESCRIPTION		SEWAGE TREATMENT PACKAGE
TYPE		–
SERVICE		SEWAGE
PRESSURE	DESIGN kg/cm ² g	VTA
	OPERATING kg/cm ² g	VTA
TEMPERATURE	DESIGN °C	VTA
	OPERATING °C	VTA
DESIGN CAPACITY m ³ /hr/KLPD		VTA
DIMENSION mm		VTA
DESIGN CODE		VTA
MATERIAL OF CONSTRUCTION		VTA

MPC-3



SEQUENCE NUMBER FOR LINES, INSTRUMENTS, VALVES & FOR SPECIALITY ITEMS EXCEPT EQUIPMENT SHALL BE CHANGED AS PER LEGEND DURING DETAIL DESIGN.

B

NOTES:
1. SEWAGE TREATMENT PACKAGE SHALL BE DESIGNED FOR 50 PERSONS.
2. SEWAGE TREATMENT SYSTEM TO BE DESIGNED AS PER THE PCB/CPCB NORMS.
3. EFFLUENT WATER OUTLET SPECIFICATION ARE
(i) OIL IN WATER < 10 ppm
(ii) SLUDGE CONTENT – NIL
(iii) OUTLET TEMPERATURE – 51°C
(iv) pH–6.5–8.5
(v) TSS–98% REMOVAL OF SUSPENDED SOLIDS > 10 MICRONS
(vi) DISSOLVED OXYGEN <0.2 ppm
(vii) SRB–NIL
(viii) ANY OTHER BACTERIAL ACTIVITY LIKE GAB, IRB & APB–NIL.
(IX) OIL AND GREASE –< 10mg/l

HOLD:
1. ALL LINE SIZES.

B	23 FEB 18	ISSUED FOR BID	MG	PSN/TKV	MSB/MSR	
A	07 DEC 17	ISSUED FOR REVIEW	MG	PSN/TKV	MSB/MSR	
REV	DATE	DESCRIPTION	BY	CHK.	APPR.	

COMPANY:



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Oil India Limited

EPCM CONSULTANT :

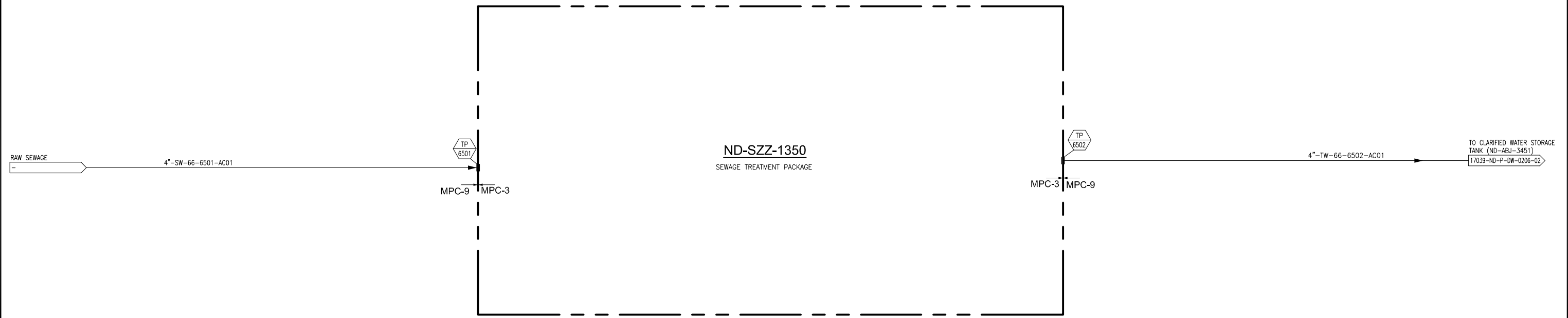


KAVINTM

PROJECT : CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN			
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TITLE : PIPING AND INSTRUMENTATION DIAGRAM SEWAGE TREATMENT PACKAGE (EK-SZZ-1350)			
PROJECT NO.: KIP-17039		PROJECT SITE:	EAST KHAGORIJAN
DRAWING NO.:	17039-EK-P-DW-0218-01	REV: B	SHEET : 1 OF 1 SCALE : NTS

TAG NUMBER		ND-SZZ-1350
DESCRIPTION		SEWAGE TREATMENT PACKAGE
TYPE		–
SERVICE		SEWAGE
PRESSURE	DESIGN $\text{kg/cm}^2 \text{ g}$	VTA
	OPERATING $\text{kg/cm}^2 \text{ g}$	VTA
TEMPERATURE	DESIGN $^{\circ}\text{C}$	VTA
	OPERATING $^{\circ}\text{C}$	VTA
DESIGN CAPACITY $\text{m}^3/\text{hr/KLPD}$		VTA
DIMENSION mm		VTA
DESIGN CODE		VTA
MATERIAL OF CONSTRUCTION		VTA

MPC-3



SEQUENCE NUMBER FOR LINES, INSTRUMENTS, VALVES & FOR SPECIALITY ITEMS EXCEPT EQUIPMENT SHALL BE CHANGED AS PER LEGEND DURING DETAIL DESIGN.



NOTES:
1. SEWAGE TREATMENT PACKAGE SHALL BE DESIGNED FOR 50 PERSONS.
2. SEWAGE TREATMENT SYSTEM TO BE DESIGNED AS PER THE PCB/CPCB NORMS.
3. EFFLUENT WATER OUTLET SPECIFICATION ARE
(i) OIL IN WATER < 10 ppm
(ii) SLUDGE CONTENT – NIL
(iii) OUTLET TEMPERATURE – 51°C
(iv) pH–6.5–8.5
(v) TSS–98% REMOVAL OF SUSPENDED SOLIDS > 10 MICRONS
(vi) DISSOLVED OXYGEN <0.2 ppm
(vii) SRB–NIL
(viii) ANY OTHER BACTERIAL ACTIVITY LIKE GAB, IRB & APB–NIL.
(IX) OIL AND GREASE –< 10mg/l

HOLD:
1. ALL LINE SIZES.

B	07 FEB 18	ISSUED FOR BID	MG	PSN/TKV	MSB/MSR	
A	07 DEC 17	ISSUED FOR REVIEW	MG	PSN/TKV	MSB/MSR	
REV	DATE	DESCRIPTION	BY	CHK.	APPR.	

COMPANY:


EPCM CONSULTANT :


PROJECT : CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN			
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TITLE : PIPING AND INSTRUMENTATION DIAGRAM SEWAGE TREATMENT PACKAGE (ND-SZZ-1350)			
PROJECT NO.: KIP-17039		PROJECT SITE:	NADUA
DRAWING NO.:	17039-ND-P-DW-0218-01	REV: B	SHEET : 1 OF 1 SCALE : NTS

CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN

Document Title : MPC-3 PROCESS DESIGN BASIS

Kavin Document No. : 17039-EK-P-DB-1001

B	08 FEB 2018	ISSUED FOR BID	MG	PSN/TKV	MSB/MSR
A	23 NOV 2017	ISSUED FOR REVIEW	MG	PSN/TKV	MSB/MSR
REV.	DATE	DESCRIPTION	BY	CHECKED	APPROVED

PROJECT DOCUMENTS ARE CONTROLLED DOCUMENTS.
REVISIONS ARE DENOTED AS | IN RIGHT HAND MARGIN

COMPANY:

OIL INDIA LIMITED

EPCM CONSULTANT:

**KAVIN ENGINEERING AND SERVICES
PRIVATE LIMITED**

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN PROCESS DESIGN BASIS	Doc No : 17039-EK-P-DB-1001 Rev : B Page : 4 of 33
 KAVIN™		

TABLE OF CONTENTS

1.0	INTRODUCTION	9
2.0	OBJECTIVE.....	10
3.0	CODES AND STANDARDS	11
3.1	PRODUCED WATER ANALYSIS.....	12
3.2	EFFLUENT WATER TREATMENT PACKAGE INLET PARAMETRS	12
3.3	DESIGN LIFE	13
3.4	LIST OF SOFTWARES	13
4.0	PRODUCT SPECIFICATION	14
4.1	PRODUCED WATER / EFFLUENT WATER/SEWAGE DISCHARGE	14
4.2	EFFLUENT WATER TREATMENT SYSTEM	14
4.3	OILY WATER COLLECTION SYSTEM.....	15
4.4	RAW WATER TREATMENT SYSTEM.....	16
4.5	SEWAGE TREATMENT SYSTEM	17
5.0	PROCESS DESIGN CRITERIA	19
5.1	PROCESS EQUIPMENT SIZING AND SELECTION	19
5.1.1	<i>VESSELS</i>	<i>19</i>
5.1.2	<i>SIZING CRITERIA FOR INLET AND OUTLET NOZZLES.....</i>	<i>22</i>
5.1.2.1	<i>TWO PHASE AND THREE PHASE SEPARATORS / KOD</i>	<i>22</i>
5.2	DESIGN MARGIN.....	23
5.3	TEMPERATURE APPROACH FOR EXCHANGERS.....	24
5.4	PRESSURE DROP GUIDELINES.....	24
5.5	DESIGN PRESSURE	25
5.5.1	<i>DESIGN PRESSURE OF PRESSURE VESSEL</i>	<i>25</i>
5.5.2	<i>DESIGN PRESSURE OF COMPRESSOR SUCTION SCRUBBER / COOLERS.....</i>	<i>25</i>
5.5.3	<i>DESIGN PRESSURE OF PIPING</i>	<i>25</i>
5.5.4	<i>DESIGN PRESSURE OF COMPRESSOR.....</i>	<i>26</i>
5.6	DESIGN TEMPERATURE.....	26
5.7	LINE SIZING CRITERIA	27
5.7.1	<i>GENERAL.....</i>	<i>27</i>
5.7.2	<i>SIZING CRITERIA FOR SINGLE PHASE LIQUID LINES.....</i>	<i>28</i>
5.7.2.1	<i>GRAVITY FLOW LINES</i>	<i>28</i>
5.7.3	<i>SIZING CRITERIA FOR SINGLE PHASE GAS LINES.....</i>	<i>28</i>
5.7.4	<i>SIZING CRITERIA FOR RELIEF LINES</i>	<i>29</i>
5.8	TURNDOWN REQUIREMENTS	30
5.9	SPARING PHILOSOPHY (INSTALLATION SPARES)	30
6.0	DIMENSION	32

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN PROCESS DESIGN BASIS	Doc No : 17039-EK-P-DB-1001 Rev : B Page : 5 of 33
 KAVIN™		

7.0	REFERENCES.....	33

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN PROCESS DESIGN BASIS	Doc No : 17039-EK-P-DB-1001
		Rev : B Page : 6 of 33

ABBREVIATION

ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
BBL	Barrel
BDV	Blow Down Valve
BS&W	Basic Sediment and Water
BTL	Bottom Tan Line
CCR	Central Control Room
CI	Chemical Injection
CPCB	Central Pollution Control Board
CPP	Captive Power Plant
CTF	Central Tank Farm
DCS	Distributed Control System
EK	East Khagorijan
EPCM	Engineering Procurement Construction Management
ESDV	Emergency Shutdown Valve
ETP	Effluent Treatment Plant
FBHP	Flowing Bottom Hole Pressure
FTHP	Flowing Tubing Head Pressure
GED	Gas Engine Driven
GGs	Group Gathering Station
GOR	Gas Oil Ratio
HAZID	Hazard Identification Study
HAZOP	Hazard and Operability Study
HC	Hydrocarbon

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN PROCESS DESIGN BASIS	Doc No : 17039-EK-P-DB-1001
 KAVIN™		Rev : B Page : 7 of 33

HLL	High Liquid Level
HP	High Pressure
IA	Instrument Air
KL	Kilo Litres
KLPD	Kilo Litres Per Day
KOD	Knock Out Drum
LAH	Liquid Alarm High
LAHH	Liquid Alarm High High
LAL	Liquid Alarm Low
LALL	Liquid Alarm Low Low
LLH	Liquid Level High
LLHH	Liquid Level High High
LLL	Liquid Level Low
LLLL	Liquid Level Low Low
LP	Low Pressure
LPM	Litres Per Minute
MCC	Motor Control Centre
MMSCFD	Million Metric Standard Cubic Feet Per Day
MMSCMD	Million Metric Standard Cubic Meters per Day
NB	Nominal Bore
ND	Nadua
NFPA	National Fire Protection Association
NHK	Nahorkatia
NLL	Normal Liquid Level
NPSH	Net Positive Suction Head
OCS	Oil Collecting Station
OISD	Oil Industry Safety Directorate

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN PROCESS DESIGN BASIS	Doc No : 17039-EK-P-DB-1001
		Rev : B Page : 8 of 33

OMR	Oil Mines Regulations
PCB	Pollution Control Board
PFD	Process Flow Diagram
RFP	Requisition For Proposal
P&ID	Piping & Instrumentation Diagram
PPM	Parts Per Million
PSD	Process Shutdown
PSV	Pressure Safety Valve
RAM	Reliability Availability and Maintainability
RP	Recommended Practice
RPM	Rotations Per Minute
RVP	Reid Vapour Pressure
SDV	Shut-Down Valve
STD	Standard
STF	Secondary Tank Farm
TBP	Technical Bid Package
TVP	True Vapour Pressure
UA	Utility Air

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN PROCESS DESIGN BASIS	Doc No : 17039-EK-P-DB-1001 Rev : B Page : 9 of 33
 KAVIN™		

1.0 INTRODUCTION

OIL INDIA LIMITED (OIL) a Government of India Enterprise, proposes to construct two number of Surface Production facilities primarily for separation of Oil, Gas & Water and processing of non-associated & associated gas in its producing field at Nadua and East Khagorijan. The installation will be constructed on Modular design concept with emphasis on skid mounted prefabricated facilities minimizing construction work at site to the extent possible as per functional specifications of various process/utility packages. Instead of permanent civil buildings, containerized offices/structures will be preferred.

KAVIN ENGINEERING AND SERVICES PRIVATE LIMITED is awarded a contract for Engineering Procurement Construction Management to conceptualize / finalize the requirements needed for the Oil Collecting Station (OCS) at Nadua and Group Gathering Station (GGS) at East Khagorijan.

The East Khagorijan (GGS) field is located near Dibrugarh town in Assam at a location approximately 200m south (aerial distance) of LoC# TAI at 27032'N 95009'E approx. elevation 121 M MSL. The field is presently producing from 02 Nos. of wells through a QPS (Quick Production Setup). Considering the potential of the field it is envisaged that Oil production is expected to rise to a level of 1000 KLPD from 06 HP wells, 06 LP wells and 06 Non Associated Gas wells. Associated Gas is expected to be around 0.1 MMSCMD. The East Khagorijan oil field also having the huge amount of non-associated gas potential and it is expected to produce about 1 MMSCMD of non-associated natural gas from this area. It is also expected that the field will produce about 800 KLPD of water along with the 1000 KLPD of crude, so the plant design will be for handling 1800KLPD of total well fluid. Oil India Limited proposes to construct a Group Gathering Station at East Khagorijan to cater to the production in that area.

Pipelines from Oil & Gas wells to the proposed plant and transfer lines for transporting Dry Crude, Separated Gas, treated water from the proposed plant to outside are not in the Project

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN PROCESS DESIGN BASIS	Doc No : 17039-EK-P-DB-1001 Rev : B
 KAVIN™		Page : 10 of 33

scope. Procurement of LAND and construction of boundary wall in the land is not in the project scope and will be done / arranged by OIL separately.

2.0 OBJECTIVE

This document “Process Design basis” defines the basis on which Process and Utility systems are to be designed. It presents an overview of concept / system selection for gas, crude oil and effluent water processing to meet product specification for gas, oil and effluent water. It also provides the basis for all the facilities design involved in Group Gathering Station (GGS) at East Khagorijan.

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN PROCESS DESIGN BASIS	Doc No : 17039-EK-P-DB-1001
		Rev : B Page : 11 of 33

3.0 CODES AND STANDARDS

Table 3.0-1 Codes and Standards

STANDARDS	DESCRIPTION
API 11P	Specification for Packaged Reciprocating Compressors for Oil and Gas Production Services
API 12J	Specification for Oil and Gas Separators
API 2030	Application of Fixed Water Spray Systems for Fire Protection in the Petroleum Industry
API 537	Flare Details for General Refinery and Petrochemical Service
API 650	Welded Steel Tanks for Oil Storage
API RP 14C	Analysis, Design, Installation & Testing of Basic Surface Safety Systems for Offshore Production Platforms
API RP 14E	Design and Installation of Offshore Production Platform Piping Systems
API RP 550	Manual on Installation of Refinery Instruments and Control Systems (Instrumentation)
API STD 521	Guide for Pressure Relieving and Depressurizing Systems
API STD 2000	Venting Atmospheric and Low-Pressure Storage Tanks
API STD 520 Part 1	Sizing, Selection and Installation of Pressure Relieving Devices in Refineries – Sizing and Selection
API STD 520 Part 2	Sizing, Selection and Installation of Pressure Relieving Devices in Refineries – Installation
API STD 526	Flanged steel Pressure Relief Valves
ASME – B31.1	Power Piping (Pressure Piping code)
ASME – B31.3	Process Piping (Pressure Piping code)
ASME SEC VIII	Boiler and Pressure Vessel Code – Rules for Construction of Pressure Vessels
IS 10500 : 2012	Drinking Water Specification
IS 1172 : 1993	Code of Basic Requirement for Water Supply, Drainage and Sanitation
ISO 13631 (2002)	Petroleum and Natural Gas Industries - Packaged Reciprocating Gas Compressors
NFPA - 2001	Standard on Clean agent Fire Extinguishing Systems
NFPA – 11	Standard for Low, Medium and High-Expansion Foam
NFPA – 12	Standard On Carbon Dioxide Extinguishing System
NFPA – 13	Standard for The Installation of Sprinkler Systems
NFPA – 15	Water Spray Fixed Systems for Fire Protection
NFPA – 20	Standard for The Installation of Stationary Pumps for Fire Protection

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN PROCESS DESIGN BASIS	Doc No : 17039-EK-P-DB-1001
		Rev : B Page : 12 of 33

NFPA – 22	Standard for Water Tanks for Private Fire Protection
OISD RP 108	Recommended practices on Oil Storage and Handling
OISD STD 116	Fire Protection Facilities for Petroleum Refineries and Oil/Gas Processing Plants
OISD STD 118	Layouts for Oil and Gas Installations
OISD STD 163	Safety of Control Room for Hydrocarbon Industry
OISD STD 173	Fire Prevention and Protection System for Electrical Installations
OISD STD 189	Fire Protection System for Onshore Drilling Rigs, Work Over Rigs and Oil/Gas Production Installations
OMR	Oil Mines Regulations 2017

3.1 PRODUCED WATER ANALYSIS

Table 5.6-1 Specification of produced formation water

Properties	Minimum	Maximum
pH	7.2	8.05
Salinity (ppm)	3000	3500
Carbonate (ppm)	nil	nil
Bi-Carbonate (ppm)	427	736

3.2 EFFLUENT WATER TREATMENT PACKAGE INLET PARAMETERS

Table 5.7-1 ETP Inlet Parameters

Properties	Values
Oil in Water (ppm)	10000
pH	7-9
TSS	Upto 100 ppm
Dissolved Oxygen	Upto 7 ppm
SRB	10 ³ to 10 ⁶ CFU/ml
Any other bacterial activity like GAB, IRB, APB	Not Measured

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN PROCESS DESIGN BASIS	Doc No : 17039-EK-P-DB-1001 Rev : B
 KAVIN™		Page : 13 of 33

3.3 DESIGN LIFE

Facility design life - 20 Years

3.4 LIST OF SOFTWARES

1. Process Simulation – Hysys 8.8 (or) Higher version (or) equivalent
2. Flarenet Study – Aspen Flare System Analyser (Flarenet) (or) equivalent
3. Firewater Network Analysis – AFT Impulse, PIPENET (or) equivalent
4. P&IDS / PFD / Drawings - AutoCAD

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN PROCESS DESIGN BASIS	Doc No : 17039-EK-P-DB-1001 Rev : B
 KAVIN™		Page : 14 of 33

4.0 PRODUCT SPECIFICATION

4.1 PRODUCED WATER / EFFLUENT WATER/SEWAGE DISCHARGE

As per Assam State Pollution control board, the produced water / effluent water discharge shall meet the below as minimum,

Temperature, °C	-	51
Pressure, kg/cm ² g	-	70.3
Oil in water, ppm	-	10 (maximum)
pH	-	6.5-8.5
TSS	-	98% removal of suspended solids >10microns
Dissolved Oxygen	-	< 0.2 ppm
SRB	-	NIL
Sludge content	-	NIL
Any other bacterial activity like GAP, IRB & APB.	-	NIL

4.2 EFFLUENT WATER TREATMENT SYSTEM

Design capacity of effluent water collection pit is such that it accommodates the produced water from Inlet separator A/B/C, Electrostatic dehydrator and other oil spills of the process systems and accommodates the first 15 minutes of rain water from Oily water collection system. Effluent water from the Effluent water storage tank is routed to Effluent treatment plant via effluent water transfer pump for de-oiling and de-sludging. This process is a batch operation and pump starts to run when the effluent water level is high. Sludge settled in effluent water storage tank is pumped to sludge collection pit from which sludge is disposed. Provision for leachate collection ground water monitoring shall be kept around the sludge collection pit. The treated produced/effluent water specification should be as per Section 4.1. The treated water shall be routed to clarified water storage tank. Effluent Treatment Plant shall be designed for 1108 KLPD of effluent water capacity. The sludge from

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN PROCESS DESIGN BASIS	Doc No : 17039-EK-P-DB-1001 Rev : B
 KAVIN™		Page : 15 of 33

effluent water storage tank will be pumped by sludge transfer pump to sludge disposal system.

The design capacity of Skim oil tank shall be 150kL and the skim oil transfer pump shall be designed to empty the skim oil tank in 24 hours. The design capacity of clarified water storage tanks (2x50%) are 554kL each. The clarified water from clarified water storage tank is pumped to injection wells by reciprocating type fuel gas driven clarified water disposal pumps to meet the discharge pressure of 70.3 kg/cm²g. Clarified water booster pumps are provided to meet the NPSH requirement of clarified water disposal pumps (3x50%). Clarified water booster pumps are configured as 3 x 50% pumps.

If the treated/clarified water from Effluent Treatment Package outlet doesn't meet specification as per section 4.1, it shall be routed to Effluent water Offspec tank. The untreated effluent water from Offspec effluent water storage tank will be routed to Effluent water storage tank through offspec effluent water transfer pumps for further treatment.

The design capacity of Offspec effluent water storage tank is 554 kL and Offspec effluent water transfer pump shall be designed to empty the Offspec effluent water storage tank in 12 hours.

Sludge disposal system is in ETP vendor scope of work and sludge transfer pumps to be supplied by ETP package supplier. Effluent water storage tank is in construction contractor scope and Effluent water transfer pumps will be in ETP package supplier scope.

4.3 OILY WATER COLLECTION SYSTEM

Oily water collection pit receives rain water from the bund wall area of the process systems and rain/storm water from other than process systems. Oily water collection system consists of check pit for collection of oily water from various process and utility systems and ON/OFF valve for diverting the first 15 minutes flow to Effluent Treatment Package. Oily water from collection pit is routed to Effluent treatment system for de-oiling and de-sludging. The check pit has been sized for collecting oily water from process area with 30 seconds residence time.

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN PROCESS DESIGN BASIS	Doc No : 17039-EK-P-DB-1001 Rev : B Page : 16 of 33
 KAVIN™		

Excess rain water after 15 minutes will be diverted to guard pond by ON/OFF valve at the oily water collection header. A Minimum 1:100 slope towards Effluent water storage tank to be maintained.

4.4 RAW WATER TREATMENT SYSTEM

Raw Water Treatment System serves as a source to safety shower, eye wash station, potable water, firefighting system and service water. Raw Water Treatment system includes potable water system and industrial water system. The potable water system is used to supply the water for drinking purpose, eye-wash and safety shower. The industrial water system is used to supply the water for the cleaning purpose of the vessels / plant.

Industrial water system consist of,

- Iron removal filters (2 x 100%)
- Overhead industrial water storage tank (1 x 100%)

The pressurized water from deep tube well / shallow tube well header is routed to the iron removal filters to remove the solid particles at 99.9% efficiency of 2 microns and above particles. The iron removal filter is vertical cartridge type. The filtered water is then routed to Potable water system, Industrial water system and Firewater system. The Filtered water from iron removal filter is stored in the industrial water storage tank for distribution. The industrial water storage tank is atmospheric – cylindrical overhead tank (two compartments with equal capacity).

Potable water system consist of,

- RO water maker (2 x 100%)
- Potable water pumps (2 x 100%)
- UV Sterilization unit (1 x 100%)

The filtered water from iron removal filter is sent to RO water maker which uses the principle of "reverse osmosis", a deep tube water flow through a membrane which allows water but not

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN	Doc No : 17039-EK-P-DB-1001 Rev : B
 KAVIN™		Page : 17 of 33

salt to pass. Then the salt removed water is routed to the UV sterilization unit via potable water pumps. The Ultraviolet rays in the UV Sterilization unit is a means of killing the harmful micro-organisms. These microorganisms can range from bacteria and viruses to algae and protozoa. The purified water is then routed to potable water storage tank. The potable water storage tank is atmospheric – cylindrical overhead tank (two compartments with equal capacity).

DESIGN BASIS

- Potable water capacity is calculated based on 100 gallons / per person / day for total of 50 persons.
- The potable water storage tank capacity is designed based 3.5 days potable water requirement.
- Potable water pump is designed to fill the potable water storage tank in 8 hours.
- The Potable water storage tank and Industrial water storage tanks are overhead tanks.
- Potable water and industrial water distribution shall be gravity flow. Hence the tanks shall be located at an elevation above all users. The minimum supply pressure at the last consumer in the unit shall be 1 kg/cm²g.
- Industrial water capacity is 50 kL. A Minimum volume of 49 m³ shall be available in Industrial water Storage Tank per day for fire water make-up once the fire water storage tank level reduces from initially filled level to High liquid level.
- Iron removal filters are designed for the removal efficiency of 99.9% of 2 micron particles and above.

4.5 SEWAGE TREATMENT SYSTEM

The sewage treatment system shall be provided for complete clarification and treatment of sewages from living quarters as per PCB/CPCB norms, which ever carries stringent specification. The design capacity of the sewage system shall be for 50 persons. Treated sewage water shall be routed to the clarified water storage tank.

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN PROCESS DESIGN BASIS	Doc No : 17039-EK-P-DB-1001 Rev : B
 KAVIN™		Page : 18 of 33

As per Assam State Pollution control board, the effluent water discharge shall meet the below as minimum,

Temperature, °C	-	51
Pressure, kg/cm ² g	-	70
Oil in water, ppm	-	10 (maximum)
pH	-	6.5-8.5
TSS	-	98% removal of suspended solids >10microns
Dissolved Oxygen	-	< 0.2 ppm
SRB	-	NIL
Sludge content	-	NIL
Any other bacterial activity like GAP, IRB & APB.	-	NIL

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN PROCESS DESIGN BASIS	Doc No : 17039-EK-P-DB-1001 Rev : B Page : 19 of 33
		

5.0 PROCESS DESIGN CRITERIA

This section is to provide criteria for equipment selection, sizing and a basis for design pressure and temperature selection for various systems in OCS.

5.1 PROCESS EQUIPMENT SIZING AND SELECTION

5.1.1 VESSELS

Horizontal vessels are preferred for 3 phase separation system as they provide more surface area for liquid settling. The greater liquid surface area in this configuration provides optimum conditions for releasing entrapped gas. Horizontal separators are better where slugs and surges are anticipated and to increase the retention time and allow to improve the separation of oil and water when the droplet size is small.

Vertical vessels are preferred for 2 phase separation systems and usually selected when the gas-liquid ratio is high or total liquid volumes are low. LP Gas Compressor suction/Discharge KOD, NAG Inlet Separator, Trunk line KOD etc., shall be of vertical 2 phase design.

HORIZONTAL VESSELS

The following design criteria are applied for design of horizontal vessels. Horizontal separators with mist extractors shall be sized using the equation given below.

$$V_a = K \{ (d_l - d_g) / d_g \}^{1/2}$$

Where,

V_a - maximum allowable superficial velocity (m/s)

d_l - Density of Liquid phase at operating conditions (kg/m³)

d_g - Density of Gas phase at operating conditions (kg/m³)

K - Constant (m/s) depending on design and operating conditions

K values recommended for horizontal vessels are listed in the table below.

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN PROCESS DESIGN BASIS	Doc No : 17039-EK-P-DB-1001
		Rev : B Page : 20 of 33

Table 9.1.1-1 K values for Horizontal vessels

Length (m)	K-Vessel, (m/s)
3	0.12 - 0.15
>3	$0.12 - 0.15 \times (L/3)^{0.56}$

The liquid retention time for 3-phase separator shall be considered as follows.

Table 9.1.1-2 Liquid retention time for 3-phase separators

Oil Gravities	Minutes
Above 35° API	3 to 5
Below 35° API	
100 + °F	5 to 10
80 + °F	10 to 20
60 + °F	20 to 30

VERTICAL VESSELS

The following design criteria are applied for design of vertical vessels. Vertical separators with mist extractors shall be sized using the equation given below.

$$V_a = K \{(d_l - d_g) / d_g\}^{1/2}$$

Where,

V_a - maximum allowable superficial velocity (m/s)

d_l - Density of Liquid phase at operating conditions (kg/m³)

d_g - Density of Gas phase at operating conditions (kg/m³)

K - Constant (m/s) depending on design and operating conditions

K values recommended for vertical vessels are listed in the table below.

Table 9.1.1-3 - K values for Vertical vessels

Height (m)	K-Vessel, (m/s)
1.5	0.04 - 0.07
3	0.05 - 0.1

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN PROCESS DESIGN BASIS	Doc No : 17039-EK-P-DB-1001
		Rev : B Page : 21 of 33

The liquid retention time for 2-phase separator shall be considered as follows:

Table 9.1.1-4 Liquid retention time for 2-phase separators

Oil Gravities	Minutes
Above 35° API	1
20° - 30° API	1 - 2
10° - 20° API	2 - 4

LEVEL SETTING FOR SEPARATORS

The following table 9.1.1-5 shall be followed for minimum level setting for both vertical and horizontal vessel.

Table 9.1.1-5 Level setting for vessels

Level	Criteria
LAHH	0.1 m above LAH (or) 1 min whichever is higher
LAH	Minimum distance between LAH and LAL is 0.35 m (or) 3 min whichever is higher
LAL	0.10 m above LALL (or) 60 sec whichever is higher
LALL	0.25 m above BTL (Bottom Tan Line) / 0.3m above BTL for horizontal vessel

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN PROCESS DESIGN BASIS	Doc No : 17039-EK-P-DB-1001
		Rev : B Page : 22 of 33

5.1.2 SIZING CRITERIA FOR INLET AND OUTLET NOZZLES

5.1.2.1 TWO PHASE AND THREE PHASE SEPARATORS / KOD

INLET NOZZLE CRITERIA

Inlet and outlet nozzles should be sized to meet the ρv^2 limitations outlined in Table 9.1.2.1-1.

Table 9.1.2.1-1 Vessel Inlet and Outlet nozzle sizing criteria

Nozzle	Type of inlet Device	Momentum (Pa)
Feed	No inlet device	≤ 1400
	Half-open pipe	≤ 2100
	Schoepentoeter	≤ 8000

GAS OUTLET NOZZLE

Gas outlet nozzle should be sized to meet the ρv^2 limitations outlined in Table 9.1.2.1-2.

Table 9.1.2.1-2 Gas outlet nozzle sizing criteria

Nozzle	Momentum (Pa)
Gas outlet	≤ 3750

LIQUID OUTLET NOZZLE

Liquid outlet nozzle should be sized to meet velocity limitations outlined in Table 9.1.2.1-3.

Table 9.1.2.1-3 Liquid outlet nozzle sizing criteria

Nozzle	Velocity (m/s)
Liquid outlet	≤ 1

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN PROCESS DESIGN BASIS	Doc No : 17039-EK-P-DB-1001
		Rev : B Page : 23 of 33

5.2 DESIGN MARGIN

The following table summarizes the design margin to be included in the design capacity mentioned in table 5.8.1 for piping and equipment:

Table 9.2-1 Design Margins for Surface Production Facilities (OCS) at Nadua

Description	Over Design (%) (Note-1)	
Equipment		
Inlet Manifold & Separation system	25 15	Surge factor Swell factor
Separators/KOD	10	on flowrate
Storage tanks		80% filled from LLLL to LLHH
Shell & Tube, Plate & Frame and Hairpin heat exchangers	10 10	on duty (or) flowrate + on surface area (Note-1&2)
Air-Coolers	10 10	on surface area + on duty (or) flowrate (Note-1&2)
Pumps	10	on flowrate
Compressors	10 5	on flowrate (or) duty + on polytropic efficiency
Crude Dehydrator	25	on flowrate
Filters	10	on flowrate
Flare and vent Lines	Sized for highest coincident relieving contingency without margin.	
Utility Systems		
IA/UA	25	on flowrate
Hot Oil	25	on flowrate (or) duty
Electric Power	20	
Fire Fighting	20	on flowrate
Other utilities	10	on flowrate (or) duty

Note:

1. 10% additional margin on either duty or flowrate is required, whichever is governing.

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN PROCESS DESIGN BASIS	Doc No : 17039-EK-P-DB-1001
		Rev : B Page : 24 of 33

- A minimum of 10% additional surface area to be considered in excess of the calculation requirements for fouled condition in addition to the criteria given in Note-1.

5.3 TEMPERATURE APPROACH FOR EXCHANGERS

Table 9.3-1 Temperature approach for exchangers

Exchanger Type	Minimum Temperature Approach (°C)
Shell & Tube	5
Plate & Frame	3 - 5
Air Cooler *	10
Printed Circuit Exchanger	3 - 5

* Minimum temperature approach of air cooled exchangers shall be based on maximum ambient temperature of 41°C.

5.4 PRESSURE DROP GUIDELINES

Table 9.5-1 Recommended Minimum Pressure Drop

Exchanger	Recommended Minimum Allowable ΔP (kg/cm ²)	Remarks
Air Cooler	0.5	
Control Valve	0.5	
Filters / Strainers	0.7	Dirty Service

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN PROCESS DESIGN BASIS	Doc No : 17039-EK-P-DB-1001
		Rev : B Page : 25 of 33

5.5 DESIGN PRESSURE

The maximum internal or external pressure will be used in determining the minimum permissible wall thickness of equipment and piping. Note that the minimum permissible wall thickness may be derived from a lower operating pressure, but higher operating temperature. Relief is normally initiated at design pressure.

5.5.1 DESIGN PRESSURE OF PRESSURE VESSEL

- Design pressure criteria for systems with high pressure trip is given in the table below

Table 9.6.1-1 Design pressure criteria for pressurized systems

High trip pressure kg/cm ² g	Minimum margin between high trip pressure and PSV set pressure kg/cm ²
0 – 35 kg/cm ² g	3.5
Over 35 kg/cm ² g	10% of PSV set pressure

- For pressurized systems without a high pressure trip, the minimum margin will be applied between the maximum operating pressure and the PSV set pressure.

5.5.2 DESIGN PRESSURE OF COMPRESSOR SUCTION SCRUBBER / COOLERS

The Minimum design pressure of the compressor suction scrubbers and coolers shall be 1.05 times of compressor settle-out pressure. This provides an adequate differential between the operating pressure and set pressure of PSV for a compressor shutdown contingency.

5.5.3 DESIGN PRESSURE OF PIPING

Mechanical design codes for piping and equipment have different limitations with regard to maximum allowable overpressure. Hence the equipment maximum pressure is considered as design pressure of associated piping.

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN PROCESS DESIGN BASIS	Doc No : 17039-EK-P-DB-1001 Rev : B
 KAVIN™		Page : 26 of 33

5.5.4 DESIGN PRESSURE OF COMPRESSOR

For initial estimate, the shut-in pressure for centrifugal compressor should be determined as the maximum operating pressure + 1.3 times the normal differential pressure developed by the compressor, to include for pressure rise at surge condition and maximum speed.

The maximum operating suction pressure of compressor shall be determined by the high trip pressure from upstream separator or compressor. Reciprocating compressor should be designed as per Table 8.6.1-1.

5.6 DESIGN TEMPERATURE

The design temperature is determined based on the temperature of the internal fluid. As margin of design temperature has great influence on the material thickness and flange rating for low and high temperature services, appropriate temperature limit is considered within which the material can be used.

Maximum design temperature

The maximum design temperature is normally determined by adding 30 °C to the maximum operating temperature.

For equipment operating at ambient conditions, the maximum design temperature is 80 °C.

Vessels and Instruments subject to steam-out shall be designed for temperature during steam-out operations (full vacuum condition).

For all heat exchangers, both shell and tube side of the exchanger shall have the same design temperature determined by the hottest of the fluids on either side.

Minimum design temperature

The minimum design temperature determines the requirements to the low temperature characteristics of the material, and shall be the more stringent of the following:

- Minimum operating temperature (obtained during normal operation, start-up, shutdown, plant blowdown or Process upsets) with a margin of 5 °C;

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN PROCESS DESIGN BASIS	Doc No : 17039-EK-P-DB-1001 Rev : B
 KAVIN™		Page : 27 of 33

- Minimum ambient temperature, the lowest temperature should be based on available weather data, and safety factors should be selected based on the quality of such weather data.
- In general, MDMT value shall be specified in vessel design.

5.7 LINE SIZING CRITERIA

5.7.1 GENERAL

SIZING BASIS

Piping will be sized for the controlling operating case determined by analysis of flow rates, operating pressures and temperatures for all identified normal operating modes.

Consideration will also be given to start-up conditions and off-design operation where these significantly impact line sizing. For gas and two phase lines, particular attention will be given to the effects of changes in operating pressures, temperatures and gas composition with time.

PIPING SIZES

Nominal piping sizes to be used in the project will be as per Piping Specifications. A minimum line size of NB 2" will be used for all main process piping. Piping smaller than NB 2" may be used in instrument air, fire water services and chemical injection services and where specified for auxiliary services such as pump cooling.

Minimum connection sizes on piping will be 1" for hazardous service and ¾" non-hazardous service. Drain and vent valves from process lines will be 1" for piping above 10" and ¾" for piping below 10".

Minimum size for the sewage and drain header shall be 4" and sub-headers shall be 3". Overflow from atmospheric tanks shall as a minimum be equal to the largest inlet pipe / outlet pipe.

Non-standard pipe sizes (2½", 3½", 5", 7", 9" and 22") will not be used except where equipment connections and drilling piping systems require these sizes. Transition to standard

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN PROCESS DESIGN BASIS	Doc No : 17039-EK-P-DB-1001 Rev : B
 KAVIN™		Page : 28 of 33

commercial pipe sizes will be made as close to the equipment as practical. The minimum nozzle size allowed on vessels will be 2" (except chemical injection tank and SS clad vessel). Smaller connection sizes shall be considered on utility vessels and vendor standard components. Tubing may be used for air and other non-combustible / non- hazardous fluids. Equivalent length of valves and fittings shall be as per API RP 14E.

5.7.2 SIZING CRITERIA FOR SINGLE PHASE LIQUID LINES

In determining maximum allowable velocities, consideration will also be given to noise and erosion / corrosion aspects.

As per API RP-14E recommendation, the single phase liquid line flow velocity should not exceed 4.5 m/s (15 ft/s) at maximum flow rates to minimize the flashing and also the flow velocity should not be lower than 0.91 m/s (3 ft/s) to minimize sand deposition.

Velocity of firewater shall not exceed 5 m/s in fire water ring main.

5.7.2.1 GRAVITY FLOW LINES

Lines flowing by gravity include tank overflows, drains (closed and open drains), and other lines where the liquid flows due to gravity forces instead of pressure difference. The vertical gravity lines will be designed such that the Froude number is less than 0.3 to avoid air entrainment and ensure undisturbed flow without pulsations. The gravity flowlines shall be sloped towards the downstream equipment with no pockets. A minimum slope of 1:100 to be maintained.

5.7.3 SIZING CRITERIA FOR SINGLE PHASE GAS LINES

High velocity may create noise problem if it exceeds 18 m/s (60 ft/s). However velocity should not be interpreted as an absolute criterion.

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN PROCESS DESIGN BASIS	Doc No : 17039-EK-P-DB-1001
		Rev : B Page : 29 of 33

Table 9.8.4-1 - Pressure drop criteria for process gas lines

Operating pressure kg/cm ²	Pressure drop kg/cm ² /100m
0 – 35	0.001 – 0.11
35 – 140	0.11 – 0.27
>140	P/500 (Note-1)

Note 1: P is operating pressure in kg/cm²g.

5.7.4 SIZING CRITERIA FOR RELIEF LINES

- All flare lines shall be designed to keep the $qV^2 < 200,000 \text{ kg/ms}^2$ criteria

Where,

q is the fluid density or mixed density for two phase conditions in kg/m³

V is the velocity in m/s

The PSV upstream and downstream line shall be sized based on the rated capacity of the PSV. The PSV inlet line shall be sized so that the pressure loss is below 3% of valve set pressure to avoid valve chattering. Pilot operated valves can tolerate higher inlet-pipe pressure losses when the pilot senses the system's pressure at a point that is not affected by inlet-pipe pressure drop. In any case the upstream line size should be at least equal to the PSV inlet nozzle size.

- Maximum flowing velocity in the lines downstream of the PSVs to the first sub-header shall in general be less than Mach 0.7.
- Flare header shall be designed for a maximum velocity of Mach 0.5.
- Flare lines downstream of control valve shall be designed for a maximum velocity of Mach 0.5.
- Maximum backpressure for vent line shall be 0.07 kg/cm²g.

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN PROCESS DESIGN BASIS	Doc No : 17039-EK-P-DB-1001
		Rev : B Page : 30 of 33

Table 5.7.4-1 Design basis for PSV Laterals and Disposal Systems headers

Device	Lateral / Tail Pipe	Main Header
Pop-action, pilot-operated PSV	PSV rated capacity	Required relieving rate
Modulating-action, pilot operated PSV	Required relieving rate	Required relieving rate
Spring loaded PSV - Blocked Discharge - Gas blowby/control valve failure	Required relieving rate Required relieving rate (100% valve opening)	Required relieving rate Required relieving rate
Rupture disk (stand-alone)	Required relieving rate	Required relieving rate
Buckling pin device (stand-alone)	Required relieving rate	Required relieving rate

5.8 TURNDOWN REQUIREMENTS

A turndown of 25% with respect to design capacity will be considered.

In order to fix effective turndown, the number of identical items (e.g. 2 x 50%, 3 x 33%) required to achieve the final value shall be analyzed.

Internals, control valves, exchangers, filters, compressors, pump and all other equipment to be designed for turndown condition.

5.9 SPARING PHILOSOPHY (INSTALLATION SPARES)

The provision of sparing shall ensure the proposed design meets the project availability requirement. However, the following general requirements are to be followed.

- Critical pumps shall be designed in accordance with an n+1 sparing philosophy.
However, this may not be required if the pump is part of a fully spared train/module.
- Critical equipment / piping without spare shall have n+1 PSV's installed.
- Control valve sparing:
 1. Critical service with unspared valve (with globe valve in bypass)
The globe valve shall be installed in the by-pass line.
 2. Critical service with spared valve

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN PROCESS DESIGN BASIS	Doc No : 17039-EK-P-DB-1001
 KAVIN™		Rev : B Page : 31 of 33

2 x 100% of control valve will be provided for critical services. When the control valve fails, the spare valve can be activated (automatically).

3. Non – Critical service

For non – critical services, spare control valve is not required.

- NAG inlet heater-1 spare will be kept in warehouse.

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJA PROCESS DESIGN BASIS	Doc No : 17039-EK-P-DB-1001
		Rev : B Page : 32 of 33

6.0 DIMENSION

Dimension	Units	Symbol
Area	Square Metre	m ²
Concentration	Mole Percentage	Mole %
Density	Kilogram per cubic metre	kg/m ³
Electric Current	Ampere	A
Energy	Kilowatt	kW
Flowrate (Liquid)	Kilo Litres Per Day	KLPD
Flowrate (gas)	Million Metric Standard Cubic Metre per day / Million Metric Standard Cubic feet per day	MMSCMD/MMSCFD
Length	Meter	m
Mass	Kilogram	kg
Momentum	Kilogram per metre square second	kg/ms ²
Power	Kilowatt	kW
Pressure	Kilogram per square centimetre	kg/cm ²
Specific Heat Capacity	Kilojoule per kilogram Celsius	kJ/kg °C
Thermal Conductivity	Watt per metre kelvin	W/ m K
Temperature	Celsius	° C
Time	Second	sec
Velocity	Metre per second	m/s
Viscosity	Centipoise	cP
Volume	Cubic Metre	m ³

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJA PROCESS DESIGN BASIS	Doc No : 17039-EK-P-DB-1001
		Rev : B Page : 33 of 33

7.0 REFERENCES

S.No.	Document No.	Description
1	IFB No. CPI4540P18	Tender Document
2	17039-EK-P-GD-0001, Latest revision	Design Data Summary – East Khagorijan
3	17039-EK-P-GD-1002, Latest revision	Site Conditions and available utilities - East Khagorijan
4	17039-EK-P-SH-1001, Latest revision	Utility Consumption Schedule - East Khagorijan
5	17039-EK-P-DW-0100-01 -24	Process Flow Diagram - East Khagorijan
6	17039-EK-P-DW-0201-0219	Piping & Instrumentation Diagram - East Khagorijan

CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN

Document Title : FIRE FIGHTING DESIGN BASIS

Kavin Document No. : 17039-EK-P-DB-1002

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COMPANY:

OIL INDIA LIMITED

EPCM CONSULTANT:

**KAVIN ENGINEERING AND SERVICES
PRIVATE LIMITED**

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN FIRE FIGHTING DESIGN BASIS	Doc No : 17039-EK-P-DB-1002 Rev : B Page : 4 of 24
 KAVIN™		

TABLE OF CONTENTS

1.0 INTRODUCTION.....	6
2.0 OBJECTIVE.....	7
3.0 CODES AND STANDARDS	8
4.0 FIRE PROTECTION REQUIREMENTS	9
5.0 FIRE WATER SYSTEM.....	10
5.1 DESIGN BASIS	10
5.1.1 FIRE WATER FLOW RATE	10
5.1.2 FIRE WATER STORAGE	12
5.1.3 FIRE WATER PUMPING SYSTEM.....	12
5.1.4 FIRE WATER NETWORK.....	13
5.1.5 WATER SPRAY SYSTEM & SPRAY NOZZLES.....	15
5.1.6 ACTUATION VALVE	16
5.1.7 HYDRANTS AND MONITORS.....	17
6.0 FOAM SYSTEM.....	19
6.1 DESIGN BASIS	19
6.1.1 FOAM SOLUTION FLOW RATE.....	19
6.1.2 FOAM POURER / FOAM DISCHARGE OUTLETS.....	20
6.1.3 DURATION OF FOAM DISCHARGE.....	20
6.1.4 FOAM QUANTITY	20
6.1.5 FOAM CONCENTRATE PUMP	21
7.0 EXTINGUISHERS.....	21
8.0 HOSES, NOZZLES AND ACCESSORIES.....	23
8.1.1 HOSES.....	23
8.1.2 NOZZLES & ACCESSORIES.....	23
9.0 CARBON DIOXIDE FIRE SUPPRESSION SYSTEM.....	23
10.0 CLEAN AGENT FIRE EXTINGUISHING SYSTEM	23

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN	Doc No : 17039-EK-P-DB-1002 Rev : B Page : 5 of 24
	FIRE FIGHTING DESIGN BASIS	

ABBREVIATION

AFFF	Aqueous Film Forming Foam
API	American Petroleum Institute
CPP	Captive Power Plant
DCP	Dry Chemical Powder
FM	Factory Mutual
GGs	Group Gathering Station
GWP	Global Warming Potential
ILBP	Inline Balanced Pressure Proportioner
IS	Indian Standard
KLPD	Kilo Litres Per Day
LPCB	Loss Prevention Certification Board
LPM	Litres Per Minute
MMSCMD	Million Metric Standard Cubic Meters per Day
MVWS	Medium Velocity Water Spray system
NFPA	National Fire Protection Association
OCS	Oil Collecting Station
ODP	Ozone Depletion Potential
OIL	Oil India Limited
OISD	Oil Industry Safety Directorate
QPS	Quick Production Setup
UL	Underwriters Laboratory

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN FIRE FIGHTING DESIGN BASIS	Doc No : 17039-EK-P-DB-1002 Rev : B Page : 6 of 24
 KAVIN™		

1.0 INTRODUCTION

OIL INDIA LIMITED (OIL) a Government of India Enterprise, proposes to construct two number of Surface Production facilities primarily for separation of Oil, Gas & Water and processing of non-associated & associated gas in its producing field at Nadua and East Khagorijan. The installation will be constructed on Modular design concept with emphasis on skid mounted prefabricated facilities minimizing construction work at site to the extent possible as per functional specifications of various process/utility packages. Instead of permanent civil buildings, containerized offices/structures will be preferred.

The East Khagorijan (GGS) field is located near Dibrugarh town in Assam at a location approximately 200m south (aerial distance) of LoC# TAI at 27032'N 95009'E, approx. elevation 121m MSL. This field is presently producing from 02 Nos. of wells through QPS (Quick Production Setup). Considering the potential of the field it is envisaged that Oil production is expected to rise to a level of 1000 KLPD from 06 HP wells, 06 LP wells and 06 Non Associated Gas wells. Associated Gas is expected to be around 0.1 MMSCMD. The East Khagorijan oil field is also having huge amount of non-associated gas potential and it is expected to produce about 1 MMSCMD of non-associated natural gas from this area. It is also expected that the field will produce about 800 KLPD of water along with the 1000 KLPD of crude, so the plant design will be for handling 1800 KLPD of total well fluid. Oil India Limited proposes to construct a Group Gathering Station at East Khagorijan to cater to the production in that area.

Pipelines from Oil & Gas wells to the proposed plant and transfer lines for transporting Dry Crude, Separated Gas, treated water from the proposed plant to outside are not in the Project scope. Procurement of Land and construction of boundary wall in the land is not in the project scope and will be done / arranged by OIL separately.

KAVIN ENGINEERING AND SERVICES PRIVATE LIMITED is awarded a contract for Engineering Procurement Construction Management Consultant to conceptualize / finalize the requirements needed for the Oil Collecting Station (OCS) at Nadua and Group Gathering Station (GGS) at East Khagorijan.

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN FIRE FIGHTING DESIGN BASIS	Doc No : 17039-EK-P-DB-1002
 KAVIN™		Rev : B Page : 7 of 24

2.0 OBJECTIVE

This document “Fire Fighting Design Basis” covers the minimum requirements and basis for designing the complete Firefighting System for the East Khagorijan GGS. The Firefighting System shall be primarily based on “OISD-STD-189 – Fire Protection System for Onshore Drilling Rigs, Workover Rigs and Oil/Gas Production Installations”.

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN FIRE FIGHTING DESIGN BASIS	Doc No : 17039-EK-P-DB-1002
		Rev : B Page : 8 of 24

3.0 CODES AND STANDARDS

Table 3.0-1 Codes and Standards

CODES / STANDARDS	DESCRIPTION
API 2030	Application Of Fixed Water Spray System For Fire Protection In The Petroleum Industry
NFPA 11	Standard For Low-, Medium-, And High-Expansion Foam
NFPA 12	Standard on Carbon Dioxide Extinguishing Systems
NFPA 13	Standard For The Installation For Sprinkler Systems
NFPA 15	Standard For Water Spray Fixed Systems For Fire Protection
NFPA 20	Standard For The Installation Of Stationary Pumps For Fire Protection
NFPA 2001	Standard On Clean Agent Fire Extinguishing Systems
NFPA 22	Standard For Water Tanks For Private Fire Protection
OISD-STD-116	Fire Protection Facilities For Petroleum Refineries And Oil/Gas Processing Plants
OISD-STD-163	Safety Of Control Room For Hydrocarbon Industry
OISD-STD-189	Fire Protection System For Onshore Drilling Rigs, Work Over Rigs And Oil/Gas Production Installations

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN FIRE FIGHTING DESIGN BASIS	Doc No : 17039-EK-P-DB-1002
 KAVIN™		Rev : B Page : 9 of 24

4.0 FIRE PROTECTION REQUIREMENTS

The Firefighting System at the East Khagorijan GGS shall, at a minimum,

1. Control fires and prevent escalation.
2. Reduce the effects of fire and smoke to allow personnel to undertake emergency response activities or escape and evacuation measures.
3. Extinguish fires where it is considered practical and safe to do so.
4. Limit damage to structures, vessels and equipment.

The facility shall have the following Firefighting systems,

- a. Fixed Water Spray System
- b. Fire Hydrants and Monitors
- c. Centralized Foam System
- d. Clean Agent Fire Extinguishing System
- e. Carbon Dioxide Fire Suppression System
- f. Fire Extinguishers
- g. Other Accessories as per OISD-STD-189

Note:

- Applicable M.B.Lal Committee Recommendations shall be followed for the entire Facility.
- The fire protection systems mentioned in this document are minimum. Actual requirements shall be finalized during detailed engineering by Contractor as per OISD/NFPA.
- Fire water cum foam monitors shall be UL Listed / FM Approved.
- Fire hoses shall be as ISI marked/UL Listed
- Foam concentrate shall be UL Listed / FM Approved
- Extinguishers shall be ISI marked/UL Listed
- Nozzles shall be ISI marked/UL Listed

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN FIRE FIGHTING DESIGN BASIS	Doc No : 17039-EK-P-DB-1002 Rev : B Page : 10 of 24
 KAVIN™		

5.0 FIRE WATER SYSTEM

Fire water system shall be provided for fire control, fire extinguishment and exposure protection of equipment and personnel from heat radiation. The fire water system shall meet the applicable Oil India Safety Directorate (OISD) standards and National Fire Protection Association (NFPA) standards.

The fire water system shall provide instantaneous supply of pressurized fire water through fire water network to fire water cum foam monitors, fire hydrants, fixed spray nozzles and foam system for the purpose of automatically or manually suppressing fire.

5.1 DESIGN BASIS

5.1.1 FIRE WATER FLOW RATE

1. The following areas/systems shall be provided with Medium Velocity Water Spray (MVWS) system – Tanks handling crude oil, Crude Separation system, Crude Stabilization system, Trunk line KOD, NAG Inlet Separators, Fuel Gas System, Hot Oil System, LP Compression system, Ground flare system, Closed Drain system, Chemical Injection system and oil handling areas in ETP.
2. Flow rate for water spray application for fixed or floating roof tanks shall be aggregate of the following:
 - a. Water flow calculated for cooling a tank on fire at a rate of 3 lpm/m² of tank shell area.
 - b. Water flow calculated for exposure protection for all other tanks falling within a radius of (R+30) m from the centre of the tank on fire (R – Radius of tank on fire) at a rate of 3 lpm/m² of tank shell area.
 - c. Water flow calculated for exposure protection for all other tanks falling outside a radius of (R+30) m from the centre of the tank on fire (R – Radius of tank on fire) and located in the same dyke at a rate of 1 lpm/m² of tank shell area.

Various combinations shall be considered in the tank farm for arriving at different fire water flow rate and the largest rate is to be considered for design.

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN FIRE FIGHTING DESIGN BASIS	Doc No : 17039-EK-P-DB-1002 Rev : B
 KAVIN™		Page : 11 of 24

3. Fire water flow rate for tank farm shall be aggregate of the following:
 - a. Water flow rate for cooling single largest tank on fire and exposure protection to other tanks as per 5.1.1-2.
 - b. Water flow rate for applying foam solution on single largest tank on fire.
4. For pressure vessels, the water spray application rate shall be 10.2 lpm/m² of shell area.
Water spray for the following shall be provided as per NFPA 15:
 - Horizontal Steel Structures (Insulated/Uninsulated)
 - Vertical Steel Structures (Insulated/Uninsulated)
 - Saddles/Equipment Supports (Insulated/Uninsulated)
5. For the gas compressors, the water spray application rate shall be by means of full flooding at a rate of 20.4 lpm/m² of gas compressor shed area. While calculating fire water flow rate of compressor shed, the shed area should be divided in suitable number of segments so that the maximum water requirement can be optimized.
6. If any of the chemicals used in the chemical injection system is flammable, the injection tank and pumps shall be provided with water spray system with application rates as per NFPA 15.
7. Fire Protection system for transformers shall be as per OISD-STD-173.
8. Extent of fire zones (for process and other equipment except tank farm) shall be decided logically based on the layout, and the equipment that are present within a fire zone shall be chosen as a single unit for deciding on the quantity of deluge valves and cooling water required for that area.
9. The design fire water flow rate for the East Khagorijan GGS shall be the highest of:
 - a. The largest fire water demand among the items (2), (8) of section 5.1.1.
 - b. Fire water flow rate for supplementary water streams - based on using 4 single hydrant outlets and 1 water monitor simultaneously. Capacity of each hydrant outlet as 36 m³/hr and of monitor as 144 m³/hr should be considered.

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN FIRE FIGHTING DESIGN BASIS	Doc No : 17039-EK-P-DB-1002 Rev : B
 KAVIN™		Page : 12 of 24

10. The capacity of one fire water pump shall be minimum 410 m³/hr. The same shall be taken as the minimum fire water design flow rate if the calculated value is less than 410 m³/hr.

5.1.2 FIRE WATER STORAGE

1. Water for firefighting shall be stored in easily accessible above ground steel tanks with positive suction.
2. The effective capacity of the tanks above the level of suction point shall be sufficient for minimum 2 hours for firefighting at the aggregate rated capacity of the pumps.
3. There shall be two tanks, each having capacity equivalent to 50% of total water storage requirement.
4. Fire water pumps and storage tanks shall be provided with circulation line.
5. Necessary automated facilities shall be provided to top up fire water storage tanks to maintain the level to their full capacity.

5.1.3 FIRE WATER PUMPING SYSTEM

1. Fire water pumping system shall be designed as per NFPA 20 and OISD-STD-189.
2. Fire water pumps shall be installed to meet the design fire water flow rate and head and shall have flooded suction.
3. The pumps shall be capable of discharging 150% of its rated capacity at a minimum of 65% of the rated head. The shut-off head shall not exceed 120% of rated head.
4. At least one standby fire water pump shall be provided for up to 2 nos. of main pumps. The standby pump shall be of the same type, capacity and head as that of the main pump(s).
5. The fire water pumps including standby pump(s) shall be diesel engine driven.
6. Jockey pump shall be provided to take care of minor leakages. A standby jockey pump of similar type, capacity and head shall be provided. The capacity of the jockey pumps shall be 10% of the design fire water flow rate and their head shall be higher than the main fire water pumps. Auto cut-in / cut-off facility shall be provided for jockey pumps.

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN FIRE FIGHTING DESIGN BASIS	Doc No : 17039-EK-P-DB-1002 Rev : B Page : 13 of 24
 KAVIN™		

7. Routing of electricity supply feeder cable shall not be done through high fire risk areas or through the space containing cables of other electrical equipment as far as practicable.
8. Each diesel engine shall have an independent fuel tank sized for three hours continuous running of the pump on full load, to be located outside the pump house.
9. Diesel driven pumps shall be capable of being readily started in coldest condition at that location.
10. Every Centrifugal pump shall have:
 - a. Strainer on suction header.
 - b. Non-return valve and pressure gauge on discharge header.
11. The diesel engine of fire pumps shall be quick starting type with the help of push buttons located on or near the pumps or located at a remote location.
12. Stopping of main fire water pumps shall be manual.
13. Fire water pumps and storage tanks shall be located minimum 30 m away from installation equipment or where hydrocarbons are handled or stored.
14. Motor Control Centre (MCC) and local control (cum annunciation) panel for fire protection system shall be located in the fire water pump house. Repeater annunciation panel shall be located in control room.

5.1.4 FIRE WATER NETWORK

1. The fire water ring main shall be provided all around the perimeter of the installation and shall not pass through buildings or dyke areas.
2. Fire water ring mains shall be sized for 120% of the design fire water flow rate and 10 Kg/cm²g.
3. Fire water system shall be designed for a minimum pressure of 7 Kg/cm² g at the most hydraulically remotest point in the installation. A pressure gauge shall be installed at the hydraulically remotest point so as to easily monitor the pressure at that point.

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN FIRE FIGHTING DESIGN BASIS	Doc No : 17039-EK-P-DB-1002 Rev : B Page : 14 of 24
 KAVIN™		

Hydraulically remotest hydrant or monitor is the one located at the farthest distance from the pump or located at the end of a poorly sized branch line, and encounters maximum pressure drop, at the designated flow rate at that point.

4. Suitable orifice plates shall be provided for the hydrants and monitors to limit the pressure to 7 Kg/cm² g at hydrant & monitor inlet and also for spray and foam systems to limit the pressure as per requirement.
5. The fire water network shall be laid in closed loops to ensure multi-directional flow in the system.
6. The firewater mains shall be laid by the side of road. They shall not be laid beside the petroleum piping.
7. Number of isolation valves on main header must be decided in such a way that at a time not more than one segment (portion of line between two junctions) of fire water line is isolated.
8. Isolation valve shall be gate valve having open/close indication which can be opened easily and quickly by one person.
9. All isolation valves shall be kept Locked Open.
10. Valves larger than six inches in diameter should be equipped with a gear mechanism to facilitate opening.
11. The isolation valves shall be easily identifiable and located where they are accessible during fire and should be close to the loop junctions.
12. Additional valves shall be provided in the segments where the length of segment exceeds 300 m.
13. The fire water network piping should normally be laid above ground at a height of at least 30 cm above finished ground level.
14. The ring main shall be laid underground at the following places.
 - a. Road crossings.
 - b. Places where above ground piping is likely cause obstruction to operations and vehicle movement.

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN FIRE FIGHTING DESIGN BASIS	Doc No : 17039-EK-P-DB-1002 Rev : B Page : 15 of 24
 KAVIN™		

- c. Places where above ground piping is likely to get damaged mechanically.
- d. Within 0.15 bar over pressure contour in plant areas where explosions cannot be excluded.

15.If fire water ring mains are laid underground, the following shall be ensured:

- a. The ring main shall have at least 1 m earth cushion in open ground, 1.5 m cushion under the road crossings and in case of crane movement area pipeline shall be protected with concrete/steel encasement.
- b. The underground ring main shall be protected against soil corrosion by suitable anticorrosion coating/wrapping. Where pipes are coming out/going in from/into the ground, the underground anticorrosion coating on the pipe will continue for a length of at least 300 mm above ground.

16.The fire water mains shall be supported at regular intervals not exceeding 6 m. For pipeline size less than 150 mm, support interval shall not exceed 3 m.

17.Pipe supports and hangers should be designed for potential damage from impact and over pressure.

18.The pipe support shall have only point contact (Pad welded to carrier pipe should rest on the support system).

19.The piping system shall be hydrostatically tested for 4 hours at 1.5 times the design pressure.

20.There shall be no branch line provision from the fire water network for any alternate use.

21.Fire water mains, hydrant and monitor stand posts, risers of water spray system shall be painted with “Fire Red” paint as per IS: 5. Anti-Corrosion coating/paint shall be used in corrosion prone areas.

5.1.5 WATER SPRAY SYSTEM & SPRAY NOZZLES

- 1. Piping downstream of a system actuation valve should be installed with minimum number of low and trapped section of pipes that will require drain points.

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN FIRE FIGHTING DESIGN BASIS	Doc No : 17039-EK-P-DB-1002 Rev : B Page : 16 of 24
 KAVIN™		

2. If carbon steel pipe and fittings are used, these must be galvanized inside and outside. If galvanizing is removed during cutting or threading, the exposed steel shall be coated with corrosion resistant paint.
3. Flushing connections should be provided on the end of cross mains and feed mains.
4. The spray density and distribution pattern for a particular application are functions of nozzle design, recommended spacing and pressure at the nozzle inlet. These factors must be considered when reviewing the placement of nozzles to ensure effective water coverage at the most hydraulically remote nozzles.
5. The discharge pressure of nozzle shall not be less than 1.4 Kg/cm² g.
6. The nozzle orifice should be at least 6 mm in size to reduce the chances of plugging by pipe scale or other debris. A suitable strainer shall be installed on the spray system supply outside the dyke wall to prevent clogging of the spray nozzle.
7. Wherever possible, nozzles should be connected to the top of water lines in upright position.
8. The nozzle configuration shall direct water spray onto all exposed surfaces without leaving any dry spot. Where stiffener rings are welded on the tank shells, spray system rings shall be so arranged to ensure uniform cooling above and below the rings without leaving any dry spots.
9. Spray nozzles shall be directed radially to the tank at a distance not exceeding 0.6 m from the tank shell
10. Only one type of spray nozzle shall be used for a particular tank/facility.
11. The nozzles shall be provided with blow off caps to prevent dirt accumulation in the nozzle.
12. Plugs should be installed at all nozzle points to provide a closed network while hydro testing.

5.1.6 ACTUATION VALVE

1. Water spray system of tanks, which could require different flow rates for cooling – 3 lpm/m² and 1 lpm/m² (based on 5.1.1), should be provided with suitable number of manifolds (with

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN FIRE FIGHTING DESIGN BASIS	Doc No : 17039-EK-P-DB-1002 Rev : B Page : 17 of 24
 KAVIN™		

separate actuation valves for the two flow rates) between the main fire water line and tanks' fire water risers.

2. The actuation valve shall be of a type, which can be opened easily and quickly by one person during an emergency.
3. The design of operating mechanism shall permit opening of any one of the two valves at a time.
4. The manifolds should be located where it is easily identifiable and accessible during fire.

5.1.7 HYDRANTS AND MONITORS

Functional Requirements for Hydrants and Monitors

1. Fire-water mains shall be equipped with double headed hydrants to which hoses can be connected. The number and position of hydrants shall be sufficient to permit effective firefighting.

Note: If portable fire water cum foam monitors are provided, additional double headed hydrants / three or four way hydrants shall be considered in order to supply the required fire water flow from the fire water header to the portable monitors.

2. Where hydrants are supplied by a fire-water main, the system shall be designed so that the pressure available will allow safe operation of such equipment at the maximum pressures which shall be present in the fire-water main.
3. Consideration should be given to the provision of suitable foam-making equipment and concentrate for use with hydrants.
4. Hoses, nozzles, valve keys, etc. should be stored adjacent to hydrants. Each hydrant shall be provided with a hose box equipped with two numbers of standard fire hose and multipurpose foam cum water spray nozzle.
5. Monitors shall be water cum foam type.
6. The design of monitors shall consider location, size of supply piping, arrangement of control valves.

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN FIRE FIGHTING DESIGN BASIS	Doc No : 17039-EK-P-DB-1002 Rev : B Page : 18 of 24
 KAVIN™		

7. Each monitor shall have sufficient movement in the horizontal and vertical planes to permit the monitor to be brought to bear on any point of the part protected by that monitor. There shall be means for locking the monitor in position.
8. Each monitor shall be capable of discharging under jet and spray conditions.

General Requirements for Hydrants and Monitors

1. Monitors and hydrants shall be provided alternatively for every 30 m of installation's perimeter in case of hazardous areas. Hydrants/Monitors shall be spaced 45 m apart in non-hazardous area.
2. Monitors and hydrants shall be located at a minimum distance of 15 m from the periphery of storage tank or equipment under protection.
3. Hydrants and monitors shall not be located more than 45 m from the hazard to be protected.
4. In case of buildings, this distance shall not be less than 5 m and not more than 15 m from the face of building. Hydrants within the building shall be provided in accordance with IS: 3844.
5. Hydrant/Monitors shall be located by the side of road and provided with operational platform for convenient operation.
6. Hydrant outlets and monitor actuation valves shall be positioned at workable height of 1.2 m above finished ground or operating platform level.
7. Hydrants and monitors shall not be installed inside the dyke areas.
8. Hydrants and monitors shall be located on branch connection and not directly on the main fire water line.
9. The monitor and hydrant assembly shall be free from sharp edges and waterways with smooth finish.
10. Mild steel/carbon steel components of monitors and hydrants which would be in direct contact with water shall be galvanized.
11. Monitors and hydrants shall be easily accessible and provided with safe approach.
12. Monitors and hydrants shall not have any obstruction within their water stream throw/reach.
13. Each hydrant and monitor shall be provided with independent isolation valve.

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN FIRE FIGHTING DESIGN BASIS	Doc No : 17039-EK-P-DB-1002 Rev : B Page : 19 of 24
 KAVIN™		

6.0 FOAM SYSTEM

A centralized foam system shall be provided in the East Khagorijan GGS in order to extinguish fire in tanks handling crude oil, effluent water storage tanks and spill fire from any crude oil handling equipment. It is also used for vapour suppression by blanketing spilled crude oil from tanks/equipment. The foam concentrate distribution header shall run alongside the fire water header and shall supply foam concentrate to all foam equipment in the tank farm area. The foam proportioning to the foam pourers of tanks shall be by means of Inline Balanced Pressure Proportioning (ILBP) system. Foam barrels placed alongside monitors shall be used for supplying foam concentrate to the fire water cum foam monitors.

Aqueous Film Forming Foam (AFFF) concentrate conforming to IS:4989 2006 / UL 162 shall be used in the facility. The foam system shall be designed as per OISD-STD-189.

Note: Manual valves along with foam connection line shall be provided in the foam concentrate header near fire water cum foam monitors in tank farm area and other areas with possibility of oil spill. This arrangement is to collect foam concentrate from the foam header to refill the foam barrels manually as and when it is required to operate the monitors.

6.1 DESIGN BASIS

6.1.1 FOAM SOLUTION FLOW RATE

1. The flow rates for Foam solution application are:
 - a. 5 lpm/m² of liquid surface area of the tank for Fixed roof tanks.
 - b. For fires in dyked areas and spills, foam solution application rate shall be 2400 lpm.
2. The foam proportioning ratio shall be 3%.
3. In determining total solution flow requirements, potential foam losses from wind and other factors shall be considered.

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN FIRE FIGHTING DESIGN BASIS	Doc No : 17039-EK-P-DB-1002
 KAVIN™		Rev : B Page : 20 of 24

6.1.2 FOAM POURER / FOAM DISCHARGE OUTLETS

1. Fixed Roof Tanks:

- a. A vapour seal chamber is required before the foam discharge outlet. The chamber shall be provided with an effective and durable seal, frangible under low pressure, to prevent entrance of vapour into the foam conveying piping system.
- b. Where two or more pourers are required, these shall be equally spaced at the periphery of the tank and each discharge outlet shall be sized to deliver foam at approximately the same rate.
- c. Spacing of foam pourers shall not be more than 24 m apart on the shell perimeter of the tank.
- d. Suitable platform shall be provided on the tanks for ease of maintenance, inspection and testing of foam pourer.

6.1.3 DURATION OF FOAM DISCHARGE

The equipment shall be capable of providing primary protection at the specified delivery rates for the following minimum duration:

1. Tanks containing Class 'A' and 'B' petroleum – 65 minutes.
2. Where the system's primary purpose is for spill fire protection – 30 minutes.

6.1.4 FOAM QUANTITY

The quantity of foam concentrate required should be calculated as below considering:

1. Foam solution application at the rate of 5 lpm/m² for the liquid surface of the single largest cone roof tank for 65 minutes.
2. One monitor stream of 2400 lpm or 4 single hydrant streams of 600 lpm each of foam solution for 30 minutes (spill fire)

The quantity of foam concentrate shall be largest of 6.1.5-1 and 6.1.5-2.

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN FIRE FIGHTING DESIGN BASIS	Doc No : 17039-EK-P-DB-1002 Rev : B Page : 21 of 24
 KAVIN™		

6.1.5 FOAM CONCENTRATE PUMP

1. The foam concentrate pump shall be designed as per NFPA 20.
2. The materials of construction for foam concentrate pumps shall be approved for use with AFFF concentrate. Special attention shall be paid to the type of seal or packing used.
3. Foam concentrate pumps shall have rated capacities at or in excess of the maximum system demand.
4. Foam concentrate pumps shall have means for flushing. They shall be provided with a drain cock of valve.
5. Foam concentrate pumps shall be automatic-starting upon system actuation.
6. At least one standby pump similar to that of the main pump shall be provided.
7. Provision shall be made for automatic shut-off of the foam concentrate pump after the foam concentrate supply is exhausted.
8. Foam concentrate pump shall be configured as 2 × 100%, one shall be diesel engine driven and the other shall be electric driven.

7.0 EXTINGUISHERS

Since a fire starts small, most fires that are discovered early and attacked quickly are usually extinguished before they go out of control. The ready availability of portable and semi-portable fire extinguishers is, therefore, very important even when fixed fire protection system is available. Points regarding the placement of fire extinguishers are given below.

The design, selection and location of fire extinguishers shall meet the applicable OISD standards – OISD-STD-189, OISD-STD-116.

Type of DCP extinguisher used shall be Stored Pressure type. Minimum 2 nos. of Extinguisher refilling kit and 2 nos. of nitrogen cylinders shall be provided in order to refill the extinguishers on the site, as necessary.

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN FIRE FIGHTING DESIGN BASIS	Doc No : 17039-EK-P-DB-1002
 KAVIN™		Rev : B Page : 22 of 24

1. Extinguishers shall be located as to be easily accessible and readily available in the event of fire.
2. They shall be placed in conspicuous positions for immediate use in all parts of the installation.
3. These shall be placed as near as possible to exits or staircase landings without hindering the escape routes.
4. Extinguishers for special risks shall be placed near to the risk area but not so near as to be inaccessible in case of fire.
5. If special risk is contained in an enclosed area, the extinguisher shall be positioned outside the area.
6. While selecting the location for wheeled extinguishers consideration for their mobility in the area should be carefully considered.
7. If wheeled extinguishers are located indoors, the size of the doorways and passages should be sufficient for easy movement of extinguisher.
8. The maximum travel distance from any point of the facility to an extinguisher location shall not exceed 15 m.
9. All extinguishers shall be mounted on wall or pole/structure. Where it is not possible to do so, suitable pre-fabricated pedestals shall be provided for placing the extinguishers so that the bottom of the extinguishers are located at a height of 1 m from the ground surface.
10. Wall mounted extinguisher shall be placed on the supporting hanger or bracket such that its top surface is not more than 1.5 m above the finished ground or floor level.
11. The extinguisher should not be placed in a location where it is likely to absorb heat from surrounding hot equipment.
12. Suitable shades or covers shall be provided to protect extinguishers placed in the open from excessive heat, cold, rains or corrosive environment. Where such shades or covers are provided, they should be designed so that the removal of extinguishers is not hampered in the event of fire.

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN FIRE FIGHTING DESIGN BASIS	Doc No : 17039-EK-P-DB-1002 Rev : B Page : 23 of 24
 KAVIN™		

13. Extinguishers shall be kept in their designated places when not in use.

14. A plan showing location of extinguishers and means of their access shall be displayed at important areas and near entrance of the premises.

8.0 HOSES, NOZZLES AND ACCESSORIES

8.1.1 HOSES

1. The length and diameter of the hoses shall be 15 m and 63 mm respectively, fitted with instantaneous type male and female couplings of non-spark type metal.
2. Fire hoses to be used shall be as per IS 636 Non-percolating Synthetic Hose (Type B).
3. Hose Reels shall be provided at the entrance of Admin Building and Captive Power Plant.

8.1.2 NOZZLES & ACCESSORIES

1. Multipurpose foam cum water with Water jet, Spray, Water curtain nozzle and Foam branch pipe as per relevant IS or equivalent standards shall be maintained at the installation.
2. Accessories such as Personal Protective Equipment, First Aid Equipment and Safety Instruments shall be provided as per OISD-STD-189.

9.0 CARBON DIOXIDE FIRE SUPPRESSION SYSTEM

1. CO₂ snuffing system shall be provided for the Gas Gensets (inside compartments).
2. The CO₂ extinguishing system shall be designed as per NFPA 12.

10.0 CLEAN AGENT FIRE EXTINGUISHING SYSTEM

1. Clean Agent fire extinguishing system shall be provided for the whole control room.
2. The Clean Agent fire extinguishing system shall be designed as per NFPA 2001 and also as per guidelines given in OISD-STD-163.
3. The fire extinguishing agent shall have zero Ozone Depletion Potential (ODP) and low Global warming potential (GWP) and as per the approved list of NFPA 2001.

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN FIRE FIGHTING DESIGN BASIS	Doc No : 17039-EK-P-DB-1002
 KAVIN™		Rev : B Page : 24 of 24

4. This system will consist of a bank of clean agent cylinders connected to a piping network which will have open nozzles. This system would be triggered by fire/smoke detection system. Manual operation of the system shall also be possible.
5. Manual interruption of agent release shall also be possible for each of the areas to avoid release due to false alarm, if any.
6. 100% standby capacity of the clean agent cylinders shall be provided.

CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN

Document Title : ISOLATION PHILOSOPHY

Kavin Document No. : 17039-EK-P-GD-1004

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COMPANY:

OIL INDIA LIMITED

EPCM CONSULTANT:

**KAVIN ENGINEERING AND SERVICES
PRIVATE LIMITED**

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN	Doc No : 17039-EK-P-GD-1004
		Rev : B Page : 4 of 24

TABLE OF CONTENTS

1.0	INTRODUCTION.....	6
2.0	OBJECTIVE.....	6
3.0	DESIGN REQUIREMENT FOR SYSTEM AND EQUIPMENT ISOLATION.....	7
4.0	ISOLATION METHODS.....	8
4.1	PHYSICAL SEPARATION (OR) POSITIVE ISOLATION.....	8
4.2	VALVED ISOLATION.....	12
5.0	ISOLATION VALVES.....	14
5.1	SECURING VALVE POSITION.....	14
6.0	SYSTEM ISOLATION REQUIREMENTS.....	15
6.1	EQUIPMENT ISOLATION.....	15
6.1.1	PRESSURE VESSELS.....	15
6.1.2	HEAT EXCHANGERS.....	16
6.1.3	ATMOSPHERIC VESSEL/TANKS.....	16
6.1.4	PUMPS.....	16
6.1.5	COMPRESSORS.....	17
6.2	INSTRUMENT ISOLATION.....	17
6.2.1	CONTROL VALVES.....	17
6.2.2	LEVEL/PRESSURE/FLOW INSTRUMENTS.....	18
6.3	CONNECTIONS TO FLARE, VENT AND DRAIN.....	19
6.3.1	CONNECTION TO FLARE.....	19
6.3.2	CONNECTION TO VENT AND DRAINS.....	23
6.4	OPERATIONAL DRAIN, VENT AND FLUSHING REQUIREMENTS.....	24

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN	Doc No : 17039-EK-P-GD-1004
		Rev : B Page : 5 of 24

ABBREVIATION

ASME	American Society of Mechanical Engineers
BDV	Blowdown Valve
DBB	Double Block and Bleed
ESD	Emergency Shutdown
FB	Full Bore
FC	Fail Close
FO	Fail Open
LC	Locked closed
LO	Locked open
NC	Normally closed
PSV	Pressure Safety Valve
P & ID	Piping and Instrumentation Diagram
RO	Restriction Orifice
RS	Removable Spool
RTJ	Ring Type Joint
RF	Raised Face
RB	Reduced Bore
SBB	Single Block and Bleed

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJA	Doc No : 17039-EK-P-GD-1004
		Rev : B Page : 6 of 24

1.0 INTRODUCTION

OIL INDIA LIMITED (OIL) a Government of India Enterprise, proposes to construct two number of Surface Production facilities primarily for separation of Oil, Gas & Water and processing of non-associated & associated gas in its producing field at Nadua and East Khagorijan. The installation will be constructed on Modular design concept with emphasis on skid mounted prefabricated facilities minimizing construction work at site to the extent possible as per functional specifications of various process/utility packages. Instead of permanent civil buildings, containerized offices/structures will be preferred.

KAVIN ENGINEERING AND SERVICES PRIVATE LIMITED is awarded a contract for Engineering Procurement Construction Management Contractor to conceptualize / finalize the requirements needed for the Oil Collecting Station (OCS) at Nadua and Group Gathering Station (GGS) at East Khagorijan.

The East Khagorijan (GGS) field is located near Dibrugarh town in Assam at a location approximately 200m south (aerial distance) of LoC# TAI at 27032'N 95009'E approx. elevation 121 M MSL. The field is presently producing from 02 Nos. of wells through a QPS (Quick Production Setup). Considering the potential of the field it is envisaged that Oil production is expected to rise to a level of 1000 KLPD from 06 HP wells, 06 LP wells and 06 Non Associated Gas wells. Associated Gas is expected to be around 0.1 MMSCMD. The East Khagorijan oil field also having the huge amount of non-associated gas potential and it is expected to produce about 1 MMSCMD of non-associated natural gas from this area. It is also expected that the field will produce about 800 KLPD of water along with the 1000 KLPD of crude, so the plant design will be for handling 1800KLPD of total well fluid. Oil India Limited proposes to construct a Group Gathering Station at East Khagorijan to cater to the production in that area.

Pipelines from Oil & Gas wells to the proposed plant and transfer lines for transporting Dry Crude, separated Gas, treated water from the proposed plant to outside are not in the Project scope.

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN	Doc No : 17039-EK-P-GD-1004
		Rev : B Page : 7 of 24

Procurement of LAND and construction of boundary wall in the land is not in the project scope and will be done / arranged by OIL separately.

2.0 OBJECTIVE

The isolation philosophy is intended primarily for use as a guide for the safe isolation of plant and equipment. The purpose of the document is to define safe and cost effective isolation methods to facilitate preparation of plant maintenance and inspection with minimum interruption to production.

3.0 DESIGN REQUIREMENT FOR SYSTEM AND EQUIPMENT ISOLATION

It shall be possible to isolate the equipment, instruments, valves and process sections during maintenance to obtain safe working conditions for the personnel. Isolation shall be accomplished by the use of block valves and/or the insertion of spectacle blinds or spades, or the removal of spool pieces and the installation of blind flanges. The minimum isolation level required shall be thoroughly considered for all systems where intervention during operation is required. This consideration shall be based on the risk associated with the intervention operation which includes,

- Requirement for equipment entry during operation
- Fluid category (level of hazard involved, e.g. flammability, toxicity)
- Operating pressure and temperature
- Pipe dimension and system volume
- Duration of operation
- Frequency of operation

Functions of Isolation device:

- To enable an entire system, comprising of a number of equipment and associated pipe and instruments, to be taken out of service safely while other systems continue to function normally.
- To provide local, physical proof that a single piece of equipment is safely isolated from all possible sources of inflow, prior to allowing maintenance and to permitting entry of personnel.

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN	Doc No : 17039-EK-P-GD-1004
		Rev : B Page : 8 of 24

- To provide the means to reinstate the equipment or system safely, following successful maintenance or inspection-testing and repair operation.

4.0 ISOLATION METHODS

Equipment/piping isolation shall be achieved using various techniques and methods. The following methods shall be used;

- Physical separation (or) positive isolation
- Valved isolation

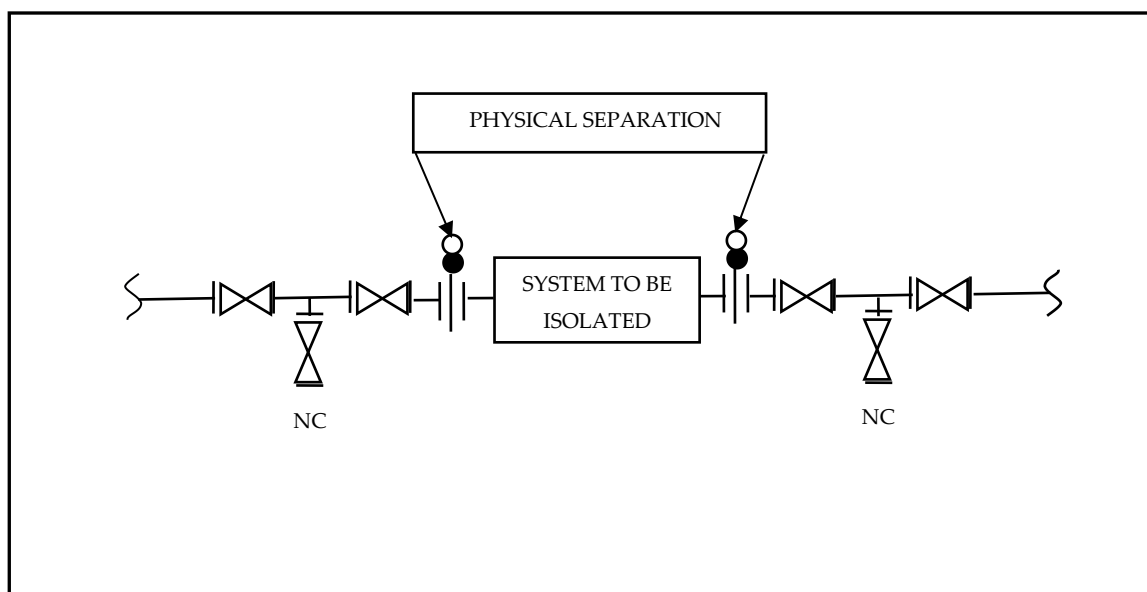
4.1 PHYSICAL SEPARATION (OR) POSITIVE ISOLATION

This method guarantees 100% physical segregation of a hazard or contamination source from a personnel and/or product inventory. It shall be accomplished through one of the following;

Physical Separation With Double Block and Bleed

This is the highest standard of isolation and provides a valve barrier by closing two block valves in series and using a bleed point in between to prove isolation point integrity. During installation or removal of the physical separation, it shall be possible to bleed down the trapped pressure by the bleed valve. The figure below illustrates the typical arrangement.

Figure 4.1-1 – Physical separation with double block and bleed

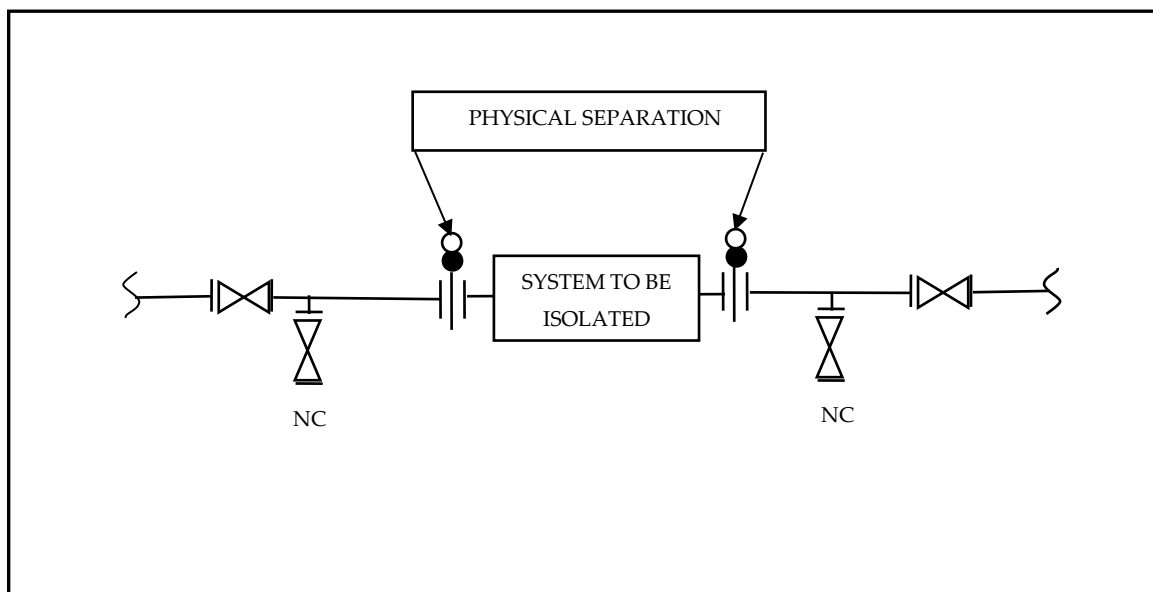


	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN ISOLATION PHILOSOPHY	Doc No : 17039-EK-P-GD-1004 Rev : B Page : 9 of 24
		

Physical Separation With Single Block and Bleed

A single block isolation provides a valve barrier by closing a single block valve. The single block arrangement provides the initial isolation to install the physical separation. There shall be possibilities for testing the isolation point integrity by bleeding off the pressure and monitoring the pressure at the point to be isolated. The figure below illustrates the typical arrangement.

Figure 4.1-2 – Physical separation with single block and bleed



	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN	Doc No : 17039-EK-P-GD-1004
		Rev : B Page : 10 of 24

Spectacle Blind / Spade and Spacer

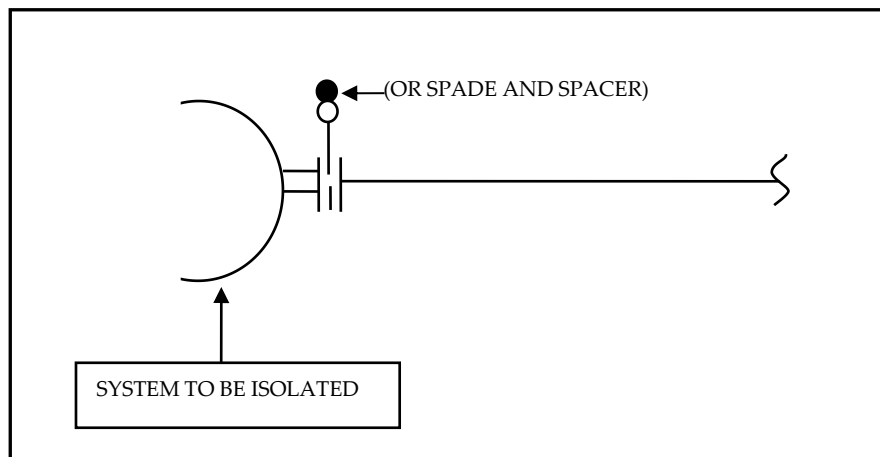
Insertion of blind flange (spade and spacer) or spectacle blind of the correct pressure rating between the flanges.

Where a spectacle blind with a ring type joint (RTJ) is used, the piping shall be arranged to include an elbow or spool to enable the blind to be swung. Alternatively, a removable spool piece may be used alone since this itself provides positive isolation. Where a spectacle blind with raised face (RF) is used, the piping shall be arranged to enable the flanges to be split apart by a sufficient distance to enable the blind to be swung without damaging the gasket.

Spade and spacer set is generally used on larger line sizes because of weight constraints based on pipe rating. Refer to Piping Material Specification - 17039-EK-M-SP-2001, for the selection of spectacle blind/spade and spacer.

The type of blind to be used in process and utility isolation points is shown in Table 5.1-1. The figure below illustrates the typical arrangement.

Figure 4.1-3 – Positive Isolation with Spectacle blind (or) Spade and Spacer



The type of blind to be used at all process and utility isolation points shall be as shown in Table 4.1-1

**CREATION OF SURFACE PRODUCTION
FACILITIES (OCS & GGS) AT NADUA &
EAST KHAGORIJAN**

ISOLATION PHILOSOPHY

Table: 4.1-1 Spectacle blind and Spacers

Flange rating	Line diameter	
	Spectacle blinds	Spades
150#	16" & below	greater than 16"
300#	12" & below	greater than 12"
600#	10" & below	greater than 10"
900#	6" & below	greater than 6"

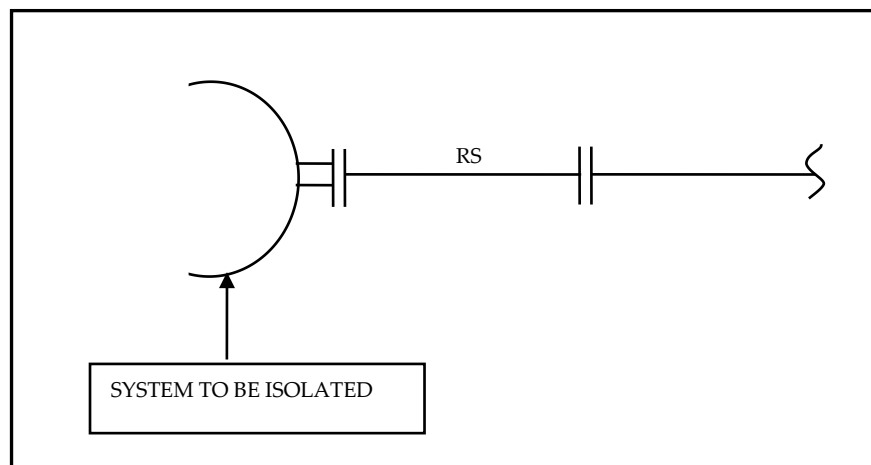
Removal Spool (RS)

The removal of a flanged spool piece and installation of a blind flange of the correct pressure rating. This type of isolation shall be required in the following area.

- For pump and compressor maintenance, spool pieces are required on the suction and discharge nozzles to provide positive isolation.
- For heat exchanger maintenance, spool pieces are required on the inlet and outlet nozzle (both process and utility side).

Piping shall be designed to permit practical removal and installation of spools via provision of sufficient pipe flexibility and appropriate material handling process. The figure below illustrates the typical arrangement.

Figure 4.1-4 – Physical separation with Removal Spool



	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN	Doc No : 17039-EK-P-GD-1004
		Rev : B Page : 12 of 24

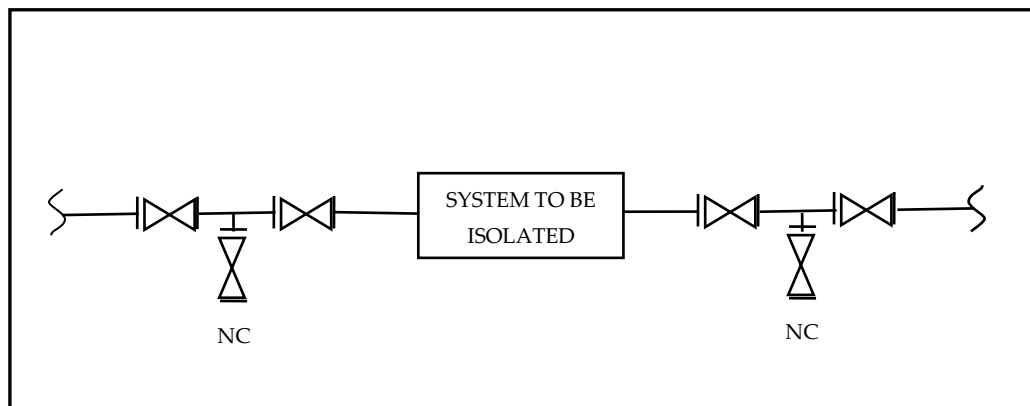
4.2 VALVED ISOLATION

This type of isolation generally comprises one (or) two in-line block valves in series with a bleed. The block valves provide the main isolation of the hazardous fluid from the designated area. Table 4.2-1 summarizes the valve isolation selection for equipment.

Double Block and Bleed (DBB)

Double block and bleed isolation provides a valve barrier by closing two block valves in series and using a bleed point in between to prove isolation point integrity. Manual block valves (or) actuated valves (emergency (or) process shutdown valves) are acceptable for use in double block and bleed isolation, except for fail open valves. Air/hydraulic/electric/ supply to the actuator shall also be isolated. The figure below illustrates the typical arrangement.

Figure 4.2-1 - Double block and bleed



	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN ISOLATION PHILOSOPHY	Doc No : 17039-EK-P-GD-1004 Rev : B
		Page : 13 of 24

Single Block And Bleed (SBB)

Single block and bleed isolation provides a valve barrier by closing a single block valve. The shutdown side of the block and bleed assembly is then drained/vented/purged to make ready for maintenance. Single block and bleed valves are used for low pressure ratings. The figure below illustrates the typical arrangement.

Figure 4.2-2 - Single block and bleed

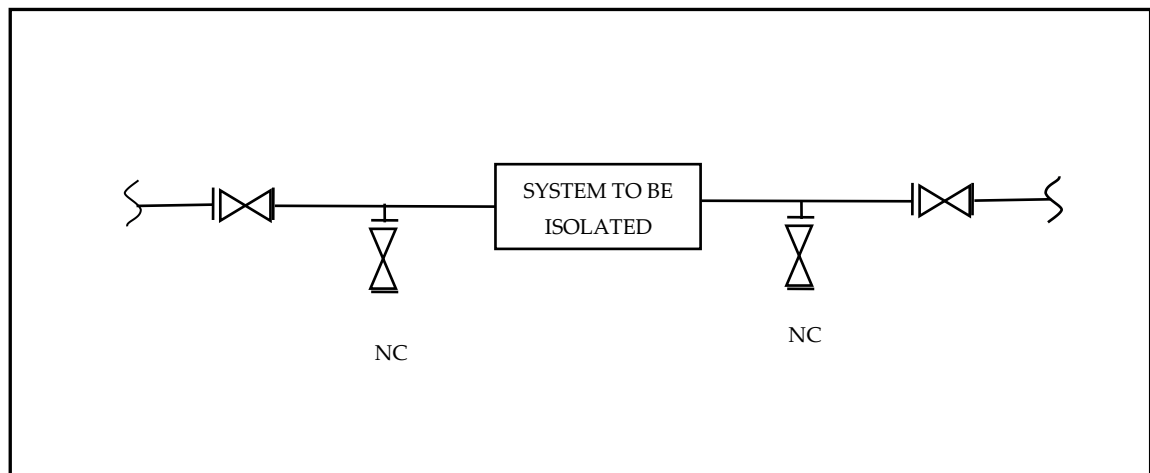


Table:4.2-1 Valve isolation selection

System Pressure Rating (ASME Class)	150#	300#	600#	900#	1500#	2500#
Isolation Method	SBB	SBB	DBB	DBB	DBB	DBB

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJA	Doc No : 17039-EK-P-GD-1004
		Rev : B Page : 14 of 24

5.0 ISOLATION VALVES

To obtain a safe isolation, it is required to utilize valves which provides good isolation and keeps the integrity towards the live process. The following valve types shall be considered to give sufficient integrity as isolation valve in the facility

- Ball valves
- Gate valves
- Needle valves
- Butterfly valves

Butterfly (or) gate valves can be used as isolation valves in water system only. Produced water shall be considered as hydrocarbon system i.e. butterfly valves shall not be used as isolation valves. Butterfly valves shall also not be used as isolation valves in heating medium system (even if the heating medium is fresh water) or in steam system (even in the condensate return lines). For safety reasons, certain block valves shall be designated 'Locked open'(LO) or 'Locked closed'(LC) on the P & IDs. Isolation valves shall be locked in position only if inadvertent operation of the valve would lead to damage to equipment or an unsafe condition.

5.1 SECURING VALVE POSITION

Securing of valves in position is primarily a method of locking the valves to avoid inadvertent opening/closing. Securing of valve position shall be achieved by use of proprietary key locking devices (identified as LO/LC on P&ID's) together with written operating procedures.

The following application of valve position securing shall be followed.

- Within the protection system, valves on firewater distribution, and local foam distribution system shall be Locked open/closes as appropriate.
- Where blowdown valves are provided with block valves shall be locked open.
- Pump suction and discharge isolation valves shall be locked open and Full Bore type.
- Valve position of relief devices for vessels and systems is illustrated in Figure 6.3.1-1 and 6.3.1-2.

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN	Doc No : 17039-EK-P-GD-1004
		Rev : B Page : 15 of 24

6.0 SYSTEM ISOLATION REQUIREMENTS

6.1 EQUIPMENT ISOLATION

Proper design shall provide isolation valves, spools, and/or flanges as close as practical to the equipment or piping being isolated. When determining isolation points, the following factors shall be considered.

- Gas freeing requirements:
Purging for entry should minimize only unswept area and volumes of purge gas need to be made available.
- Potential hazard involved:
Personnel access and material handling for the isolation operation shall be considered.
- System liquid volume:
When draining vessels, the disposition of the liquids need to be available and appropriately sized for the rate being drained.
- Upstream and downstream conditions and influences:
Piping specification changes and location of relief devices may dictate where isolation can be placed, to avoid overpressure/ lack of protection issues.

6.1.1 PRESSURE VESSELS

Equipment isolation for vessel entry shall provide all process, utility, vent and drain connections with positive isolation. Direct instrument connections and flanges on vessels do not require a spectacle blind. Pressure vessels containing hydrocarbons shall be provided with a utility connection for general vessel flushing to purge with nitrogen.

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN	Doc No : 17039-EK-P-GD-1004
		Rev : B Page : 16 of 24

6.1.2 HEAT EXCHANGERS

Removal spool piece shall be installed for maintenance purpose. Vent and drain shall be located on the associated pipework, wherever possible, chemical cleaning connections of suitable size shall be provided between the exchanger nozzle and the isolation blind. The chemical connection will normally be located on the spool piece.

6.1.3 ATMOSPHERIC VESSEL/TANKS

Atmospheric vessels/tanks shall be provided with single block valve on inlet/outlet line. Drain connection shall be provided with spectacle blind in closed position to prevent loss of inventory due to leakage. In general, isolation for atmospheric vessels will be considered case to case basis, depending on the fluid being stored (hazardous/non-hazardous).

6.1.4 PUMPS

All pumps with sparing shall be provided with isolation facilities to enable process isolation and mechanical isolation. When pumps are installed in parallel, independent positive isolation of the inlet and outlet of each pump shall be provided to allow maintenance of one pump whilst the other remains operational.

Removable spool pieces shall be provided to allow access to the suction and discharge nozzles and enable removal of the pump for maintenance purposes. Installation of blind flange following the removal of spool piece may be used to achieve positive isolation of the pump.

Drain valves shall be fitted on all low points to ensure that the pump casing and all pipe work between isolation valves can be fully drained.

For pump with permanent suction strainers, the strainer shall be able to be isolated and closed without draining of any upstream vessels or tanks.

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN	Doc No : 17039-EK-P-GD-1004
		Rev : B Page : 17 of 24

6.1.5 COMPRESSORS

Removal spool piece shall be installed on the suction and discharge nozzles of all compressor stages. For Compressors with permanent screen/Filters, the screen shall be able to be isolated and cleaned. Temporary screens shall be removed after commissioning.

6.2 INSTRUMENT ISOLATION

6.2.1 CONTROL VALVES

Isolation of control valve shall follow typical arrangement shown in figure 6.2.1-1 and 6.2.1-2.

Figure 6.2.1-1 - Control Valve arrangement for Pressure rating below 600#

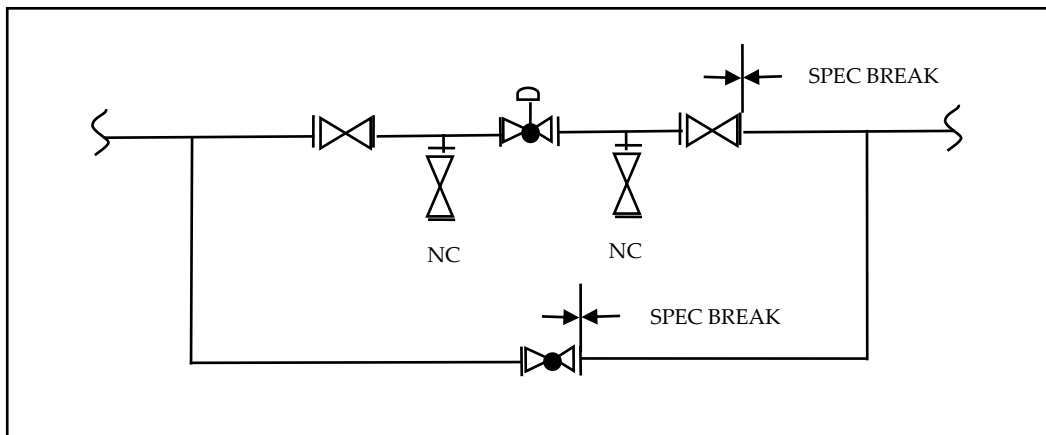
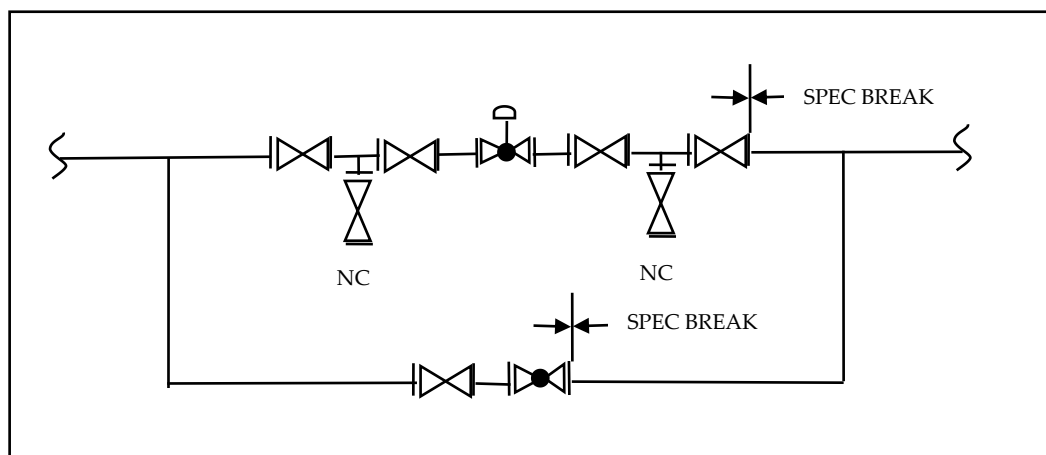


Figure 6.2.1-2 - Control Valve arrangement for Pressure rating 600# and above



	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJA	Doc No : 17039-EK-P-GD-1004
		Rev : B Page : 18 of 24

Requirement of draining of inventory upstream and downstream of the control valve is based on the type of control valve used for the service.

- For Failed Open (FO) Control Valve, single drain valve upstream or downstream of the control valve is sufficient.
- For Failed Close (FC) Control Valve, both upstream and downstream of the control valve is provided with a drain valve.

6.2.2 LEVEL/PRESSURE/FLOW INSTRUMENTS

All level, pressure and flow instruments shall be isolated from the process (Vessel/line) with a block valves. The document “Instrument/Electronic symbols - 17039-EK-P-DW-0301-03/04” defines the typical isolation assembly for instruments.

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJA	Doc No : 17039-EK-P-GD-1004
		Rev : B Page : 19 of 24

6.3 CONNECTIONS TO FLARE, VENT AND DRAIN

6.3.1 CONNECTION TO FLARE

The following requirements shall apply;

Relief Valves / Rupture Discs

- Arrangement and location of PSVs and rupture discs shall be in accordance with the relevant pressure relieving design code and the corresponding mechanical design code. Relief valves shall be equipped with block valves. Isolation shall be in accordance with Table 5.2-1. The PSV in service shall have inlet and outlet block valve locked open, and the spare PSV shall have the inlet block valve locked close and outlet block valve locked open. All isolation valves for relief valves shall be full bore. Installations with more than 2 PSVs shall follow the same logic, i.e. all in-service valves shall have inlet and outlet block valves locked open and the spare shall have inlet locked close and outlet locked open.
- For multi train systems/equipments (N+1), if entire train or equipment is spared, single relief valve is acceptable. For systems/equipments with 'N' configuration, spare PSV shall be required.
- When PSV is removed for maintenance, its connection shall be fitted with adequately rated blind flanges. All PSVs, regardless of configuration, shall be isolated, removed or blinded. Blinds should be used on the header side of the connection to prevent gas blowback.
- When Shell & Tube Exchanger is protected with Rupture discs, it shall be mounted directly on the exchanger or immediately adjacent on the connected piping.

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN ISOLATION PHILOSOPHY	Doc No : 17039-EK-P-GD-1004 Rev : B
		Page : 20 of 24

Figure 6.3.1-1 - Arrangement for Multiple Relief Valves

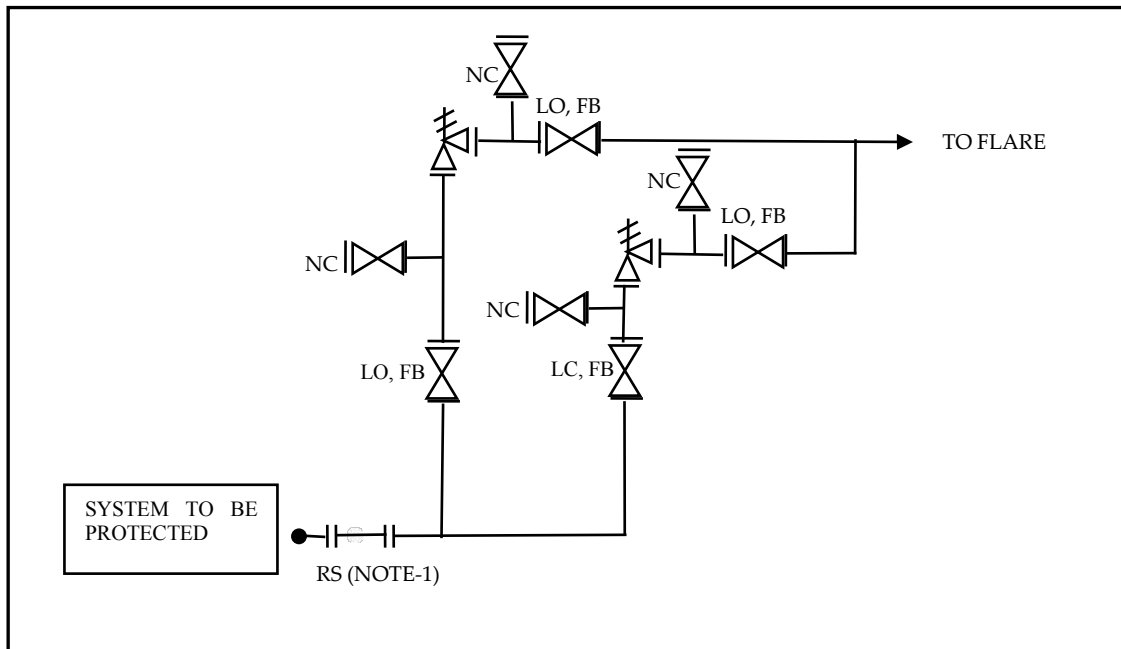
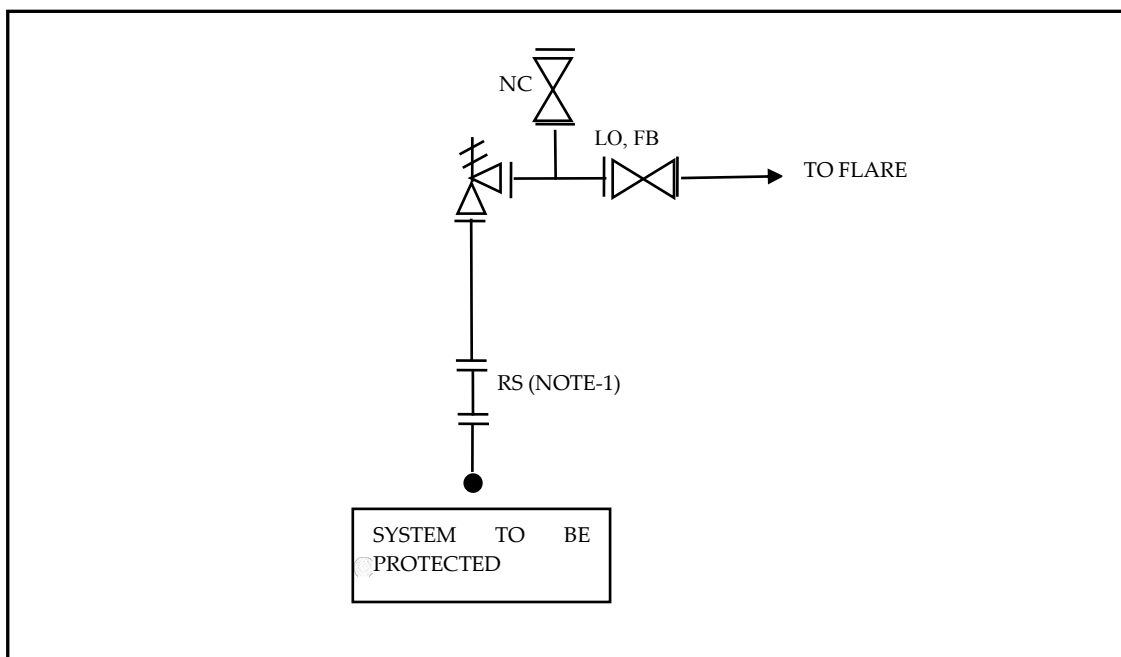
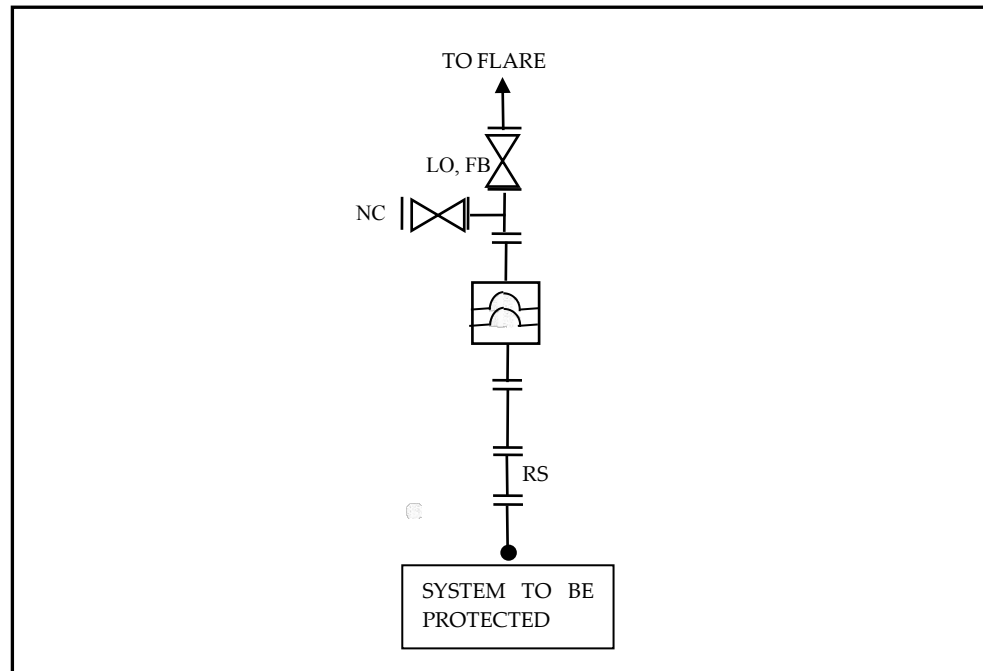


Figure 6.3.1-2 - Arrangement for Single Relief Valve



	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN ISOLATION PHILOSOPHY	Doc No : 17039-EK-P-GD-1004 Rev : B
		Page : 21 of 24

Figure 6.3.1-3 - Arrangement for Rupture discs



Notes

1. Removable spool (RS) is required only when Relief device is installed on equipment and it is not required when installed on piping.

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN ISOLATION PHILOSOPHY	Doc No : 17039-EK-P-GD-1004 Rev : B Page : 22 of 24
		

Depressuring Valves (Blowdown Valves)

- Blowdown valves shall be located at high points in the piping system.
- Blowdown shall be arranged with one blowdown valve and an orifice. Blowdown valve shall have isolation towards downstream flare system to allow maintenance and functional testing of blowdown valve (i.e., opening of valve) without flaring.
- Manual depressurization to flare for maintenance purposes require block valve and a throttle valve. Refer Figure 6.3.1-5 for typical arrangement.
- For blowdown lines, design shall take into account the low temperature expected upstream of the orifice resulting from temperature creep-back.
- For blowdown lines, if there is a potential for solidification in upstream or downstream lines, adequate heat tracing or insulation shall be provided.

Figure 6.3.1-4 - Arrangement for Blowdown Valves

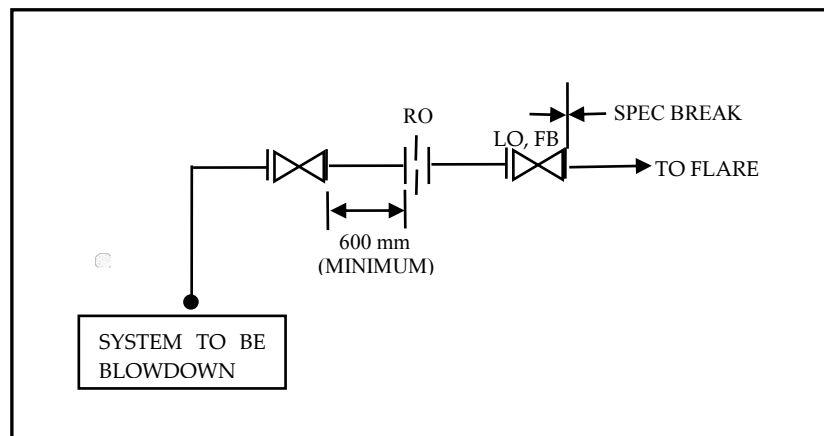
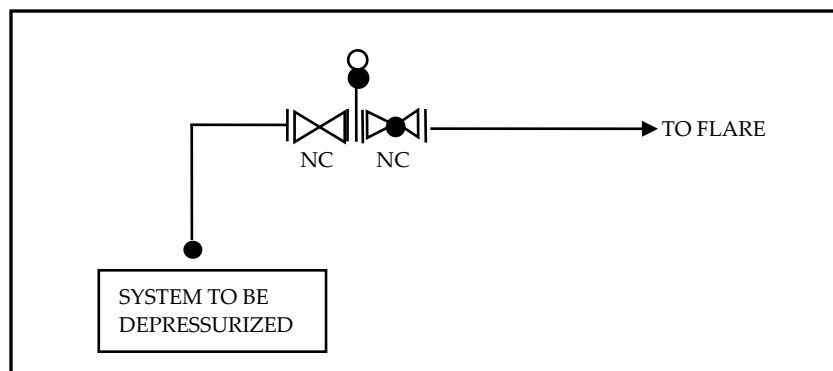


Figure 6.3.1-5 - Arrangement for Manual Depressurization



	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN	Doc No : 17039-EK-P-GD-1004
		Rev : B Page : 23 of 24

6.3.2 CONNECTION TO VENT AND DRAINS

The following requirements shall apply;

- For venting to atmosphere during maintenance, a vent valve and blind shall be included.
- Connections to the closed drain system from equipment and piping shall be as shown in figure below.

Figure 6.3.2-1 - Arrangement for closed drain connections (pressurized)

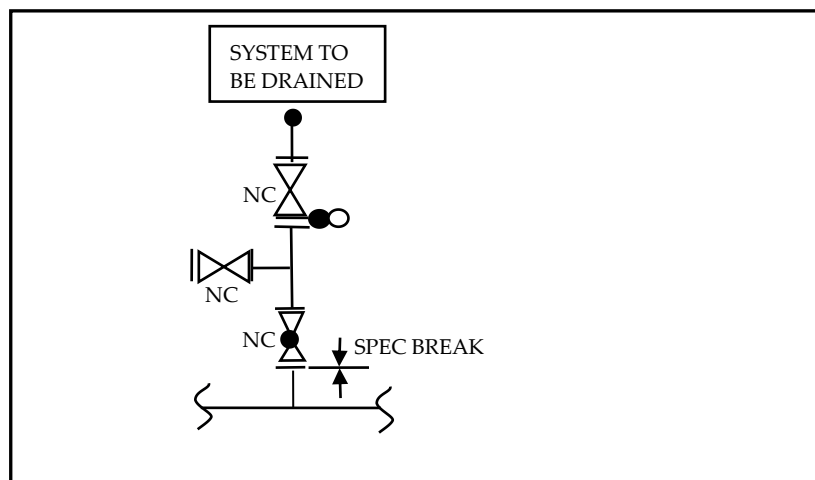
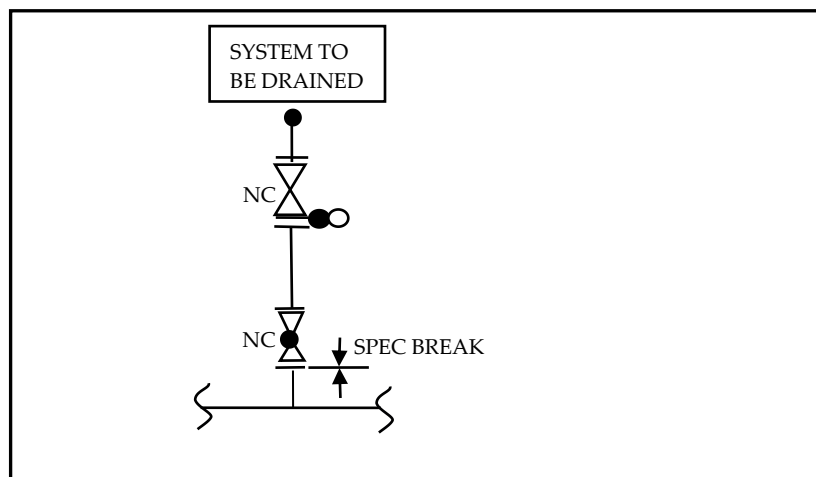


Figure 6.3.2-2 - Arrangement for closed drain connections (atmospheric)



	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN	Doc No : 17039-EK-P-GD-1004
		Rev : B Page : 24 of 24

6.4 OPERATIONAL DRAIN, VENT AND FLUSHING REQUIREMENTS

- All equipment and piping shall be provided with high point vents and low point drains within isolation valves isolating equipment or process sections. All such vents and drains shall be fitted with valve and blind flange. For piping and headers low point drain and high point vent shall in general be provided.
- Utility connections shall be provided and located to ensure efficient flushing and cleaning required for inspection and maintenance.
- Where provision shall be made for chemical cleaning of heat exchangers with the tube bundle in place, blind flange connection shall be provided for chemical hose attachments. This connection shall be minimum 3", but not exceeding the line size and shall be located between the exchanger nozzles and the block valves/positive isolation.

CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN

Document Title : VENT AND DRAIN PHILOSOPHY

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PROJECT DOCUMENTS ARE CONTROLLED DOCUMENTS.
REVISIONS ARE DENOTED | IN RIGHT HAND MARGIN

COMPANY:

OIL INDIA LIMITED

EPCM CONSULTANT:

**KAVIN ENGINEERING AND SERVICES
PRIVATE LIMITED**

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN	Doc No : 17039-EK-P-GD-1003 Rev : B Page : 4 of 11
	VENT AND DRAIN PHILOSOPHY	

TABLE OF CONTENTS

1.0 INTRODUCTION	6
2.0 OBJECTIVE	7
3.0 DRAIN SYSTEM.....	7
3.1 TYPE OF DRAIN SYSTEMS	7
3.1.1 CLOSED DRAIN SYSTEM.....	8
3.1.2 OILY WATER COLLECTION SYSTEM	9
3.1.3 OTHER DRAINS	9
3.1.3.1 HOT OIL DRAINS.....	9
3.1.3.2 CHEMICAL DRAINS	9
3.1.3.3 LABORATORY DRAINS.....	9
3.2 SOURCES AND DESTINATION OF VARIOUS DRAINS	10
4.0 VENT SYSTEM.....	11
5.0 OPERATING / MAINTENANCE REQUIREMENTS	11

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN VENT AND DRAIN PHILOSOPHY	Doc No : 17039-EK-P-GD-1003 Rev : B Page : 5 of 11
		

ABBREVIATION

EK	East Khagorijan
EPCM	Engineering Procurement Construction Management
ETP	Effluent Treatment Plant
GGs	Group Gathering Station
HC	Hydrocarbon
KL	Kilo Litres
KLPD	Kilo Litres Per Day
MMSCMD	Million Metric Standard Cubic Meters per Day
MSL	Mean Sea Level
ND	Nadua
OCS	Oil Collecting Station
QPS	Quick Production Setup

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN VENT AND DRAIN PHILOSOPHY	Doc No : 17039-EK-P-GD-1003 Rev : B Page : 6 of 11
 KAVIN™		

1.0 INTRODUCTION

OIL INDIA LIMITED (OIL) a Government of India Enterprise, proposes to construct two number of Surface Production facilities primarily for separation of Oil, Gas & Water and processing of non-associated & associated gas in its producing field at Nadua and East Khagorijan. The installation will be constructed on Modular design concept with emphasis on skid mounted prefabricated facilities minimizing construction work at site to the extent possible as per functional specifications of various process/utility packages. Instead of permanent civil buildings, containerized offices/structures will be preferred.

KAVIN ENGINEERING AND SERVICES PRIVATE LIMITED is awarded a contract for Engineering Procurement Construction Management Contractor to conceptualize/finalize the requirements needed for the Oil Collecting Station (OCS) at Nadua and Group Gathering Station (GGS) at East Khagorijan.

The East Khagorijan (GGS) field is located near Dibrugarh town in Assam at a location approximately 200m south (aerial distance) of LoC# TAI at 27032'N 95009'E approx. elevation 121 M MSL. The field is presently producing from 02 Nos. of wells through a QPS (Quick Production Setup). Considering the potential of the field it is envisaged that Oil production is expected to rise to a level of 1000 KLPD from 06 HP wells, 06 LP wells and 06 Non Associated Gas wells. Associated Gas is expected to be around 0.1 MMSCMD. The East Khagorijan oil field is also having the huge amount of non-associated gas potential and it is expected to produce about 1 MMSCMD of non-associated natural gas from this area. It is also expected that the field will produce about 800 KLPD of water along with the 1000 KLPD of crude, so the plant design will be for handling 1800 KLPD of total well fluid. Oil India Limited proposes to construct a Group Gathering Station at East Khagorijan to cater to the production in that area. Pipelines from Oil & Gas wells to the proposed plant and transfer lines for transporting Dry Crude, separated Gas, treated water from the proposed plant to outside are not in the Project scope.

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN VENT AND DRAIN PHILOSOPHY	Doc No : 17039-EK-P-GD-1003 Rev : B Page : 7 of 11
		

2.0 OBJECTIVE

The objective of this document is to specify the design/engineering requirements and selection of Vent and Drain System for Group Gathering Station at East Khagorijan. The vent and drain systems are needed for maintenance of equipment, piping and instruments. It shall safely collect and transport residual process fluids from various part of the facility to an appropriate disposal location giving consideration to protection of personnel, plant, equipment and environment. This specification does not cover domestic wash water or sewage drain system for accommodation areas, buildings and control room which shall separate from plant drain system.

3.0 DRAIN SYSTEM

Drain system shall be designed to cater for the following as a minimum:

- Meet statutory and regulatory discharge requirements.
- Drain minor spills and limit the potential and extent of pool fires.
- Effectively remove deluge water and rain water from plant areas.
- Prevent escalation of fire by minimizing drainage system interconnections

The Drain system normally comprises of fluid from the following streams:

- Equipment / skid drain
- Instrument drains
- Drainage of overflow, wash down , rain water, deluge water.

3.1 TYPE OF DRAIN SYSTEMS

The drain system can be classified as follows:

- Closed drain system
- Oily water collection system

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN VENT AND DRAIN PHILOSOPHY	Doc No : 17039-EK-P-GD-1003 Rev : B Page : 8 of 11
		

3.1.1 CLOSED DRAIN SYSTEM

The closed drain system shall be designed to drain the fluids from process equipment and it shall be considered as a low pressure hydrocarbon system. Draining activity normally takes place prior to entry or other maintenance operations such as long term shutdown. Before equipment is drained to the closed drain system, operating procedures shall ensure the following:

- Equipment shall be emptied to the lowest extent possible.
- Equipment that is drained into the closed drain system is to be fully depressurized to atmospheric pressure.

All the collected liquids shall be routed to Closed Drain Drum located in a pit (underground) where any flashed gas shall be routed to flare system. Liquid shall be pumped to Off-spec crude storage tank using Condensate Transfer Pumps. The pump capacity shall be higher than the maximum drainage rate. Closed Drain Drum shall be designed in accordance with criteria given in Process Design Basis (17039-EK-P-DB-1001). Heating coil requirement in closed drain drum will be confirmed based on wax appearance temperature.

All process drain connections shall be equipped with positive isolation to avoid accidental draining of pressurized liquids. Refer Isolation Philosophy (17039-EK-P-GD-1004) for typical arrangement. Drain piping shall be adequately and continuously sloped to eliminate the possibility of creating liquid pockets. A minimum 4" pipe size shall be provided in drain header and sufficient rodding points shall be provided. Operating procedures should take care of the possibility of over-pressurization of the drain header due to inadvertent opening of a drain valve in the plant system while the spectacle blind in Closed Drain Drum is closed.

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN VENT AND DRAIN PHILOSOPHY	Doc No : 17039-EK-P-GD-1003 Rev : B Page : 9 of 11
		

3.1.2 *OILY WATER COLLECTION SYSTEM*

The Oily water collection system collects predominantly rain water and deluge water from bund wall area of the process systems and also from other process system. It also collects lube oil, diesel fuel spillage during normal operation or during other routine operations (e.g. maintenance). Check pit and valve pit shall be provided in each process systems as required. Rainwater or deluge water from process system shall be collected in respective check pit from where it shall be routed to valve pit through hard pipe and finally routed to guard pond through trenches. Oily water may be expected initially which shall be routed to Effluent treatment plant (ETP) for 15 minutes for further treatment. After 15 minutes, it shall be diverted to guard pond.

3.1.3 *OTHER DRAINS*

3.1.3.1 *HOT OIL DRAINS*

Hot oil drain system shall be provided to collect hot oil drained from the hot oil system. This system shall enable maintenance of the hot oil system. The hot oil drain tank shall be designed to hold the total hot oil system inventory and shall also be designed for the possibility of draining at elevated temperature. Hot oil drain tank shall be located in a pit to allow gravity draining.

There should be sufficient head available to generate flow by overcoming any back-pressure and piping system pressure losses. The contents of the Hot oil drain tank shall be pumped back to Hot oil Expansion drum and/or Off loading truck.

3.1.3.2 *CHEMICAL DRAINS*

A separate chemical drain network is not considered. Drain from Chemical Injection system shall be routed to Closed Drain Drum.

3.1.3.3 *LABORATORY DRAINS*

Laboratory drains are used for the disposal of samples, chemical solutions, solvents and chemicals. Laboratory drains are independent drain systems. Only oily water drain from the laboratory may be connected to closed drain system. All other drains shall be collected in drums for removal from the lab.

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJA VENT AND DRAIN PHILOSOPHY	Doc No : 17039-EK-P-GD-1003 Rev : B Page : 10 of 11
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3.2 SOURCES AND DESTINATION OF VARIOUS DRAINS

Table: 3.2-1 Sources and Destination of various Drains

Source	Expected Components	Destination		
		Closed Drain	Oily water collection system	Other drain systems
Process equipment and lines containing hydrocarbons for maintenance purpose	Oil, Condensate, Water	✓		
Compressor lube oil	Lube oil	✓		
Atmospheric oil storage tanks	Oil, Water	✓		
Deluge water/Rainwater	Contaminated oil-water		✓ (Note-1)	
Floor drains	Spilt oil, Wash water		✓	
Sample drains	Oil, Water	✓		
Instrument drains	Oil, Water	✓		
Flare Knock-out drum	Oil, Water	✓		
Discharge from thermal relief valve in oil system	Oil, Water	✓		
Laboratory drains	Oil, Water	✓		
Process chemicals drains	Chemicals	✓		
Hot oil drains	Hot oil			Hot oil drain tank

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJA VENT AND DRAIN PHILOSOPHY	Doc No : 17039-EK-P-GD-1003 Rev : B Page : 11 of 11
		

Note:

1. During rainy or firefighting condition, contaminated water i.e. Oily water will be routed to Effluent water treatment plant for first 15 minutes, excess water will be routed to Guard bond after 15 minutes.

4.0 VENT SYSTEM

Vent acts to relieve positive pressure as well as potential negative pressure relative to atmospheric pressure. The sources of vents are as follows:

- Vent from Atmospheric Storage Tanks
- Maintenance Vents from equipment

The location of vent outlet shall be located such that in the event of accidental ignition of vent, it will not impinge upon adjacent equipment and heat radiation to equipment or personnel shall be within the limit specified in relevant codes.

For vents associated with flammable materials, the end of the discharge pipe shall be cut off squarely and rounded off to minimize the risk of ignition by static electricity and the pipe earthed. The vent velocity should be as high as practicable.

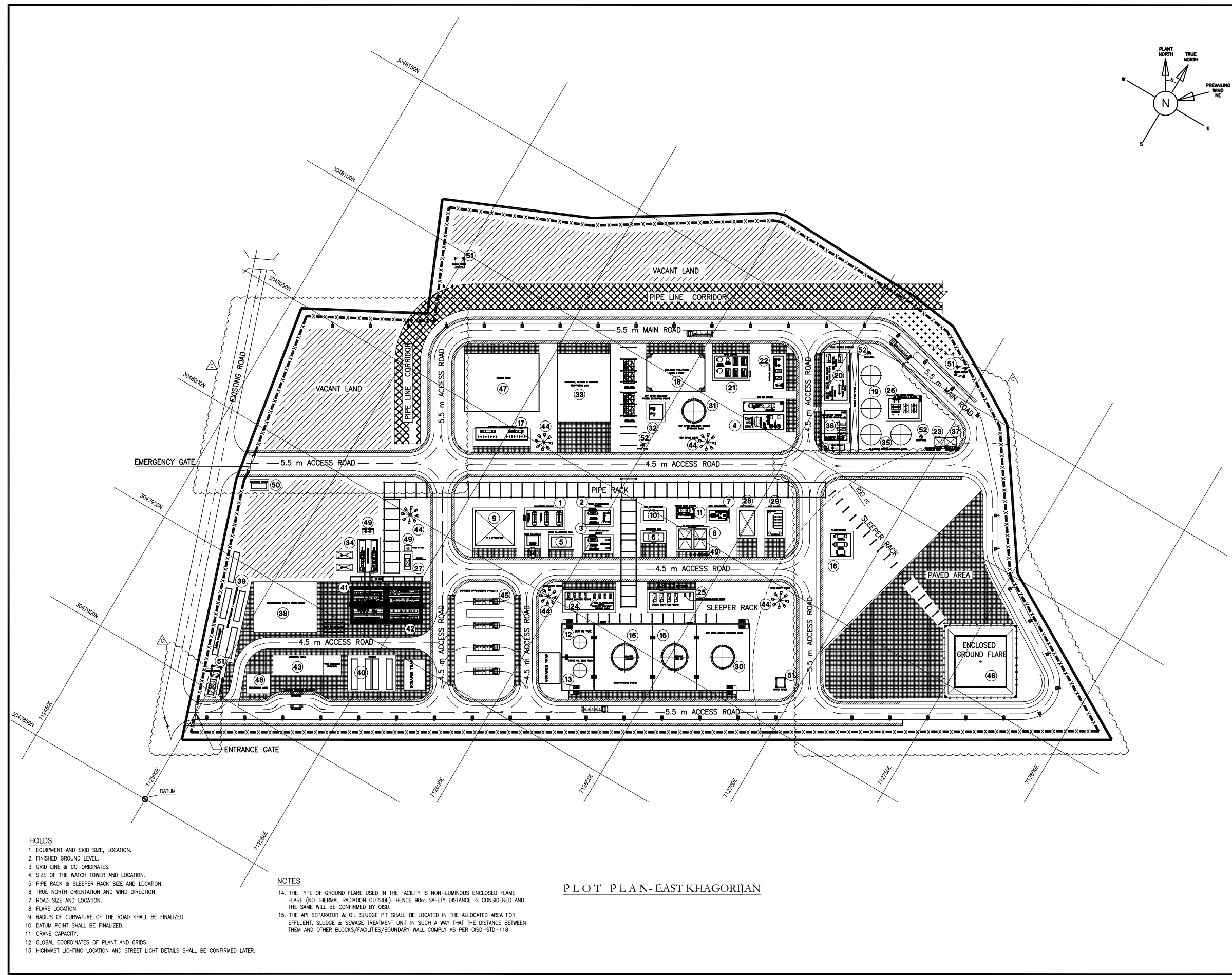
Chemical Injection tank vent shall be provided with suitable safety devices e.g. Flame Arrestors. When vessel is taken for maintenance, it shall be purged with nitrogen or other inert fluid and depressurized to atmosphere. Utilities connection shall be provided for purging to each vessel/equipment subject to venting operation.

For piping above 10", the vent , drain & bleed valve size shall be 1" with blind flange.

5.0 OPERATING / MAINTENANCE REQUIREMENTS

Drainage activities shall be performed in accordance with operating manuals. The following points shall be observed.

- Drainage shall never be done from live system. Systems need to be emptied as much as possible through the normal procedure.
- Proper house keeping is essential in avoiding blockage of drainage piping.



EQUIPMENT LEGEND					
ITEM NO.	DESCRIPTION	SIZE (mm)	CONTAINER (Y/N)	SHED (Y/N)	CRANE CAPACITY
1	SEPARATION SYSTEM	14000 L X 6500 W	N	N	-
2	CRUDE STABILIZATION TRAIN-A	10000 L X 5500 W	N	N	-
3	CRUDE STABILIZATION TRAIN-B	10000 L X 5500 W	N	N	-
4	HOT OIL SYSTEM (NOTE-11)	16000 L X 11000 W	N	Y	-
5	CRUDE OIL METERING SKID	8000 L X 4000 W	N	N	-
6	TRUNK LINE K00	8000 L X 3100 W	N	N	-
7	FUEL GAS SYSTEM	7000 L X 4000 W	N	N	-
8	LP GAS COMPRESSION PACKAGE	11000 L X 8000 W	N	N	-
9	HP/LP MANIFOLD SYSTEM	15500 L X 14000 W	N	N	-
10	GAS METERING SKID	8000 L X 4000 W	N	N	-
11	CLOSED DRAIN SYSTEM	7000 L X 4000 W	N	Y	H.O.T (HOLD-11)
12	SKIM OIL TANK	5500 (I/D) X 8000 (H)	N	N	-
13	CRUDE OIL TEST TANK	5500 (I/D) X 8300 (H)	N	N	-
14	TEST SEPARATOR	4500 L X 4000 W	N	N	-
15	TREATED CRUDE STORAGE TANK A/B	9500 (I/D) X 14250 (H)	N	N	-
16	FLARE SYSTEM	9000 L X 8000 W	N	N	-
17	CHEMICAL INJECTION SYSTEM	10000 L X 7500 W	N	N	-
18	EFFLUENT TREATMENT TANK & PUMP	23000 L X 15000 W X 4000 H	N	N	-
19	FIRE WATER TANKS A/B	7900 I/D X 10000 H	N	N	-
20	FIRE WATER & FOAM CONCENTRATE PUMPS	20000 L X 9000 W	N	Y	E.O.T (HOLD-11)
21	I/A/UA SYSTEM	12800 L X 8700 W	N	N	-
22	NITROGEN SYSTEM	12800 L X 4000 W	N	N	-
23	INDUSTRIAL WATER STORAGE TANK	3800 L X 3500 W X 5000 H	N	N	-
24	CRUDE CHARGE PUMPS, CRUDE OIL TEST TANK TRANSFER PUMP & SKIM OIL TRANSFER PUMP	19000 L X 7000 W	N	Y	E.O.T (HOLD-11)
25	CRUDE CIRCULATION PUMP & CRUDE DISPATCH PUMP	17300 L X 7000 W	N	Y	E.O.T (HOLD-11)
26	RO WATER MAKER/UV STABILIZER & FILTERS	12000 L X 8000 W	N	N	-
27	EMERGENCY DIESEL GENERATOR	8000 L X 4400 W	Y	N	-
28	NAG MANIFOLD	10000 L X 6000 W	N	N	-
29	NAG SYSTEM	10000 L X 6000 W	N	N	-
30	OFF SPEC CRUDE STORAGE TANK	8230 I/D X 12100 H	N	N	-
31	OFF SPEC EFFLUENT WATER STORAGE TANK	8450 I/D X 12600 H	N	N	-
32	OFF SPEC EFFLUENT WATER TRANSFER PUMPS	6000 L X 5300 W	N	Y	H.O.T (HOLD-11)
33	EFFLUENT, SLUDGE & SEWAGE TREATMENT UNIT	27000 L X 21000 W	N	N	-
34	CAPTIVE POWER PLANT	13000 L X 8000 W	Y (QTY-2)	N	-
35	CLARIFIED WATER STORAGE TANK	8100 I/D X 12000 H	N	N	-
36	CLARIFIED & BOOSTER PUMPS	12000 L X 11800 W	N	Y	H.O.T (HOLD-11)
37	POTABLE WATER STORAGE TANK	4800 L X 3500 W X 5000 H	N	N	-
38	MAINTENANCE SHED & STORE ROOM	30000 L X 20000 W	N	Y	E.O.T (HOLD-11)
39	SECURITY BARRACK / ACCOMMODATION	-	Y (QTY-5)	N	-
40	OFFICE	-	Y (QTY-4)	N	-
41	CONTROL ROOM	-	Y (QTY-2)	N	-
42	SUBSTATION (SWITCH ROOM/MCC ROOM)	-	Y (QTY-6)	N	-
43	PARKING AREA	16000 L X 8000 W	N	Y	-
44	HIGH MAST LIGHT (QTY-3)	-	N	N	-
45	BOWSER OFFLOADING FACILITY	-	N	Y	-
46	ENCLOSED GROUND FLARE	-	N	N	-
47	GUARD POND	29500 L X 23000 W	N	N	-
48	MUSTERING AREA	9500 L X 8000 W	N	N	-
49	VENT STACK (QTY-6)	-	N	N	-
50	SECURITY CABIN (QTY-2)	-	Y	N	-
51	WATCH TOWER (QTY-4)	-	N	N	-
52	BORE WELL (QTY-3)	-	N	N	-

LEGEND:

- GREEN BELT
- ROAD
- FIRE WALL
- DYKE WALL
- FUTURE EXPANSION
- PAVED AREA
- CULVERT/BRIDGE
- BORE WELL
- UNDERGROUND TANK
- UTILITY STATION
- STORM WATER
- TREE
- HIGH MAST (LED FIXTURE)
- STREET LIGHT (LED FIXTURE)
- F.G.L - FINISHED GROUND LEVEL
- F.F.L - FINISHED FLOOR LEVEL
- CHAIN LINK FENCING
- BOUNDARY LINE

NOTES

1. ALL DIMENSIONS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.

2. FINISHED GRADE LEVEL 0.000 ~ 115.00m MEAN SEA LEVEL.

3. THE GIVEN PACKAGE SIZE & LOCATIONS ARE PRELIMINARY WILL BE FINALIZED.

4. REF. ELEVATION SHALL BE FINISHED GROUND LEVEL EL+ 0.000.

5. MINIMUM INTER DISTANCES FOR VARIOUS STATION FACILITIES HAS BEEN MAINTAINED AS PER OMR 2017/OISD 118 REQUIREMENT.

6. FABRICATION SHED AND STORAGE SHED SHALL BE TEMPORARY SHED FOR THE CONSTRUCTION PURPOSE AND LOCATION SHALL BE SUIT AT SITE AS PER THE EPC CONTRACTOR.

7. STREET LIGHTING FIXTURE POLE SHALL BE OF 10m HEIGHT HAVING A PLANTING DEPTH OF MINIMUM 1.5m.

8. PCC/VDF FLOORING SHALL BE PROVIDED INSIDE SHEDS, OVER PCC/VDF FLOORING IRONITE(METALLIC HARDENER) FLOORING OF 52mm SHALL BE PROVIDED INCLUDING PARKING SHED.

NOTES

9. MENTIONED LIGHTING FIXTURES LOCATIONS ARE TENTATIVE ONLY, SAME SHALL BE CONFIRMED DURING DETAILED ENGINEERING.

10. FLASH POINT OF CRUDE OIL IS 37°C AND IT FALLS UNDER PETROLEUM CLASS B HOWEVER, OPERATING TEMPERATURE OF STORAGE TANKS IS 55°C AS PER OISD-117, IN THIS CASE CLASS B PRODUCT SHALL BE CONSIDERED AS CLASS A PRODUCT.

11. CENTRALIZED / COMMON API SEPARATORS, CORRUGATED PLATE INTERCEPTOR (CPI), OPEN OIL SEPARATORS SHALL BE CATEGORIZED UNDER THE SAME RISK AND SHALL BE LOCATED AT A DISTANCE OF 90M FROM HEATERS/BOILERS. HOWEVER, IF THESE ARE COVERED FROM THE TOP AND PROVIDED WITH ADEQUATE VENTING TO SAFE LOCATION, THE MINIMUM SEPARATION DISTANCE SHALL BE 30M.

12. HOT OIL DRAIN TANK & CLOSED DRAIN TANK SHALL BE SHED ARRANGEMENT.

13. ELEVATED TANKS FOR POTABLE & INDUSTRIAL WATER.

COMPANY:

Oil India Limited

EPCM CONSULTANT:

KAVIN™

PROJECT:

CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJA

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DOC NAME :

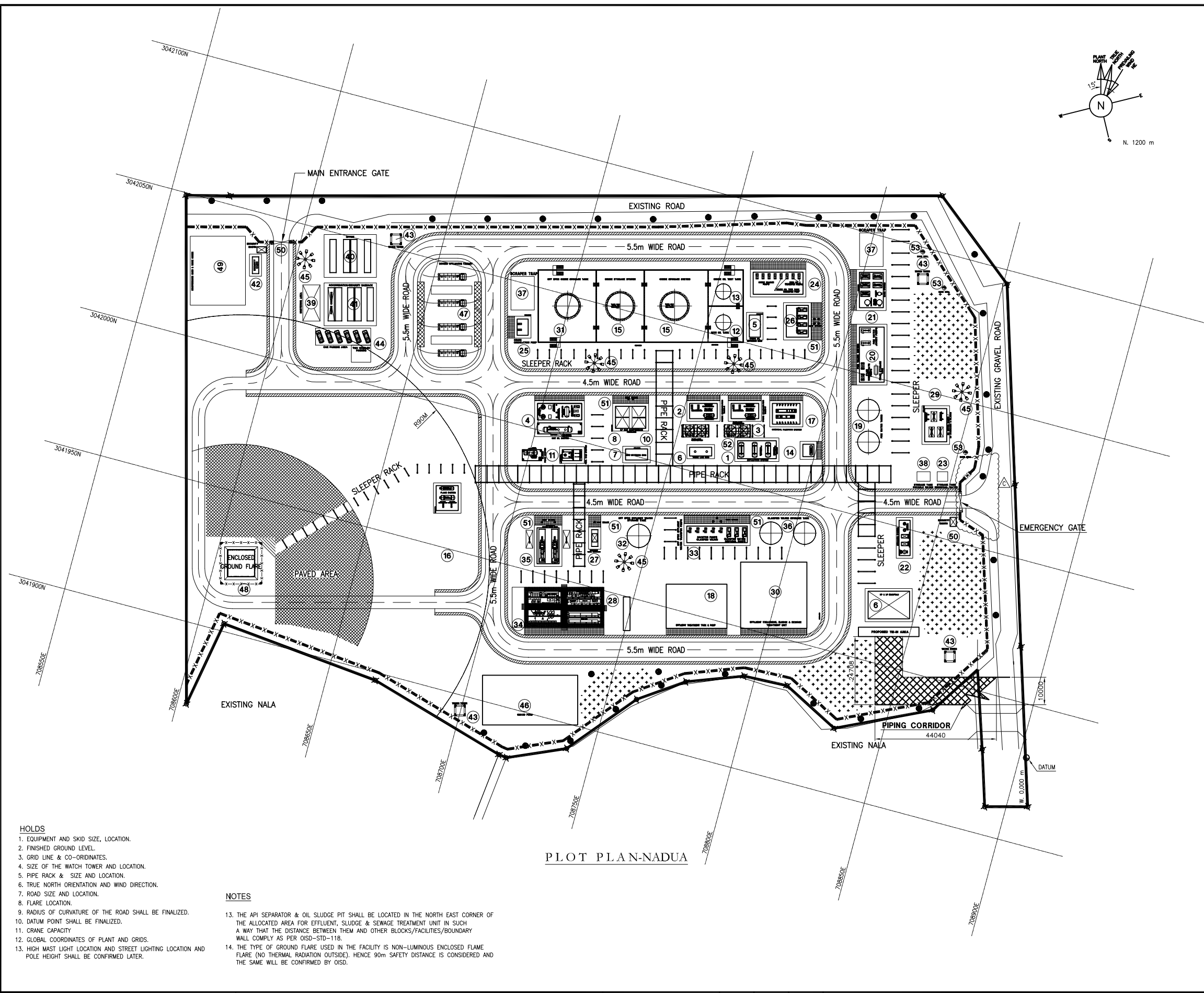
EAST KHAGORIJA - OVERALL PLOT PLAN

PROJECT NO.:	KIP-17039	PROJECT SITE:	EAST KHAGORIJA
DRAWING NO.:	17039-EK-I-DW-4001	REV: C	SHEET: 1 of 2
		SCALE:	1:750

REV	DATE	DESCRIPTION	DRAWN	CHK.	APPR.
C	13 APR 18	ISSUED FOR APPROVAL	M.P	G.K/ASH	MSB/MSR
B	02 APR 18	ISSUED FOR BID	M.P	G.K/ASH	MSB/MSR
A	08 DEC 17	ISSUED FOR REVIEW	MNS	SHV/ASH	MSB/MSR

SAFETY DISTANCE					
SL. No.	DISTANCE FROM	DISTANCE TO	DISTANCE REQD. AS PER OISD 118 (M)	DISTANCE MAINTAINED IN PLOT PLAN (M)	COMPLIANCE
01	STORAGE TANK CLASS "A" NOTE-9	PROCESS UNIT	30	42	YES
		PROCESS CONTROL ROOM	60	92	YES
		ENCLOSED GROUND FLARE	150	88	NO
		BOUNDARY WALL	0.5 D OR MIN 20	27	YES
		SERVICE BUILDING	60	117	YES
		OIL SLUDGE PIT IN ETP/ API SEPARATOR	50	55	YES
		ELECTRICAL SUB STATION	60	77	YES
		BOWSER OFFLOADING FACILITY	15	39	YES
02	PROCESS UNIT (DEHYDRATOR + SEPARATOR + COMPRESSOR + HEAT EXCHANGER	PROCESS CONTROL ROOM	30	103	YES
		ENCLOSED GROUND FLARE	150	104	YES
		BOUNDARY WALL	60	120	YES
		SERVICE BUILDING	60	143	NO
		OIL SLUDGE PIT IN ETP/ API SEPARATOR	30 (NOTE-10)	46	YES
		ELECTRICAL SUB STATION	15	103	YES
03	PROCESS CONTROL ROOM	ENCLOSED GROUND FLARE	150	211	YES
		BOUNDARY WALL	30	54	YES
		SERVICE BUILDING	15	15	YES
		OIL SLUDGE PIT IN ETP/ API SEPARATOR	30	49	YES
		ELECTRICAL SUB STATION	00	23	YES
04	ENCLOSED GROUND FLARE	BOUNDARY WALL	150	30	NO
		SERVICE BUILDING	150	252	YES
		OIL SLUDGE PIT IN ETP/ API SEPARATOR	150	174	YES
		ELECTRICAL SUB STATION	150	222	YES
05	BOUNDARY WALL	SERVICE BUILDING	6	28	YES
		OIL SLUDGE PIT IN ETP/ API SEPARATOR	50	124	YES
		ELECTRICAL SUB STATION	15	47	YES
		BOWSER OFFLOADING FACILITY	15	41	YES
06	SERVICE BUILDING	OIL SLUDGE PIT IN ETP/ API SEPARATOR	50	106	YES
		ELECTRICAL SUB STATION	12	28	YES
07	OIL SLUDGE PIT IN ETP/ API SEPARATOR	ELECTRICAL SUB STATION	45	60	YES

							COMPANY:		PROJECT : CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN				
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									DOC NAME : EAST KHAGORIJAN - OVERALL PLOT PLAN				
									PROJECT NO.: KIP-17039PROJECT SITE: EAST KHAGORIJAN				
									DRAWING NO.: 17039-EK-L-DW-4001REV: C SHEET : 2 of 2SCALE : 1:600				
							EPCM CONSULTANT :						
	C	13 APR 18	ISSUED FOR APPROVAL	M.P	G.K/ASH	MSB/MSR							
	B	02 APR 18	ISSUED FOR BID	M.P	G.K/ASH	MSB/MSR							
	A	08 DEC 17	ISSUED FOR REVIEW	MNS	SHIV/ASH	MSB/MSR							
	REV	DATE	DESCRIPTION	DRAWN	CHK.	APPR.							



- HOLDS**
- EQUIPMENT AND SKID SIZE, LOCATION.
 - FINISHED GROUND LEVEL.
 - GRID LINE & CO-ORDINATES.
 - SIZE OF THE WATCH TOWER AND LOCATION.
 - PIPE RACK & SIZE AND LOCATION.
 - TRUE NORTH ORIENTATION AND WIND DIRECTION.
 - ROAD SIZE AND LOCATION.
 - FLARE LOCATION.
 - RADIUS OF CURVATURE OF THE ROAD SHALL BE FINALIZED.
 - DATUM POINT SHALL BE FINALIZED.
 - CRANE CAPACITY
 - GLOBAL COORDINATES OF PLANT AND GRIDS.
 - HIGH MAST LIGHT LOCATION AND STREET LIGHTING LOCATION AND POLE HEIGHT SHALL BE CONFIRMED LATER.

- NOTES**
- THE API SEPARATOR & OIL SLUDGE PIT SHALL BE LOCATED IN THE NORTH EAST CORNER OF THE ALLOCATED AREA FOR EFFLUENT, SLUDGE & SEWAGE TREATMENT UNIT IN SUCH A WAY THAT THE DISTANCE BETWEEN THEM AND OTHER BLOCKS/FACILITIES/BOUNDARY WALL COMPLY AS PER OISD-STD-118.
 - THE TYPE OF GROUND FLARE USED IN THE FACILITY IS NON-LUMINOUS ENCLOSED FLARE (NO THERMAL RADIATION OUTSIDE). HENCE 90m SAFETY DISTANCE IS CONSIDERED AND THE SAME WILL BE CONFIRMED BY OISD.

- NOTES**
- ALL DIMENSIONS ARE IN MM, UNLESS OTHERWISE SPECIFIED.
 - FINISHED GRADE LEVEL 0.000 = 113.00m MEAN SEA LEVEL.
 - THE GIVEN PACKAGE SIZE & LOCATIONS ARE PRELIMINARY.
 - REF. ELEVATION SHALL BE FINISHED GROUND LEVEL EL+ 0.000.
 - MINIMUM INTER DISTANCES FOR VARIOUS STATION FACILITIES HAVE BEEN MAINTAINED AS PER OMR 2017/OISD 118 REQUIREMENT.
 - FABRICATION SHED AND STORAGE SHED SHALL BE TEMPORARY SHED FOR THE CONSTRUCTION PURPOSE AND LOCATION SHALL BE SUIT AT SITE AS PER THE EPC CONTRACTOR.
 - PCC/VDF FLOORING SHALL BE PROVIDED INSIDE SHEDS. OVER PCC/VDF FLOORING IRONITE(METALLIC HARDENER) FLOORING OF 52mm SHALL BE PROVIDED INCLUDING PARKING SHED.

- MENTIONED LIGHTING FIXTURES LOCATIONS ARE TENTATIVE ONLY, SAME SHALL BE CONFIRMED DURING DETAILED ENGINEERING.
- FLASH POINT OF CRUDE OIL IS 29°C AND IT FALLS UNDER PETROLEUM CLASS B HOWEVER, OPERATING TEMPERATURE OF STORAGE TANKS IS 50°C. AS PER OISD-117, IN THIS CASE CLASS B PRODUCT SHALL BE CONSIDERED AS CLASS A PRODUCT.
- CENTRALIZED / COMMON API SEPARATORS, CORRUGATED PLATE INTERCEPTOR (CPI), OPEN OIL SEPARATORS SHALL BE CATEGORIZED UNDER THE SAME RISK AND SHALL BE LOCATED AT A DISTANCE OF 90M FROM HEATERS/BOILERS. HOWEVER, IF THESE ARE COVERED FROM THE TOP AND PROVIDED WITH ADEQUATE VENTING TO SAFE LOCATION, THE MINIMUM SEPARATION DISTANCE SHALL BE 30M.
- HOT OIL DRAIN TANK & CLOSED DRAIN TANK SHALL BE SHED ARRANGEMENT.
- ELEVATED TANKS FOR POTABLE & INDUSTRIAL WATER.

REV	DATE	DESCRIPTION	DRAWN	CHK.	APPR.
C	12 APR 18	ISSUED FOR APPROVAL	M.P	G.K/ASH	MSB/MSR
B	05 APR 18	ISSUED FOR BID	M.P	G.K/ASH	MSB/MSR
A	08 DEC 18	ISSUED FOR REVIEW	MNS	SHV/ASH	MSB/MSR

COMPANY:

Oil India Limited

EPCM CONSULTANT:

KAVIN™

EQUIPMENT LEGEND					
ITEM NO	DESCRIPTION	SIZE (mm)	CONTAINER (Y/N)	SHED (Y/N)	CRANE (CAPACITY)
1	SEPARATION SYSTEM	14000 L X 6500 W	N	N	-
2	CRUDE STABILIZATION TRAIN-A	10000 L X 5500 W	N	N	-
3	CRUDE STABILIZATION TRAIN-B	10000 L X 5500 W	N	N	-
4	HOT OIL SYSTEM (NOTE-11)	16000 L X 11000 W	N	Y	-
5	CRUDE OIL METERING SKID	8000 L X 4000 W	N	N	-
6	TRUNK LINE KOD	8000 L X 3100 W	N	N	-
7	FUEL GAS SYSTEM	7000 L X 4000 W	N	N	-
8	LP GAS COMPRESSION PACKAGE	11000 L X 8000 W	N	N	-
9	HP,LP MANIFOLD SYSTEM	15000 L X 10000 W	N	N	-
10	GAS METERING SKID	8000 L X 4000 W	N	N	-
11	CLOSED DRAIN SYSTEM	7000 L X 4000 W	N	Y	H.O.T (HOLD-11)
12	SKIM OIL TANK	5500 I/D X 8000 H	N	N	-
13	CRUDE OIL TEST TANK	5550(I/D) x 8300(H)	N	N	-
14	CRUDE OIL TEST SEPARATOR	4500 L X 4000 W	N	N	-
15	TREATED CRUDE STORAGE TANK A/B	9500 I/D x 14250 H	N	N	-
16	FLARE SYSTEM	9000 L X 8000 W	N	N	-
17	CHEMICAL INJECTION SYSTEM	10000 L X 7500 W	N	N	-
18	EFFLUENT TREATMENT TANK & PUMP	22000 L X 16000 W X 4000 H	N	N	-
19	FIRE WATER TANKS A/B	7900 I/D x 10000 H	N	N	-
20	FIRE WATER/FOAM CONCENTRATE PUMPS & STORAGE TANK	20000 L X 9000 W	N	Y	E.O.T (HOLD-11)
21	IA/UA SYSTEM	12800 L X 8700 W	N	N	-
22	NITROGEN SYSTEM	12800 L X 4000 W	N	N	-
23	INDUSTRIAL WATER STORAGE TANK	3800 L X 3500 W X 5000 H	N	N	-
24	CRUDE OIL TEST TANK TRANSFER PUMP, SKIM OIL TRANSFER PUMP & CRUDE CHARGE PUMPS	18100 L X 8000 W	N	Y	E.O.T (HOLD-11)
25	CRUDE CIRCULATION PUMP	5900 L X 4000 W	N	Y	E.O.T (HOLD-11)
26	CRUDE DISPATCH PUMPS	11500 L X 8000 W	N	Y	H.O.T (HOLD-11)
27	EMERGENCY DIESEL GENERATOR	8000 L X 4400 W	Y (QTY-1)	N	-
28	SUBSTATION (SWITCH ROOM/MCC ROOM)	-	Y (QTY-2)	N	-
29	RO WATER MAKER / UV STABILIZER & FILTERS	12000 L X 8000 W	N	Y	-
30	EFFLUENT,SLUDGE & SEWAGE TREATMENT UNIT	24000 L X 24000 W	N	N	-
31	OFF SPEC CRUDE STORAGE TANK	8710 (I/D) x 12900 (H)	N	N	-
32	OFF SPEC EFFLUENT WATER STORAGE TANK	8450 (I/D) x 12600 (H)	N	N	-
33	OFF SPEC EFFLUENT WATER TRANSFER PUMPS CLARIFIED WATER DISPOSAL & BOOSTER PUMPS	22000 L X 6000 W	N	Y	E.O.T (HOLD-11)
34	CONTROL ROOM	-	Y (QTY-2)	N	-
35	CAPTIVE POWER PLANT	13000 L X 8000 W	Y (QTY-2)	N	-
36	CLARIFIED WATER STORAGE TANK A/B	8100 I/D x 12000 H	N	N	-
37	SCRAPER TRAP (2 NOS.)	12200 L X 8500 W	N	Y	-
38	POTABLE WATER STORAGE TANK	4800 L X 3500 W X 5000 H	N	N	-
39	MUSTERING AREA	13100 L X 6200 W	N	N	-
40	OFFICE	19000 L X 15500 W	Y (QTY-4)	N	-
41	ACCOMMODATION/SECURITY BARRACK	19000 L X 15500 W	Y (QTY-5)	N	-
42	SECURITY CABIN (QTY-1)	-	Y	N	-
43	WATCH TOWER (QTY-4)	-	N	N	-
44	PARKING AREA	27000 L X 6200 W	N	Y	-
45	HIGH MAST LIGHT (QTY-5)	-	N	N	-
46	GUARD POND	34500 L x 18000 X 4000 H	N	N	-
47	BOWSER OFFLOADING	-	N	Y	-
48	ENCLOSED FLARE FLARE	-	N	N	-
49	MAINTENANCE SHED & WARE HOUSE	30000 L x 20000 W	N	Y	E.O.T (HOLD-11)
50	SECURITY BOOTH (QTY-2)	-	N	N	-
51	VENT STACK (QTY-2)	-	N	N	-
52	PRODUCED WATER COOLER	TBA	Y (QTY-2)	N	-
53	BORE WELL (QTY-3)	-	N	N	-

- LEGEND:**
- GREEN BELT
 - ROAD
 - FIRE WALL
 - DYKE WALL
 - FUTURE AREA
 - PAVED AREA
 - CULVERT/BRIDGE
 - BORE WELL
 - UNDERGROUND TANK
 - UTILITY STATION
 - STORM WATER
 - TREE
 - HIGH MAST (LED FIXTURE)
 - STREET LIGHT (LED FIXTURE)
 - F.G.L - FINISHED GROUND LEVEL
 - F.F.L - FINISHED FLOOR LEVEL
 - BOUNDARY WALL
 - BOUNDARY

PROJECT : CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN

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DOC NAME : NADUA - OVERALL PLOT PLAN

PROJECT NO.: KIP-17039	PROJECT SITE:
DRAWING NO.: 17039-ND-1-DW-4001	REV: C SHEET : 1 of 2
SCALE : 1:700	

SAFETY DISTANCE					
SL. No.	DISTANCE FROM	DISTANCE TO	DISTANCE REQD. AS PER OISD-118 (M)	DISTANCE MAINTAINED IN PLOT PLAN (M)	COMPLIANCE
01	STORAGE TANK CLASS "A" NOTE-9	PROCESS UNIT	30	30	YES
		PROCESS CONTROL ROOM	60	105	YES
		ENCLOSED FLAME FLARE	150	175	YES
		BOUNDARY WALL	0.5 D OR MIN 20	23	YES
		SERVICE BUILDING	60	100	YES
		OIL SLUDGE PIT IN ETP/ API SEPARATOR	50	87	YES
		ELECTRICAL SUB STATION	60	97	YES
		BOWSER OFFLOADING FACILITY	15	29	YES
02	PROCESS UNIT (DEHYDRATOR + SEPARATOR + COMPRESSOR + HEAT EXCHANGER	PROCESS CONTROL ROOM	30	54	YES
		ENCLOSED GROUND FLARE	150	127	YES (NOTE-14)
		BOUNDARY WALL	60	60	YES
		SERVICE BUILDING	60	60	YES
		OIL SLUDGE PIT IN ETP/ API SEPARATOR	30 (NOTE-10)	37	YES
		ELECTRICAL SUB STATION	15	34	YES
03	PROCESS CONTROL ROOM	ENCLOSED GROUND FLARE	150	250	YES
		BOUNDARY WALL	30	32	YES
		SERVICE BUILDING	15	134	YES
		OIL SLUDGE PIT IN ETP/ API SEPARATOR	30	65	YES
		ELECTRICAL SUB STATION	00	03	YES
04	ENCLOSED FLAME FLARE	BOUNDARY WALL	150	15	NO
		SERVICE BUILDING	150	109	YES
		OIL SLUDGE PIT IN ETP/ API SEPARATOR	150	172	YES
		ELECTRICAL SUB STATION	150	109	YES
05	BOUNDARY WALL	SERVICE BUILDING	6	14	YES
		OIL SLUDGE PIT IN ETP/ API SEPARATOR (NOTE-13)	30 (NOTE-10)	30	YES
		ELECTRICAL SUB STATION	15	40	YES
		BOWSER OFFLOADING FACILITY	20	21	YES
06	SERVICE BUILDING	OIL SLUDGE PIT IN ETP/ API SEPARATOR	50	162	YES
		ELECTRICAL SUB STATION	12	126	YES
07	OIL SLUDGE PIT IN ETP/ API SEPARATOR	ELECTRICAL SUB STATION	45	50	YES



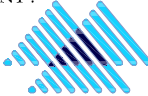
C	12 APR 18	ISSUED FOR APPROVAL	M.P	G.K/ASH	MSB/MSR	
B	05 APR 18	ISSUED FOR BID	M.P	G.K/ASH	MSB/MSR	
A	08 DEC 17	ISSUED FOR REVIEW	MNS	SHV/ASH	MSB/MSR	
REV	DATE	DESCRIPTION	DRAWN	CHK.	APPR.	

COMPANY:



ऑयल इंडिया लिमिटेड
Oil India Limited

EPCM CONSULTANT :



KAVIN™

PROJECT :

CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN

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DOC NAME :

NADUA - OVERALL PLOT PLAN

PROJECT NO.: KIP-17039

PROJECT SITE: NADUA

DRAWING NO.: 17039-ND-L-DW-4001

REV: C

SHEET : 2 of 2

SCALE : 1:600

CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN

Document Title : PIPING MATERIAL SPECIFICATION

Kavin Document No : 17039-EK-M-SP-2001

B	06-Feb-18	ISSUED FOR BID	SN	APRK / JB	MSR/MSB
A	29-Nov-17	ISSUED FOR REVIEW	SN	APRK / JB	MSR/MSB
REV.	DATE	DESCRIPTION	BY	CHECKED	APPROVED

**PROJECT DOCUMENTS ARE CONTROLLED DOCUMENTS.
REVISION CHANGES ARE DENOTED AS Δ IN RIGHT HAND MARGIN**

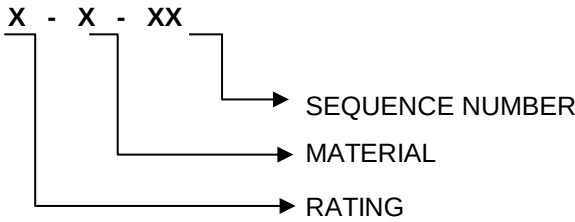
**CLIENT:
OIL INDIA LIMITED**

**EPCM
KAVIN ENGINEERING AND SERVICES PRIVATE
LIMITED**

TITLE	 	KAVIN DOCUMENT No.	
PROJECT		SHEET No.	Rev.
CREATION OF SURFACE PRODUCTION FACILITY GGs AT EAST KHAGORIJAN		4 of 33	B

PIPING SPECIFICATION INDEX						
Sl. No.	Piping Class	Rating	Material Description	Services	Pressure Temperature Range	
					Temp (°C)	Press. (kg/cm ² g)
1	AC01	150 #	CS + 3mm CA	Fuel Gas (FG), Drain Open (DO), HP Flare (HF), Heating Medium(HM)- Hot Oil, Produced Water (PW), Process Hydrocarbon Vapor (PV), LP Flare (LF), Process Hydrocarbon Liquid (PL), Drain Closed (DC), Raw/Fresh Water (WP), Potable Water (WD), Atmospheric Vent (VA).	-29 to 38	19.9
					250	12.3
2	AS20	150 #	SS	Potable water (WD), Nitrogen gas (GN), Demulsifier (CE), Oil Scale Inhibitor (CO), Corrosion Inhibitor (CK), Wax Inhibitor (CV), Flow Improver (CF), Process HC Liquid (PL), Process Hydrocarbon Vapor (PV), Deoiler (CD), Water Scale Inhibitor (CS).	-29 to 38	19.3
					250	12.3
3	AG01	150 #	CS + Galvanized + 3mm CA	Instrument air (IA), Utility Air (UA), Atmospheric Air- Vent (VA), Fire Water (WF), Nitrogen Gas (GN).	-29 to 38	19.9
					200	14
4	BC01	300 #	CS + 3mm CA	Fuel Gas (FG), Drain Open (DO), HP Flare (HF), Heating Medium(HM)- Hot Oil, Produced Water (PW), Process Hydrocarbon Vapor (PV), LP Flare (LF), Process Hydrocarbon Liquid (PL), Drain Closed (DC), Raw/Fresh Water (WP), Potable Water (WD), Atmospheric Vent (VA).	-29 to 38	52.1
					250	42.7
5	BS20	300 #	SS	Potable water (WD), Nitrogen gas (GN), Demulsifier (CE), Oil Scale Inhibitor (CO), Corrosion Inhibitor (CK), Wax Inhibitor (CV), Flow Improver (CF), Process HC Liquid (PL), Process Hydrocarbon Vapor (PV), Deoiler (CD), Water Scale Inhibitor (CS).	-29 to 38	50.5
					250	34
6	CC01	600 #	CS + 3mm CA	Produced Water (PW), Process Two Phase (PT), Process Hydrocarbon Vapor (PV), Process Hydrocarbon Liquid (PL).	-29 to 38	104.1
					250	85.5
7	CS20	600 #	SS	Potable water (WD), Nitrogen gas (GN), Demulsifier (CE), Oil Scale Inhibitor (CO), Corrosion Inhibitor (CK), Wax Inhibitor (CV), Flow Improver (CF), Process HC Liquid (PL), Process Hydrocarbon Vapor (PV), Deoiler (CD), Water Scale Inhibitor (CS).	-29 to 38	101.2
					250	68.1
8	DC01	900#	CS + 3mm CA	Produced Water (PW), Process Two Phase (PT), Process Hydrocarbon Vapor (PV), Process Hydrocarbon Liquid (PL).	-29 to 38	156.2
					250	128.2
9	DS20	900#	SS	Potable water (WD), Nitrogen gas (GN), Demulsifier (CE), Oil Scale Inhibitor (CO), Corrosion Inhibitor (CK), Wax Inhibitor (CV), Flow Improver (CF), Process HC Liquid (PL), Process Hydrocarbon Vapor (PV), Deoiler (CD), Water Scale Inhibitor (CS).	-29 to 38	151.8
					250	102
10	EC01	1500#	CS + 3mm CA	Produced Water (PW), Process Two Phase (PT), Process Hydrocarbon Vapor (PV), Process Hydrocarbon Liquid (PL).	-29 to 38	260.3
					204	222.55
11	ES20	1500#	SS	Potable water (WD), Nitrogen gas (GN), Demulsifier (CE), Oil Scale Inhibitor (CO), Corrosion Inhibitor (CK), Wax Inhibitor (CV), Flow Improver (CF), Process HC Liquid (PL), Process Hydrocarbon Vapor (PV), Deoiler (CD), Water Scale Inhibitor (CS).	-29 to 38	253
					204	180.8
12	FC01	2500#	CS + 3mm CA	Produced Water (PW), Process Two Phase (PT), Process Hydrocarbon Vapor (PV), Process Hydrocarbon Liquid (PL).	-29 to 38	388.17
					130	388.17
					(DE-RATED)	
13	FS20	2500#	SS	Potable water (WD), Nitrogen gas (GN), Demulsifier (CE), Oil Scale Inhibitor (CO), Corrosion Inhibitor (CK), Wax Inhibitor (CV), Flow Improver (CF), Process HC Liquid (PL), Process Hydrocarbon Vapor (PV), Deoiler (CD), Water Scale Inhibitor (CS).	-29 to 38	378.63
					80	378.63
					(DE-RATED)	
15	GT20	3000 psi	SS 316 (TUBING)	Demulsifier (CE), Oil Scale Inhibitor (CO), Corrosion Inhibitor (CK), Wax Inhibitor (CV), Flow Improver (CF), Water Scale Inhibitor (CS).	-28 to 37	210.9
					93	210.9

LEGENDS:



RATING	MATERIAL	SEQUENCE NUMBER
A - 150 #	C - Carbon Steel (CS) S - Stainless Steel (SS) P - GRE G - Carbon Steel + Galvanized Y - Incoloy L - Inconel D - Duplex Stainless Steel (DSS) R - Super Duplex Stainless Steel (SDSS) T - SS 316 (Tubing)	01 - 3mm CA
B - 300 #		
C - 600 #		11 - Low Temp. + 6mm CA
D - 900 #		20 - No CA
E - 1500 #		21 - 6mm CA
F - 2500 #		
G - 3000 psi (Tubing)		

TITLE				PIPING MATERIAL SPECIFICATION												DOCUMENT. No. :											
PROJECT				Oil India Limited												17039-EK-M-SP-2001											
CREATION OF SURFACE PRODUCTION FACILITY GGs AT EAST KHAGORIJAN																											
PIPING MATERIAL SPECIFICATION																											
Piping Class		Rating		Material				CA				Spec No				Rev No.		B									
AC01		#150		CS				3 mm				-				Sheet No.		6 of 33									
Design Code																											
Service		Fuel Gas (FG), Drain Open (DO), HP Flare (HF), Heating Medium(HM)- Hot Oil, Produced Water (PW), Process Hydrocarbon Vapor (PV), LP Flare (LF),																									
		Process Hydrocarbon Liquid (PL), Drain Closed (DC), Raw/Fresh Water (WP), Potable Water (WD), Atmospheric Vent (VA).																									
PIPE DATA																											
ASME B36.10M																											
Size (in)		0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24										
O.D (mm)		21.3	26.7	33.4	48.3	60.3	88.9	114.3	168.3	219.1	273.1	323.9	355.6	406.4	457.2	508	610										
Sch		160	160	160	160	XS	STD	STD	STD	20	20	20	20	20	20	20	20										
WT (mm)		4.78	5.56	6.35	7.14	5.54	5.49	6.02	7.11	6.35	6.35	6.35	7.92	7.92	7.92	9.53	9.53										
M.T (%)		12.5																									
Type		Seamless (Note-1)																									
MOC		ASTM A 106 Gr B (Note-1)																									
Ends		PE				BE																					
FITTING DATA																											
Size (in)		0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24										
Type		Socket Weld				Butt Weld																					
Rating		# 3000				Schedule same as pipe																					
MOC		ASTM A105				ASTM A234 Gr WPB, Seamless (Note-1)																					
Elbow		ASME B 16.11				ASME B 16.9																					
Tee		ASME B 16.11				ASME B 16.9																					
Reducer		ASME B 16.11				ASME B 16.9																					
Cap		ASME B 16.11				ASME B 16.9																					
Coupling		ASME B 16.11				-																					
Plug		ASME B 16.11				-																					
Union		ASME B 16.11				-																					
Elbowlet		-				-																					
Sockolet		MSS-SP-97				-																					
Weldolet		-				MSS-SP-97																					
Nipple		Sch 160 (MOC Same as pipe)				-																					
Swage		Sch 160				-																					
FLANGE DATA																											
ASME B16.5																											
Size (in)		0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24										
Type		Socket Weld, Blind				Weld Neck, Blind																					
MOC		ASTM A105				ASTM A105																					
RATING , FACE		150 # , RF				150 # , RF																					
STD		ASME B 16.5				ASME B 16.5, Butt welding ends as per ASME B 16.25																					
SPECTACLE BLIND/SPADE & SPACER DATA (NOTE-3)																											
Size (in)		0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24										
MOC		ASTM A516 Gr 70																									
Type		Spectacle Blind										Spade & Spacer															
MECHANICAL JOINTS DATA (NOTE-2)																											
Stud Bolt		ASTM A 193 Gr. B7 / ASME B16.5 (Hot dip galvanized)																									
Hex Nuts		ASTM A 194 Gr. 2H / ASME B 16.5 (Hot dip galvanized)																									
Gasket		150# SPWND Gasket 4.5mm THK TO ASME B 16.20: Windings - SS316, Filler- CNAF, Inner Ring -SS316, Outer Ring- CS																									
PRESSURE - TEMPERATURE RATING											Maximum Hydrostatic Pressure																
Temp (°C)						Pressure (kg/cm ² g)						As per ASME B31.3															
-29 to 38						19.9																					
250						12.3						Limited by flange considering flange as the weakest joint in piping system															
NOTES RELATED TO PIPE, FITTINGS, FLANGES, GASKETS AND STUD BOLTS & NUTS																											
1) As an alternative , for size ≥18", API 5L Gr.B Welded pipes / Fitting with 100% Radiography may be used.																											
2) All low Alloyed steel stud bolts, nuts and Washers shall be hot dipped galvanized according to ASTM A153..																											
3) Spectacle blind / Spade & spacer shall be in accordance with ASME B16.48.																											
4) Two jackscrew, 180 degree apart shall be provided in one of the flanges for all orifice flange and specified spectacle blind assemblies																											

TITLE		 										DOCUMENT. No. :																																																																																																																																																																																																																																																																																																																																																																																				
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TITLE					ऑयल इंडिया लिमिटेड Oil India Limited KAVIN™										DOCUMENT. No. :						
PROJECT															17039-EK-M-SP-2001						
CREATION OF SURFACE PRODUCTION FACILITY GGs AT EAST KHAGORIJAN																					
PIPING MATERIAL SPECIFICATION																					
Piping Class	Rating		Material					CA			Spec No			Rev No.		B					
AS20	#150		SS					0 mm			-			Sheet No.		8 of 33					
Design Code	ASME B31.3																				
Service	Potable water (WD), Nitrogen gas (GN), Demulsifier (CE), Oil Scale Inhibitor (CO), Corrosion Inhibitor (CK), Wax Inhibitor (CV), Flow Improver (CF), Process HC Liquid (PL),																				
	Process Hydrocarbon Vapor (PV), Deoiler (CD), Water Scale Inhibitor (CS).																				
PIPE DATA																					
ASME B36.19M																					
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24					
O.D (mm)	21.3	26.7	33.4	48.3	60.3	88.9	114.3	168.3	219.1	273.1	323.9	355.6	406.4	457.2	508	610					
Sch	40S	40S	40S	40S	10S	5S	5S	5S	5S	5S	5S	5S	5S	5S	5S	10S					
WT (mm)	2.77	2.87	3.38	3.68	2.77	2.11	2.11	2.77	2.77	3.4	3.96	3.96	4.19	4.19	4.78	6.35					
M.T (%)	12.5																				
Type	Seamless (Note-1)																				
MOC	ASTM A312 TP316 (Note-1)																				
Ends	PE					BE															
FITTING DATA																					
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24					
Type	Socket Weld					Butt Weld															
Rating	# 3000					Schedule same as pipe															
MOC	ASTM A182 F316					ASTM A 403 Gr. WP 316, Seamless (Note-1)															
Elbow	ASME B 16.11					ASME B 16.9															
Tee	ASME B 16.11					ASME B 16.9															
Reducer	ASME B 16.11					ASME B 16.9															
Cap	ASME B 16.11					ASME B 16.9															
Coupling	ASME B 16.11					-															
Plug	ASME B 16.11					-															
Union	ASME B 16.11					-															
Elbowlet	-					-															
Sockolet	MSS-SP-97					-															
Weldolet	-					A182 F316 / MSS-SP-97															
Nipple	Sch 80S (MOC Same as pipe)					-															
Swage	Sch 80S					-															
FLANGE DATA																					
ASME B16.5																					
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24					
Type	Socket Weld, Blind					Weld Neck, Blind															
MOC	ASTM A182 F316					ASTM A182 F316															
RATING , FACE	150 # , RF					150 # , RF															
STD	ASME B 16.5					ASME B 16.5, Butt welding ends as per ASME B 16.25															
SPECTACLE BLIND/SPADE & SPACER DATA (NOTE-2)																					
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24					
MOC	ASTM A240 GR 316																				
Type	Spectacle Blind										Spade & Spacer										
MECHANICAL JOINTS DATA																					
Stud Bolt	ASTM A 193 Gr. B7 / ASME B 16.5 (Hot dip galvanized)																				
Hex Nuts	ASTM A 194 Gr. 2H / ASME B 16.5 (Hot dip galvanized)																				
Gasket	150# SPWND Gasket 4.5mm THK TO ASME B 16.20: Windings - SS316, Filler- CNAF, Inner Ring -SS316, Outer Ring- SS 316																				
PRESSURE - TEMPERATURE RATING											Maximum Hydrostatic Pressure										
Temp (°C)					Pressure (kg/cm ² g)					As per ASME B31.3											
-29 to 38					19.3																
250					12.3					Limited by flange considering flange as the weakest joint in piping system											
NOTES RELATED TO PIPE, FITTINGS, FLANGES, GASKETS AND STUD BOLTS & NUTS																					
1) As an alternative , for size > 10", ASTM A 358 TP 316 Welded pipes / Fitting with 100% Radiography may be used.																					
2) Spectacle blind / Spade & spacer shall be in accordance with ASME B16.48.																					
3) Two jackscrew, 180 degree apart shall be provided in one of the flanges for all orifice flange and specified spectacle blind assemblies																					

TITLE	 	DOCUMENT. No. :
PROJECT		17039-EK-M-SP-2001
PIPING MATERIAL SPECIFICATION		
CREATION OF SURFACE PRODUCTION FACILITY GGS AT EAST KHAGORIJAN		

PIPING MATERIAL SPECIFICATION						
Piping Class	Rating	Material	CA	Spec No	Rev No.	B
AS20	#150	SS	0 mm	-	Sheet No.	9 of 33
Design Code	ASME B31.3					
Service	Potable water (WD), Nitrogen gas (GN), Demulsifier (CE), Oil Scale Inhibitor (CO), Corrosion Inhibitor (CK), Wax Inhibitor (CV), Flow Improver (CF), Process HC Liquid (PL), Process Hydrocarbon Vapor (PV), Deoiler (CD), Water Scale Inhibitor (CS).					

BRANCH TABLES AS PER API RP 14E

RUN PIPE	0.5	T																
	0.75	T	T															
	1	T	T	T														
	1.5	T	T	T	T													
	2	S	S	T	T	T												
	3	S	S	S	T	T	T											
	4	S	S	S	S	T	T	T										
	6	S	S	S	S	W	T	T	T									
	8	S	S	S	S	W	W	T	T	T								
	10	S	S	S	S	W	W	W	T	T	T							
	12	S	S	S	S	W	W	W	T	T	T	T						
	14	S	S	S	S	W	W	W	W	T	T	T	T					
	16	S	S	S	S	W	W	W	W	T	T	T	T	T				
	18	S	S	S	S	W	W	W	W	W	T	T	T	T	T			
	20	S	S	S	S	W	W	W	W	W	T	T	T	T	T	T		
	24	S	S	S	S	W	W	W	W	W	W	T	T	T	T	T	T	
		0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24	
BRANCH PIPE																		

LEGEND	
S	Sockolet
W	Weldolet
T	Equal / Reducing TEE

VALVE DATA

Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24	-	-	-	-

BALL VALVE																				
Tag	BFAS20R				BRAS20R, BFAS20R												-			

GLOBE VALVE																				
Tag	GVAS20R																			

CHECK VALVE																				
Tag	CLAS20R				CDAS20R, CSAS20R												-			

TITLE					 ऑयल इंडिया लिमिटेड Oil India Limited  KAVIN™										DOCUMENT. No. :				
PROJECT															17039-EK-M-SP-2001				
CREATION OF SURFACE PRODUCTION FACILITY GGs AT EAST KHAGORIJA																			
PIPING MATERIAL SPECIFICATION																			
Piping Class	Rating			Material					CA			Spec No			Rev No.		B		
AG01	#150			CS + GALVANIZED					3 mm			-			Sheet No.		10 of 33		
Design Code	ASME B31.3																		
Service	Instrument air (IA), Utility Air (UA), Atmospheric Air- Vent (VA), Fire Water (WF), Nitrogen Gas (GN).																		
PIPE DATA																			
ASME B36.10M																			
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24			
O.D (mm)	21.3	26.7	33.4	48.3	60.3	88.9	114.3	168.3	219.1	273.1	323.9	355.6	406.4	457.2	508	610			
Sch	160	160	160	160	XS	STD	STD	STD	20	20	20	20	20	20	20	20			
WT (mm)	4.78	5.56	6.35	7.14	5.54	5.49	6.02	7.11	6.35	6.35	6.35	7.92	7.92	7.92	9.53	9.53			
M.T (%)	12.5				12.5														
Type	Seamless				Seamless (Note-1)														
MOC	ASTM A 53 Gr B (Galvanized) (Note-5)				ASTM A106 Gr.B (Galvanized) (Note-1,4)														
Ends	Threaded & Coupled (Note-5)				BE														
FITTING DATA																			
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24			
Type	Threaded				Butt Weld														
Rating	# 3000				Schedule same as pipe														
MOC	ASTM A105 (Galvanized) (Note-4)				ASTM A234 Gr WPB (Galvanized) (Note-1,4)														
Elbow	ASME B 16.11				ASME B 16.9														
Tee	ASME B 16.11				ASME B 16.9														
Reducer	ASME B 16.11				ASME B 16.9														
Cap	ASME B 16.11				ASME B 16.9														
Coupling	ASME B 16.11				-														
Plug	ASME B 16.11				-														
Union	ASME B 16.11				-														
Thredolet	MSS-SP-97				-														
Sockolet	-				-														
Weldolet	-				MSS-SP-97														
Nipple	Sch 160 (MOC Same as pipe)				-														
Swage	Sch 160				-														
FLANGE DATA																			
ASME B16.5																			
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24			
Type	Threaded, Blind				Weld Neck, Blind														
MOC	ASTM A105 (Note-4)				ASTM A105 (NOTE-4)														
RATING , FACE	150 # , RF				150 # , RF														
STD	ASME B16.5				ASME B 16.5, Butt welding ends as per ASME B 16.25														
SPECTACLE BLIND/SPADE & SPACER DATA (NOTE-2)																			
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24			
MOC	ASTM A516 Gr 70 (GALVANIZED) (Note-4)																		
Type	Spectacle Blind										Spade & Spacer								
MECHANICAL JOINTS DATA (NOTE-1)																			
Stud Bolt	ASTM A 193 Gr. B7 / ASME B16.5 (Hot dip galvanized) (Note-4)																		
Hex Nuts	ASTM A 194 Gr. 2H / ASME B16.5 (Hot dip galvanized) (Note-4)																		
Gasket	150# SPWND Gasket 4.5mm THK TO ASME B 16.20: Windings - SS316, Filler- CNAF, Inner Ring -SS316, Outer Ring- CS																		
PRESSURE - TEMPERATURE RATING											Maximum Hydrostatic Pressure								
Temp (°C)					Pressure (kg/cm ² g)					As per ASME B31.3									
-29 to 38					19.9														
200					14					Limited by flange considering flange as the weakest joint in piping system									
NOTES RELATED TO PIPE, FITTINGS, FLANGES, GASKETS AND STUD BOLTS & NUTS																			
1) As an alternative , for size > 18", API 5L Gr.B Welded pipes / Fitting with 100% Radiography may be used.																			
2) Spectacle blind / Spade & spacer shall be in accordance with ASME B16.48.																			
3) Two jackscrew, 180 degree apart shall be provided in one of the flanges for all orifice flange and specified spectacle blind assemblies																			
4) Hot dip galvanized according to ASTM A153.																			
5) Galvanized pipe shall be supplied threaded in random length with coupling at one end.																			

TITLE PIPING MATERIAL SPECIFICATION		 ऑयल इंडिया लिमिटेड Oil India Limited  KAVIN™										DOCUMENT. No. : 17039-EK-M-SP-2001																																																																																																																																																																																																																																																																																																																																																											
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AG01	#150				CS + GALVANIZED				3 mm		-		Sheet No.		11 of 33																																																																																																																																																																																																																																																																																																																																																								
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BRANCH TABLES AS PER API RP 14E																																																																																																																																																																																																																																																																																																																																																																							
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Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24	-	-	-	-																																																																																																																																																																																																																																																																																																																																																			
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TITLE				ऑयल इंडिया लिमिटेड Oil India Limited KAVIN™												DOCUMENT. No. :				
PROJECT																17039-EK-M-SP-2001				
CREATION OF SURFACE PRODUCTION FACILITY GGs AT EAST KHAGORIJAN																				
PIPING MATERIAL SPECIFICATION																				
Piping Class	Rating			Material				CA				Spec No			Rev No.		B			
BC01	#300			CS				3 mm				-			Sheet No.		12 of 33			
Design Code	ASME B31.3																			
Service	Fuel Gas (FG), Drain Open (DO), HP Flare (HF), Heating Medium(HM)- Hot Oil, Produced Water (PW), Process Hydrocarbon Vapor (PV), LP Flare (LF), Process Hydrocarbon																			
	Liquid (PL), Drain Closed (DC), Raw/Fresh Water (WP), Potable Water (WD), Atmospheric Vent (VA).																			
PIPE DATA																				
ASME B36.10M																				
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24				
O.D (mm)	21.3	26.7	33.4	48.3	60.3	88.9	114.3	168.3	219.1	273.1	323.9	355.6	406.4	457.2	508	610				
Sch	160	160	160	160	XS	STD	STD	STD	60	XS	XS	XS	XS	40	40	40				
WT (mm)	4.78	5.56	6.35	7.14	5.54	5.49	6.02	7.11	10.31	12.7	12.7	12.7	12.7	14.3	15.09	17.5				
M.T (%)	12.5																			
Type	Seamless (Note-1)																			
MOC	ASTM A 106 Gr B (Note-1)																			
Ends	PE				BE															
FITTING DATA																				
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24				
Type	Socket Weld				Butt Weld															
Rating	# 6000				Schedule same as pipe															
MOC	ASTM A105				ASTM A234 Gr WPB, Seamless (Note-1)															
Elbow	ASME B 16.11				ASME B 16.9															
Tee	ASME B 16.11				ASME B 16.9															
Reducer	ASME B 16.11				ASME B 16.9															
Cap	ASME B 16.11				ASME B 16.9															
Coupling	ASME B 16.11				-															
Plug	ASME B 16.11				-															
Union	ASME B 16.11				-															
Elbowlet	-				-															
Sockolet	MSS-SP-97				-															
Weldolet	-				MSS-SP-97															
Nipple	Sch 160 (MOC Same as pipe)				-															
Swage	Sch 160				-															
FLANGE DATA																				
ASME B16.5																				
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24				
Type	Socket Weld, Blind				Weld Neck, Blind															
MOC	ASTM A105				ASTM A105															
RATING , FACE	300 # , RF				300 # , RF															
STD	ASME B 16.5				ASME B 16.5, Butt welding ends as per ASME B 16.25															
SPECTACLE BLIND/SPADE & SPACER DATA (NOTE-3)																				
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24				
MOC	ASTM A516 Gr 70																			
Type	Spectacle Blind										Spade & Spacer									
MECHANICAL JOINTS DATA (NOTE-2)																				
Stud Bolt	ASTM A 193 Gr. B7 / ASME B16.5 (Hot dip galvanized)																			
Hex Nuts	ASTM A 194 Gr. 2H / ASME B 16.5 (Hot dip galvanized)																			
Gasket	300# SPWND Gasket 4.5mm THK TO ASME B 16.20: Windings - SS316, Filler- CNAF, Inner Ring -SS316, Outer Ring- CS																			
PRESSURE - TEMPERATURE RATING											Maximum Hydrostatic Pressure									
Temp (°C)					Pressure (kg/cm ² g)					As per ASME B31.3										
-29 to 38					52.1															
250					42.7					Limited by flange considering flange as the weakest joint in piping system										
NOTES RELATED TO PIPE, FITTINGS, FLANGES, GASKETS AND STUD BOLTS & NUTS																				
1) As an alternative , for size ≥18", API 5L Gr.B Welded pipes / Fitting with 100% Radiography may be used.																				
2) All low Alloyed steel stud bolts, nuts and Washers shall be hot dipped galvanized according to ASTM A153..																				
3) Spectacle blind / Spade & spacer shall be in accordance with ASME B16.48.																				
4) Two jackscrew, 180 degree apart shall be provided in one of the flanges for all orifice flange and specified spectacle blind assemblies																				

TITLE		 												DOCUMENT. No. :																																																																																																																																																																																																																																																																																																								
PROJECT														17039-EK-M-SP-2001																																																																																																																																																																																																																																																																																																								
PIPING MATERIAL SPECIFICATION		CREATION OF SURFACE PRODUCTION FACILITY		GGS AT EAST KHAGORIJAN																																																																																																																																																																																																																																																																																																																		
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Service		Fuel Gas (FG), Drain Open (DO), HP Flare (HF), Heating Medium(HM)- Hot Oil, Produced Water (PW), Process Hydrocarbon Vapor (PV), LP Flare (LF), Process Hydrocarbon Liquid (PL), Drain Closed (DC),																																																																																																																																																																																																																																																																																																																				
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Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24	-	-	-	-																																																																																																																																																																																																																																																																																																		
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TITLE				ऑयल इंडिया लिमिटेड Oil India Limited KAVIN™												DOCUMENT. No. :			
PROJECT																17039-EK-M-SP-2001			
CREATION OF SURFACE PRODUCTION FACILITY GGs AT EAST KHAGORIJJAN																			
PIPING MATERIAL SPECIFICATION																			
Piping Class	Rating			Material				CA				Spec No			Rev No.	B			
BS20	#300			SS				0 mm				-			Sheet No.	14 of 33			
Design Code	ASME B31.3																		
Service	Potable water (WD), Nitrogen gas (GN), Demulsifier (CE), Oil Scale Inhibitor (CO), Corrosion Inhibitor (CK), Wax Inhibitor (CV), Flow Improver (CF), Process HC Liquid (PL),																		
	Process Hydrocarbon Vapor (PV), Deoiler (CD), Water Scale Inhibitor (CS).																		
PIPE DATA																			
ASME B36.19																			
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24			
O.D (mm)	21.3	26.7	33.4	48.3	60.3	88.9	114.3	168.3	219.1	273.1	323.9	355.6	406.4	457.2	508	610			
Sch	40S	40S	40S	40S	10S	5S	10S	40S	40S	40S	40S	40S	40S	80S	80S	30			
WT (mm)	2.77	2.87	3.38	3.68	2.77	2.11	3.05	7.11	8.18	9.27	9.53	9.53	9.53	12.7	12.7	14.3			
M.T (%)	12.5																		
Type	Seamless (Note-1)																		
MOC	A312 TP316 (Note-1)																		
Ends	PE				BE														
FITTING DATA																			
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24			
Type	Socket Weld				Butt Weld														
Rating	# 3000				Schedule same as pipe														
MOC	ASTM A182 F316				ASTM A 403 Gr. WP 316, Seamless (Note-1)														
Elbow	ASME B 16.11				ASME B 16.9														
Tee	ASME B 16.11				ASME B 16.9														
Reducer	ASME B 16.11				ASME B 16.9														
Cap	ASME B 16.11				ASME B 16.9														
Coupling	ASME B 16.11				-														
Plug	ASME B 16.11				-														
Union	ASME B 16.11				-														
Elbowlet	-				-														
Sockolet	MSS-SP-97				-														
Weldolet	-				A182 F316 / MSS-SP-97														
Nipple	Sch 80S (MOC Same as pipe)				-														
Swage	Sch 80S				-														
FLANGE DATA																			
ASME B16.5																			
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24			
Type	Socket Weld, Blind				Weld Neck, Blind														
MOC	ASTM A182 F316				ASTM A182 F316														
RATING , FACE	300 # , RF				300 # , RF														
STD	ASME B 16.5				ASME B 16.5, Butt welding ends as per ASME B 16.25														
SPECTACLE BLIND / SPADE & SPACER DATA (NOTE-2)																			
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24			
MOC	ASTM A240 GR 316																		
Type	Spectacle Blind										Spade & Spacer								
MECHANICAL JOINTS DATA																			
Stud Bolt	ASTM A 193 Gr. B7 / ASME B 16.5 (Hot dip galvanized)																		
Hex Nuts	ASTM A 194 Gr. 2H / ASME B 16.5 (Hot dip galvanized)																		
Gasket	300# SPWND Gasket 4.5mm THK TO ASME B 16.20: Windings - SS316, Filler- CNAF, Inner Ring -SS316, Outer Ring- SS 316																		
PRESSURE - TEMPERATURE RATING										Maximum Hydrostatic Pressure									
Temp (°C)					Pressure (kg/cm²g)					As per ASME B31.3									
-29 to 38					50.5					Limited by flange considering flange as the weakest joint in piping system									
250					34														
NOTES RELATED TO PIPE, FITTINGS, FLANGES, GASKETS AND STUD BOLTS & NUTS																			
1) As an alternative , for size > 10", ASTM A 358 TP 316 Welded pipes / Fitting with 100% Radiography may be used.																			
2) Spectacle blind / Spade & spacer shall be in accordance with ASME B16.48.																			
3) Two jackscrew, 180 degree apart shall be provided in one of the flanges for all orifice flange and specified spectacle blind assemblies																			

TITLE	ऑयल इंडिया लिमिटेड Oil India Limited KAVIN™	DOCUMENT. No. :
PROJECT		17039-EK-M-SP-2001
CREATION OF SURFACE PRODUCTION FACILITY GGS AT EAST KHAGORIJAN		

PIPING MATERIAL SPECIFICATION						
Piping Class	Rating	Material	CA	Spec No	Rev No.	B
BS20	#300	SS	0 mm	-	Sheet No.	15 of 33
Design Code	ASME B31.3					
Service	Potable water (WD), Nitrogen gas (GN), Demulsifier (CE), Oil Scale Inhibitor (CO), Corrosion Inhibitor (CK), Wax Inhibitor (CV), Flow Improver (CF), Process HC Liquid (PL), Process Hydrocarbon Vapor (PV),					
	Deoiler (CD), Water Scale Inhibitor (CS).					

BRANCH TABLES AS PER API RP 14E

RUN PIPE	0.5	T																
	0.75	T	T															
	1	T	T	T														
	1.5	T	T	T	T													
	2	S	S	T	T	T												
	3	S	S	S	T	T	T											
	4	S	S	S	S	T	T	T										
	6	S	S	S	S	W	T	T	T									
	8	S	S	S	S	W	W	T	T	T								
	10	S	S	S	S	W	W	W	T	T	T							
	12	S	S	S	S	W	W	W	T	T	T	T						
	14	S	S	S	S	W	W	W	W	T	T	T	T					
	16	S	S	S	S	W	W	W	W	T	T	T	T	T				
	18	S	S	S	S	W	W	W	W	W	T	T	T	T	T			
	20	S	S	S	S	W	W	W	W	W	T	T	T	T	T	T		
	24	S	S	S	S	W	W	W	W	W	W	T	T	T	T	T	T	
	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24		
BRANCH PIPE																		

VALVE DATA

Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24	-	-	-	-

BALL VALVE

Tag	BFBS20R	BRBS20R, BFBS20R	-

GLOBE VALVE

Tag	-	GVBS20R	

CHECK VALVE

Tag	CLBS20R	CDBS20R, CSBS20R	-

TITLE		ऑयल इंडिया लिमिटेड Oil India Limited KAVIN™															DOCUMENT. No. :				
PROJECT																	17039-EK-M-SP-2001				
CREATION OF SURFACE PRODUCTION FACILITY GGs AT EAST KHAGORIJJAN																					
PIPING MATERIAL SPECIFICATION																					
Piping Class	Rating		Material					CA			Spec No			Rev No.		B					
CC01	#600		CS					3 mm			-			Sheet No.		16 of 33					
Design Code	ASME B31.3																				
Service	Produced Water (PW), Process Two Phase (PT), Process Hydrocarbon Vapor (PV), Process Hydrocarbon Liquid (PL).																				
PIPE DATA																					
ASME B36.10M																					
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24	-	-	-		
O.D (mm)	21.3	26.7	33.4	48.3	60.3	88.9	114.3	168.3	219.1	273.1	323.9	355.6	406.4	457.2	508	610	-	-	-		
Sch	160	160	160	160	160	80	80	80	100	100	80	80	80	80	80	80	-	-	-		
WT (mm)	4.78	5.56	6.35	7.14	8.74	7.62	8.56	10.97	15.09	18.26	17.48	19.05	21.44	23.83	26.19	30.96	-	-	-		
M.T (%)	12.5																				
Type	Seamless (Note-1)																				
MOC	ASTM A 106 Gr B (Note-1)																				
Ends	BE																				
FITTING DATA																					
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24	-	-	-		
Type	Butt Weld																				
Sch	Same as pipe																				
MOC	ASTM A234 Gr WPB, Seamless (Note-1)																				
Elbow	ASME B 16.9																				
Tee	ASME B 16.9																				
Reducer	ASME B 16.9																				
Cap	ASME B 16.9																				
Coupling	-																				
Plug	-																				
Union	-																				
Elbowlet	-																				
Sockolet	-																				
Weldolet	ASTM A105 / MSS-SP-97																				
Nipple	Sch 160 (MOC Same as pipe)				-																
Swage	Sch 160				-																
FLANGE DATA																					
ASME B16.5																					
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24	-	-	-		
Type	Weld Neck, Blind																				
MOC	ASTM A105																				
RATING , FACE	600 # , RTJ																				
STD	ASME B 16.5, Butt welding ends as per ASME B 16.25																				
SPECTACLE BLIND / SPADE & SPACER DATA (NOTE-3)																					
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24	-	-	-		
MOC	ASTM A516 Gr 70																				
Type	Spectacle blind								Spade & Spacer												
MECHANICAL JOINTS DATA (NOTE-2)																					
Stud Bolt	ASTM A 193 Gr. B7 / ASME B 16.5 (Hot dip galvanized)																				
Hex Nuts	ASTM A 194 Gr. 2H / ASME B16.5 (Hot dip galvanized)																				
Gasket	600#, Type R(Oval)-Ring Joint, Soft iron - 90 BHN as per ASME B16.20																				
PRESSURE - TEMPERATURE RATING										Maximum Hydrostatic Pressure											
Temp (°c)					Pressure (kg/cm²g)					As per ASME B31.3											
-29 to 38					104.1																
250					85.5					Limited by flange considering flange as the weakest joint in piping system											
NOTES RELATED TO PIPE, FITTINGS, FLANGES, GASKETS AND STUD BOLTS & NUTS																					
1) As an alternative , for size ≥18", API 5L Gr.B Welded pipes / Fitting with 100% Radiography may be used.																					
2) All low Alloyed steel stud bolts, nuts and Washers shall be hot dipped galvanized according to ASTM A153..																					
3) Spectacle blind / Spade & spacer shall be in accordance with ASME B16.48.																					
4) Two jackscrew, 180 degree apart shall be provided in one of the flanges for all orifice flange and specified spectacle blind assemblies																					

TITLE		 										DOCUMENT. No. :																																																																																																																																																																																																																																																																																																																																																																																																		
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Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24	-	-	-	-																																																																																																																																																																																																																																																																																																																																																																																										
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TITLE				ऑयल इंडिया लिमिटेड Oil India Limited KAVIN™												DOCUMENT. No. :			
PROJECT																17039-EK-M-SP-2001			
CREATION OF SURFACE PRODUCTION FACILITY GGs AT EAST KHAGORIJAN																			
PIPING MATERIAL SPECIFICATION																			
PIPING MATERIAL SPECIFICATION																			
Piping Class	Rating		Material					CA			Spec No			Rev No.	B				
CS20	#600		SS					0 mm			-			Sheet No.	18 of 33				
Design Code	ASME B31.3																		
Service	Potable water (WD), Nitrogen gas (GN), Demulsifier (CE), Oil Scale Inhibitor (CO), Corrosion Inhibitor (CK), Wax Inhibitor (CV), Flow Improver (CF), Process HC Liquid (PL),																		
	Process Hydrocarbon Vapor (PV), Deoiler (CD), Water Scale Inhibitor (CS).																		
PIPE DATAASME B36.19M																			
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24	-	-	
O.D (mm)	21.3	26.7	33.4	48.3	60.3	88.9	114.3	168.3	219.1	273.1	323.9	355.6	406.4	457.2	508	610	-	-	
Sch	40S	40S	40S	40S	10S	40S	40S	80S	80S	80S	80	80	80	80	80	80	-	-	
WT (mm)	2.77	2.87	3.38	3.68	2.77	5.49	6.02	10.97	12.7	12.7	17.48	19.05	21.44	23.83	26.19	30.95	-	-	
M.T (%)	12.5																		
Type	Seamless																		
MOC	A312 TP316																		
Ends	BE																		
FITTING DATA																			
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24	-	-	
Type	Butt Weld																		
Sch	Schedule same as pipe																		
MOC	ASTM A 403 Gr. WP 316, Seamless (Note-1)																		
Elbow	ASME B 16.9																		
Tee	ASME B 16.9																		
Reducer	ASME B 16.9																		
Cap	ASME B 16.9																		
Coupling	-																		
Plug	-																		
Union	-																		
Elbowlet	-																		
Sockolet	-																		
Weldolet	A182 F316 / MSS-SP-97																		
Nipple	Sch 80S (MOC Same as pipe)				-														
Swage	Sch 80S				-														
FLANGE DATAASME B16.5																			
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24	-	-	
Type	Weld Neck, Blind																		
MOC	ASTM A182 F316																		
RATING , FACE	600 # , RTJ																		
STD	ASME B 16.5, Butt welding ends as per ASME B 16.25																		
SPECTACLE BLIND/SPADE & SPACER DATA (NOTE-2)																			
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24	-	-	
MOC	ASTM A240 GR 316																		
Type	Spectacle blind									Spade & Spacer									
MECHANICAL JOINTS DATA (NOTE-2)																			
Stud Bolt	ASTM A 193 Gr. B7 / ASME B 16.5 (Hot dip galvanized)																		
Hex Nuts	ASTM A 194 Gr. 2H / ASME B 16.5 (Hot dip galvanized)																		
Gasket	600#, Type R(Oval)-Ring Joint, 316L SS - 160 BHN as per ASME B16.20																		
PRESSURE - TEMPERATURE RATING										Maximum Hydrostatic Pressure									
Temp (°C)					Pressure (kg/cm ² g)					As per ASME B31.3									
-29 to 38					101.2														
250					68.1					Limited by flange considering flange as the weakest joint in piping system									
NOTES RELATED TO PIPE, FITTINGS, FLANGES, GASKETS AND STUD BOLTS & NUTS																			
1) As an alternative , for size > 10", ASTM A 358 TP 316 Welded pipes / Fitting with 100% Radiography may be used.																			
2) Spectacle blind / Spade & spacer shall be in accordance with ASME B16.48.																			
3) Two jackscrew, 180 degree apart shall be provided in one of the flanges for all orifice flange and specified spectacle blind assemblies																			

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Service		Potable water (WD), Nitrogen gas (GN), Demulsifier (CE), Oil Scale Inhibitor (CO), Corrosion Inhibitor (CK), Wax Inhibitor (CV), Flow Improver (CF), Process HC Liquid (PL), Process Hydrocarbon Vapor (PV),																																																																																																																																																																																																																																																																																																																																																																																												
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TITLE					ऑयल इंडिया लिमिटेड Oil India Limited KAVIN™										DOCUMENT. No. :					
PROJECT															17039-EK-M-SP-2001					
CREATION OF SURFACE PRODUCTION FACILITY GGs AT EAST KHAGORIJAN																				
PIPING MATERIAL SPECIFICATION																				
Piping Class	Rating		Material					CA			Spec No		Rev No.		B					
DC01	#900		CS					3 mm			-		Sheet No.		20 of 33					
Design Code	ASME B31.3																			
Service	Produced Water (PW), Process Two Phase (PT), Process Hydrocarbon Vapor (PV), Process Hydrocarbon Liquid (PL).																			
PIPE DATA																				
ASME B36.10M																				
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24				
O.D (mm)	21.3	26.7	33.4	48.3	60.3	88.9	114.3	168.3	219.1	273.1	323.9	355.6	406.4	457.2	508	610				
Sch	160	160	160	160	160	160	120	120	120	120	120	120	120	120	120	120				
WT (mm)	4.78	5.56	6.35	7.14	8.74	11.13	11.13	14.27	18.26	21.44	25.4	27.79	30.96	34.93	38.1	46.02				
M.T (%)	12.5																			
Type	Seamless (Note-1)																			
MOC	ASTM A106 Gr B (Note-1)																			
Ends	BE																			
FITTING DATA																				
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24				
Type	Butt Weld																			
Sch	Same as pipe																			
MOC	ASTM A234 Gr WPB, Seamless (Note-1)																			
Elbow	ASME B 16.9																			
Tee	ASME B 16.9																			
Reducer	ASME B 16.9																			
Cap	ASME B 16.9																			
Coupling	-																			
Plug	-																			
Union	-																			
Elbowlet	-																			
Sockolet	-																			
Weldolet	ASTM A105 / MSS-SP-97																			
Nipple	Sch 160 (MOC Same as pipe)				-															
Swage	Sch 160				-															
FLANGE DATA																				
ASME B16.5																				
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24				
Type	Weld Neck, Blind					Weld Neck, Blind														
MOC	ASTM A105					ASTM A105														
RATING , FACE	1500 # , RTJ					900 # , RTJ														
STD	ASME B 16.5, Butt welding ends as per ASME B 16.25																			
SPECTACLE BLIND / SPADE & SPACER DATA (NOTE-3)																				
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24				
MOC	ASTM A516 Gr 70																			
Type	Spectacle blind								Spade & Spacer											
MECHANICAL JOINTS DATA (NOTE-2)																				
Stud Bolt	ASTM A 193 Gr. B7 / ASME B16.5 (Hot dip galvanized)																			
Hex Nuts	ASTM A 194 Gr. 2H / ASME B16.5 (Hot dip galvanized)																			
Gasket	1500#, Type R(Oval)-Ring Joint, Soft iron - 90 BHN as per ASME B16.20					900#, Type R(Oval)-Ring Joint, Soft iron - 90 BHN as per ASME B16.20														
PRESSURE - TEMPERATURE RATING										Maximum Hydrostatic Pressure										
Temp (°C)					Pressure (kg/cm ² g)					As per ASME B31.3										
-29 to 38					156.2															
250					128.2					Limited by flange considering flange as the weakest joint in piping system										
NOTES RELATED TO PIPE, FITTINGS, FLANGES, GASKETS AND STUD BOLTS & NUTS																				
1) As an alternative , for size ≥18", API 5L Gr.B Welded pipes / Fitting with 100% Radiography may be used.																				
2) All low Alloyed steel stud bolts, nuts and Washers shall be hot dipped galvanized according to ASTM A153..																				
3) Spectacle blind / Spade & spacer shall be in accordance with ASME B16.48.																				
4) Two jackscrew, 180 degree apart shall be provided in one of the flanges for all orifice flange and specified spectacle blind assemblies																				

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TITLE				ऑयल इंडिया लिमिटेड Oil India Limited KAVIN™												DOCUMENT. No. :			
PROJECT																17039-EK-M-SP-2001			
CREATION OF SURFACE PRODUCTION FACILITY GGs AT EAST KHAGORIJJAN																			
PIPING MATERIAL SPECIFICATION																			
Piping Class	Rating		Material				CA			Spec No			Rev No.		B				
DS20	#900		SS				0 mm			-			Sheet No.		22 of 33				
Design Code	ASME B31.3																		
Service	Potable water (WD), Nitrogen gas (GN), Demulsifier (CE), Oil Scale Inhibitor (CO), Corrosion Inhibitor (CK), Wax Inhibitor (CV), Flow Improver (CF), Process HC Liquid (PL),																		
	Process Hydrocarbon Vapor (PV), Deoiler (CD), Water Scale Inhibitor (CS).																		
PIPE DATA																			
ASME B36.19M																			
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24			
O.D (mm)	21.3	26.7	33.4	48.3	60.3	88.9	114.3	168.3	219.1	273.1	323.9	355.6	406.4	457.2	508	610			
Sch	40S	40S	40S	40S	40S	80S	80S	80S	100	100	100	100	120	120	120	120			
WT (mm)	2.77	2.87	3.38	3.68	3.91	7.62	8.56	10.97	15.1	18.26	21.4	23.83	30.96	34.93	38.1	46.02			
M.T (%)																			
Type	Seamless (Note-1)																		
MOC	ASTM A312 TP316 (Note-1)																		
Ends	BE																		
FITTING DATA																			
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24			
Type	Butt Weld																		
Sch	Schedule same as pipe																		
MOC	ASTM A 403 Gr. WP 316, Seamless (Note-1)																		
Elbow	ASME B 16.9																		
Tee	ASME B 16.9																		
Reducer	ASME B 16.9																		
Cap	ASME B 16.9																		
Coupling	-																		
Plug	-																		
Union	-																		
Elbowlet	-																		
Sockolet	-																		
Weldolet	A182 F316 / MSS-SP-97																		
Nipple	Sch 80S (MOC Same as pipe)				-														
Swage	Sch 80S				-														
FLANGE DATA																			
ASME B16.5																			
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24			
Type	Weld Neck, Blind					Weld Neck, Blind													
MOC	ASTM A182 F316					ASTM A182 F316													
RATING , FACE	1500 # , RTJ					900 # , RTJ													
STD	ASME B 16.5, Butt welding ends as per ASME B 16.25																		
SPECTACLE BLIND / SPADE & SPACER DATA (NOTE-2)																			
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24			
MOC	ASTM A240 GR 316																		
Type	Spectacle blind							Spade & Spacer											
MECHANICAL JOINTS DATA																			
Stud Bolt	ASTM A 193 Gr. B7 / ASME B 16.5 (Hot dip galvanized)																		
Hex Nuts	ASTM A 194 Gr. 2H / ASME B 16.5 (Hot dip galvanized)																		
Gasket	1500#, Type R(Oval)-Ring Joint, 316L SS - 160 BHN as per ASME B16.20					900#, Type R(Oval)-Ring Joint, 316L SS - 160 BHN as per ASME B16.20													
PRESSURE - TEMPERATURE RATING										Maximum Hydrostatic Pressure									
Temp (°C)					Pressure (kg/cm ² g)					As per ASME B31.3									
-29 to 38					151.8														
250					102					Limited by flange considering flange as the weakest joint in piping system									
NOTES RELATED TO PIPE, FITTINGS, FLANGES, GASKETS AND STUD BOLTS & NUTS																			
1) As an alternative , for size > 10", ASTM A 358 TP 316 Welded pipes / Fitting with 100% Radiography may be used.																			
2) Spectacle blind / Spade & spacer shall be in accordance with ASME B16.48.																			
3) Two jackscrew, 180 degree apart shall be provided in one of the flanges for all orifice flange and specified spectacle blind assemblies																			

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Tag	DBDS20C, DBDS20J																-																																																																																																																																																																																																																																																																																																																		

TITLE				 ऑयल इंडिया लिमिटेड Oil India Limited  KAVIN™										DOCUMENT. No. :							
PROJECT														17039-EK-M-SP-2001							
PIPING MATERIAL SPECIFICATION				CREATION OF SURFACE PRODUCTION FACILITY GGs AT EAST KHAGORIJAN																	
PIPING MATERIAL SPECIFICATION																					
Piping Class		Rating		Material				CA				Spec No		Rev No.		B					
EC01		#1500		CS				3 mm				-		Sheet No.		24 of 33					
Design Code		ASME B31.3																			
Service		Produced Water (PW), Process Two Phase (PT), Process Hydrocarbon Vapor (PV), Process Hydrocarbon Liquid (PL).																			
PIPE DATA																					
ASME B36.10M																					
Size (in)		0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24	-	-		
O.D (mm)		21.3	26.7	33.4	48.3	60.3	88.9	114.3	168.3	219.1	273.1	323.9	355.6	406.4	457.2	508	610	-	-		
Sch		XXS	XXS	XXS	XXS	XXS	XXS	XXS	XXS	Thk. 20.6	Thk. 25.4	Thk. 31.8	Thk. 31.8	Thk. 36	Thk. 40	Thk. 45	Thk. 56	-	-		
WT (mm)		7.47	7.82	9.09	10.15	11.07	15.24	17.12	21.95	20.6	25.4	31.8	31.8	36	40	45	56	-	-		
M.T (%)		12.5																			
Type		Seamless (Note-1)								Welded pipe with 100% Radiographed											
MOC		ASTM A 106 Gr B (Note-1)								API 5L X65 PSL-2											
Ends		BE																			
FITTING DATA																					
Size (in)		0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24				
Type		Butt Weld																			
Sch		SAME AS PIPE																			
MOC		ASTM A234 Gr WPB, Seamless (Note-1)																			
Elbow		ASME B 16.9																			
Tee		ASME B 16.9																			
Reducer		ASME B 16.9																			
Cap		ASME B 16.9																			
Coupling		-																			
Plug		-																			
Union		-																			
Elbowlet		-																			
Sockolet		-																			
Weldolet		ASTM A105 / MSS-SP-97																			
Nipple		Sch 160 (MOC Same as pipe)				-															
Swage		Sch 160				-															
FLANGE DATA																					
ASME B16.5																					
Size (in)		0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24				
Type		WELD NECK , BLIND																			
MOC		ASTM A105																			
RATING , FACE		1500 # , RTJ																			
STD		ASME B 16.5, Butt welding ends as per ASME B 16.25																			
SPECTACLE BLIND/SPADE & SPACER DATA (NOTE-3)																					
Size (in)		0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24				
MOC		ASTM A516 Gr 70																			
Type		Spectacle Blind								Spade & Spacer											
MECHANICAL JOINTS DATA (NOTE-2)																					
Stud Bolt		ASTM A 193 Gr. B7 / ASME B16.5 (Hot dip galvanized)																			
Hex Nuts		ASTM A 194 Gr. 2H / ASME B16.5 (Hot dip galvanized)																			
Gasket		1500#, Type R(Oval)- Ring joint, soft iron - 90 BHN as per ASME B16.20																			
PRESSURE - TEMPERATURE RATING										Maximum Hydrostatic Pressure											
Temp (°C)					Pressure (kg/cm ² g)					As per ASME B31.3											
-29 to 38					260.3																
204					222.55					Limited by flange considering flange as the weakest joint in piping system											
NOTES RELATED TO PIPE, FITTINGS, FLANGES, GASKETS AND STUD BOLTS & NUTS																					
1) As an alternative , for size ≥18", API 5L Gr.B Welded pipes / Fitting with 100% Radiography may be used.																					
2) All low Alloyed steel stud bolts, nuts and Washers shall be hot dipped galvanized according to ASTM A153..																					
3) Spectacle blind / Spade & spacer shall be in accordance with ASME B16.48.																					
4) Two jackscrew, 180 degree apart shall be provided in one of the flanges for all orifice flange and specified spectacle blind assemblies																					

TITLE	 	DOCUMENT. No. :
PROJECT		17039-EK-M-SP-2001
PIPING MATERIAL SPECIFICATION CREATION OF SURFACE PRODUCTION FACILITY GGS AT EAST KHAGORIJAN		

PIPING MATERIAL SPECIFICATION						
Piping Class	Rating	Material	CA	Spec No	Rev No.	B
EC01	#1500	CS	3 mm	-	Sheet No.	25 of 33
Design Code	ASME B31.3					
Service	Produced Water (PW), Process Two Phase (PT), Process Hydrocarbon Vapor (PV), Process Hydrocarbon Liquid (PL).					

BRANCH TABLES AS PER API RP 14E																		
RUN PIPE	0.5	T																
	0.75	T	T															
	1	T	T	T														
	1.5	T	T	T	T													
	2	W	W	T	T	T												
	3	W	W	W	T	T	T											
	4	W	W	W	W	T	T	T										
	6	W	W	W	W	W	T	T	T									
	8	W	W	W	W	W	W	T	T	T								
	10	W	W	W	W	W	W	W	T	T	T							
	12	W	W	W	W	W	W	W	W	T	T	T	T					
	14	W	W	W	W	W	W	W	W	W	T	T	T	T	T			
	16	W	W	W	W	W	W	W	W	W	T	T	T	T	T	T		
	18	W	W	W	W	W	W	W	W	W	W	T	T	T	T	T	T	
	20	W	W	W	W	W	W	W	W	W	W	T	T	T	T	T	T	T
	24	W	W	W	W	W	W	W	W	W	W	W	T	T	T	T	T	T
		0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24	
BRANCH PIPE																		

VALVE DATA																				
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24	-	-	-	-
BALL VALVE																				
Tag	BFEC01J				BFEC01J, BREC01J												-			
GLOBE VALVE																				
Tag	GVEC01J						-													
CHECK VALVE																				
Tag	-				CDEC01J, CSEC01J												-			
DOUBLE BLOCK & BLEED VALVE																				
Tag	DBEC01C, DBEC01J															-				
NEEDLE VALVE																				
Tag	NVEC01J				-															

TITLE				 										DOCUMENT. No. :					
PROJECT														17039-EK-M-SP-2001					
PIPING MATERIAL SPECIFICATION				CREATION OF SURFACE PRODUCTION FACILITY GGs AT EAST KHAGORIJAN															
PIPING MATERIAL SPECIFICATION																			
Piping Class		Rating		Material				CA		Spec No				Rev No.		B			
ES20		#1500		SS				0 mm		-				Sheet No.		26 of 33			
Design Code		ASME B31.3																	
Service		Potable water (WD), Nitrogen gas (GN), Demulsifier (CE), Oil Scale Inhibitor (CO), Corrosion Inhibitor (CK), Wax Inhibitor (CV), Flow Improver (CF), Process HC Liquid (PL),																	
		Process Hydrocarbon Vapor (PV), Deoiler (CD), Water Scale Inhibitor (CS).																	
PIPE DATA																			
ASME B36.19M																			
Size (in)		0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24	-	-
O.D (mm)		21.3	26.7	33.4	48.3	60.3	88.9	114.3	168.3	219.1	273.1	323.9	355.6	406.4	457.2	508	610	-	-
Sch		40S	40S	40S	80S	160	160	160	160	160	160	Thk. 36	Thk. 36	Thk. 45	Thk. 50	Thk. 56	Thk. 63	-	-
WT (mm)		2.77	2.87	3.38	5.08	8.74	11.13	13.49	18.26	23.01	28.58	36	36	45	50	56	63	-	-
M.T (%)		12.5																	
Type		Seamless										Welded pipe with 100% Radiographed							
MOC		A312 TP316										A358 Gr.316							
Ends		BE																	
FITTING DATA																			
Size (in)		0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24	-	-
Type		Butt Weld																	
Sch		Same as pipe																	
MOC		ASTM A 403 Gr. WP 316, Seamless (Note-1)																	
Elbow		ASME B 16.9																	
Tee		ASME B 16.9																	
Reducer		ASME B 16.9																	
Cap		ASME B 16.9																	
Coupling		-																	
Plug		-																	
Union		-																	
Elbowlet		-																	
Sockolet		-																	
Weldolet		ASTM A182 F316 / MSS-SP-97																	
Nipple		Sch 80S (MOC Same as pipe)				-													
Swage		Sch 80S				-													
FLANGE DATA																			
ASME B16.5																			
Size (in)		0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24	-	-
Type		WELD NECK , BLIND																	
MOC		ASTM A182 F316																	
RATING , FACE		1500 # , RTJ																	
STD		ASME B 16.5, Butt welding ends as per ASME B 16.25																	
SPECTACLE BLIND/SPADE & SPACER DATA (NOTE-2)																			
Size (in)		0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24	-	-
MOC		ASTM A240 Gr.316																	
Type		Spectacle Blind								Spade & Spacer									
MECHANICAL JOINTS DATA (NOTE-2)																			
Stud Bolt		ASTM A 193 Gr. B7 / ASME B 16.5 (Hot dip galvanized)																	
Hex Nuts		ASTM A 194 Gr. 2H / ASME B 16.5 (Hot dip galvanized)																	
Gasket		1500#, Type R(Oval)- Ring joint, 316 SS - 160 BHN as per ASME B16.20																	
PRESSURE - TEMPERATURE RATING										Maximum Hydrostatic Pressure									
Temp (°C)					Pressure (kg/cm ² g)					As per ASME B31.3									
-29 to 38					253														
204					180.8					Limited by flange considering flange as the weakest joint in piping system									
NOTES RELATED TO PIPE, FITTINGS, FLANGES, GASKETS AND STUD BOLTS & NUTS																			
1) As an alternative , for size > 10", ASTM A 358 TP 316 Welded pipes / Fitting with 100% Radiography may be used.																			
2) Spectacle blind / Spade & spacer shall be in accordance with ASME B16.48.																			
3) Two jackscrew, 180 degree apart shall be provided in one of the flanges for all orifice flange and specified spectacle blind assemblies																			

TITLE	ऑयल इंडिया लिमिटेड Oil India Limited KAVIN™	DOCUMENT. No. :
PROJECT		17039-EK-M-SP-2001
CREATION OF SURFACE PRODUCTION FACILITY GGS AT EAST KHAGORIJAN		

PIPING MATERIAL SPECIFICATION						
Piping Class	Rating	Material	CA	Spec No	Rev No.	B
ES20	#1500	SS	0 mm	-	Sheet No.	27 of 33
Design Code	ASME B31.3					
Service	Potable water (WD), Nitrogen gas (GN), Demulsifier (CE), Oil Scale Inhibitor (CO), Corrosion Inhibitor (CK), Wax Inhibitor (CV), Flow Improver (CF), Process HC Liquid (PL), Process Hydrocarbon Vapor (PV), Deoiler (CD), Water Scale Inhibitor (CS).					

BRANCH TABLES AS PER API RP 14E

RUN PIPE	0.5	T																
	0.75	T	T															
	1	T	T	T														
	1.5	T	T	T	T													
	2	W	W	T	T	T												
	3	W	W	W	T	T	T											
	4	W	W	W	W	T	T	T										
	6	W	W	W	W	W	T	T	T									
	8	W	W	W	W	W	W	T	T	T								
	10	W	W	W	W	W	W	W	T	T	T							
	12	W	W	W	W	W	W	W	T	T	T	T						
	14	W	W	W	W	W	W	W	W	T	T	T	T					
	16	W	W	W	W	W	W	W	W	T	T	T	T	T				
	18	W	W	W	W	W	W	W	W	W	T	T	T	T	T			
	20	W	W	W	W	W	W	W	W	W	T	T	T	T	T	T		
	24	W	W	W	W	W	W	W	W	W	W	T	T	T	T	T	T	
	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24		
BRANCH PIPE																		

VALVE DATA

Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24	-	-	-	-

BALL VALVE

Tag	BFES20J	BFES20J, BRES20J	-

GLOBE VALVE

Tag	GVES20J	-

CHECK VALVE

Tag	-	CDES20J, CSES20J	-

DOUBLE BLOCK & BLEED VALVE

Tag	DBES20C, DBES20J	-

TITLE																DOCUMENT. No. :						
PIPING MATERIAL SPECIFICATION				ऑयल इंडिया लिमिटेड Oil India Limited KAVIN™												17039-EK-M-SP-2001						
PROJECT																						
CREATION OF SURFACE PRODUCTION FACILITY GGs AT EAST KHAGORIJA																						
PIPING MATERIAL SPECIFICATION																						
Piping Class	Rating		Material				CA				Spec No			Rev No.		B						
FC01	#2500		CS				3 mm				-			Sheet No.		28 of 33						
Design Code	ASME B31.3																					
Service	Produced Water (PW), Process Two Phase (PT), Process Hydrocarbon Vapor (PV), Process Hydrocarbon Liquid (PL).																					
PIPE DATA																						
ASME B36.10M																						
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24	-	-	-			
O.D (mm)	21.3	26.7	33.4	48.3	60.3	88.9	114.3	168.3	219.1	273.1	323.9	355.6	406.4	457.2	508	610	-	-	-			
Sch	XXS	XXS	XXS	XXS	XXS	XXS	XXS	Thk. 25	Thk. 32	Thk. 36	Thk. 45	Thk. 45	Thk. 50	Thk. 56	Thk. 63	Thk. 75	-	-	-			
WT (mm) - Note-5	7.47	7.82	9.09	10.15	11.07	15.24	17.12	25	32	36	45	45	50	56	63	75	-	-	-			
M.T (%)	12.5																					
Type	Seamless			Seamless / Welded pipe with 100% Radiographed																		
MOC	ASTM A106 Gr B			API 5L X65 PSL-2																		
Ends	BE																					
FITTING DATA																						
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24	-	-	-			
Type	Butt Weld																					
Sch	Same as pipe																					
MOC	ASTM A234 Gr WPB, Seamless (Note-1)																					
Elbow	ASME B 16.9																					
Tee	ASME B 16.9																					
Reducer	ASME B 16.9																					
Cap	ASME B 16.9																					
Coupling	-																					
Plug	-																					
Union	-																					
Nippolet	-																					
Sockolet	-																					
Weldolet	ASTM A105 / MSS-SP-97																					
Nipple	Sch 160 (MOC Same as pipe)				-																	
Swage	Sch 160				-																	
FLANGE DATA																						
ASME B16.5												TECHLOK CONNECTION (NOTE-6)										
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24	-	-	-			
Type	Weld Neck, Blind											Weld Neck, Blind										
MOC	ASTM A105											ASTM A105										
RATING , FACE	2500#, RTJ											As per TECHLOK catalogue										
STD	ASME B16.5, Butt welding ends as per ASME B16.25											As per manufacturer Standard										
SPECTACLE BLIND/SPADE & SPACER DATA (NOTE-3)																						
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24	-	-	-			
MOC	ASTM A516 Gr 70																					
Type	Spectacle Blind, RTJ							Spade & Spacer, RTJ					NOTE-7									
MECHANICAL JOINTS DATA (NOTE-2)																						
Stud Bolt	ASTM A 193 Gr. B7 / ASME B16.5 (Hot dip galvanized)											As per manufacturer Standard										
Hex Nuts	ASTM A 194 Gr. 2H / ASME B16.5 (Hot dip galvanized)											As per manufacturer Standard										
Gasket	2500#, Type R (Oval) - Ring joint, soft iron - 90 BHN as per ASME B16.20											4140 (or) Equiv. PTFE coated Seal ring										
PRESSURE - TEMPERATURE RATING (NOTE-5)												Maximum Hydrostatic Pressure										
Temp (°c)					Pressure (kg/cm²g)							As per ASME B31.3										
-29 to 38					388.17																	
130					388.17							Limited by flange considering flange as the weakest joint in piping system										
NOTES RELATED TO PIPE, FITTINGS, FLANGES, GASKETS AND STUD BOLTS & NUTS																						
1) Welded fittings shall be 100% radiographed. 2) All low Alloyed steel stud bolts, nuts and Washers shall be hot dipped galvanized according to ASTM A153.. 3) Spectacle blind / Spade & spacer shall be in accordance with ASME B16.48. 4) Two jackscrew, 180 degree apart shall be provided in one of the flanges for all flangeS and specified spectacle blind assemblies 5) Pipe thickness has been selected for the DE-RATED condition.										6) Hub Connector Assembly (Hub Connector,Seal Ring and clamp shall be of the same manufacturer 7) Spade & Spacer shall be used as per TECHLOK catalogue.												

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RUN PIPE <table><tr><td>0.5</td><td>T</td><td colspan="16"></td></tr><tr><td>0.75</td><td>T</td><td>T</td><td colspan="15"></td></tr><tr><td>1</td><td>T</td><td>T</td><td>T</td><td colspan="13"></td></tr><tr><td>1.5</td><td>T</td><td>T</td><td>T</td><td>T</td><td colspan="11"></td></tr><tr><td>2</td><td>W</td><td>W</td><td>T</td><td>T</td><td>T</td><td colspan="9"></td></tr><tr><td>3</td><td>W</td><td>W</td><td>W</td><td>T</td><td>T</td><td>T</td><td colspan="7"></td></tr><tr><td>4</td><td>W</td><td>W</td><td>W</td><td>W</td><td>T</td><td>T</td><td>T</td><td colspan="6"></td></tr><tr><td>6</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>T</td><td>T</td><td>T</td><td colspan="5"></td></tr><tr><td>8</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>T</td><td>T</td><td>T</td><td colspan="4"></td></tr><tr><td>10</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>T</td><td>T</td><td>T</td><td colspan="3"></td></tr><tr><td>12</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>T</td><td>T</td><td>T</td><td>T</td><td colspan="2"></td></tr><tr><td>14</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>T</td><td>T</td><td>T</td><td>T</td><td colspan="1"></td></tr><tr><td>16</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>T</td><td>T</td><td>T</td><td>T</td><td>T</td><td colspan="1"></td></tr><tr><td>18</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>T</td><td>T</td><td>T</td><td>T</td><td>T</td><td colspan="1"></td></tr><tr><td>20</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>T</td><td>T</td><td>T</td><td>T</td><td>T</td><td>T</td><td colspan="1"></td></tr><tr><td>24</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>T</td><td>T</td><td>T</td><td>T</td><td>T</td><td>T</td><td colspan="1"></td></tr><tr><td colspan="2"></td><td>0.5</td><td>0.75</td><td>1</td><td>1.5</td><td>2</td><td>3</td><td>4</td><td>6</td><td>8</td><td>10</td><td>12</td><td>14</td><td>16</td><td>18</td><td>20</td><td>24</td><td colspan="2"></td></tr></table> LEGEND <table><tr><td>W</td><td>Weldolet</td></tr><tr><td>T</td><td>Equal / Reducing TEE</td></tr></table>																						0.5	T																	0.75	T	T																1	T	T	T														1.5	T	T	T	T												2	W	W	T	T	T										3	W	W	W	T	T	T								4	W	W	W	W	T	T	T							6	W	W	W	W	W	T	T	T						8	W	W	W	W	W	W	T	T	T					10	W	W	W	W	W	W	W	T	T	T				12	W	W	W	W	W	W	W	T	T	T	T			14	W	W	W	W	W	W	W	W	T	T	T	T		16	W	W	W	W	W	W	W	W	T	T	T	T	T		18	W	W	W	W	W	W	W	W	W	T	T	T	T	T		20	W	W	W	W	W	W	W	W	W	T	T	T	T	T	T		24	W	W	W	W	W	W	W	W	W	W	T	T	T	T	T	T				0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24			W	Weldolet	T	Equal / Reducing TEE
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Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24	-	-	-	-																																																																																																																																																																																																																																																																																	
BALL VALVE																																																																																																																																																																																																																																																																																																					
Tag	BFFC01J				BFFC01J, BRFC01J						BFFC01H, BRFC01H						-																																																																																																																																																																																																																																																																																				
GLOBE VALVE																																																																																																																																																																																																																																																																																																					
Tag	GVFC01J								-																																																																																																																																																																																																																																																																																												
CHECK VALVE																																																																																																																																																																																																																																																																																																					
Tag	-				CDFC01J, CSFC01J						-																																																																																																																																																																																																																																																																																										
DOUBLE BLOCK AND BLEED VALVE																																																																																																																																																																																																																																																																																																					
Tag	DBFC01C, DBFC01J								-																																																																																																																																																																																																																																																																																												
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TITLE														DOCUMENT. No. :													
PIPING MATERIAL SPECIFICATION																											
PROJECT														17039-EK-M-SP-2001													
CREATION OF SURFACE PRODUCTION FACILITY GGs AT EAST KHAGORIJAN																											
PIPING MATERIAL SPECIFICATION																											
Piping Class	Rating		Material					CA			Spec No			Rev No.		B											
FS20	#2500		SS					0 mm			-			Sheet No.		30 of 33											
Design Code	ASME B31.3																										
Service	Potable water (WD), Nitrogen gas (GN), Demulsifier (CE), Oil Scale Inhibitor (CO), Corrosion Inhibitor (CK), Wax Inhibitor (CV), Flow Improver (CF), Process HC Liquid (PL),																										
	Process Hydrocarbon Vapor (PV), Deoiler (CD), Water Scale Inhibitor (CS).																										
PIPE DATA																											
ASME B36.19M																											
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24	-	-									
O.D (mm)	21.3	26.7	33.4	48.3	60.3	88.9	114.3	168.3	219.1	273.1	323.9	355.6	406.4	457.2	508	610	-	-									
Sch	80S	80S	160	160	160	XXS	XXS	Thk. 25	Thk. 32	Thk. 40	Thk. 45	Thk. 50	Thk. 63	Thk. 75	Thk. 75	Thk. 90	-	-									
WT (mm) (Note-4)	3.73	3.91	6.35	7.14	8.74	15.24	17.12	25	32	40	45	50	63	75	75	90	-	-									
M.T (%)	12.5																										
Type	Seamless							Welded pipe with 100% Radiographed																			
MOC	ASTM A312 TP 316							ASTM A358 Gr.316																			
Ends	BE																										
FITTING DATA																											
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24											
Type	Butt Weld																										
Sch	Same as pipe																										
MOC	ASTM A 403 Gr. WP 316, Seamless (Note-1)																										
Elbow	ASME B 16.9																										
Tee	ASME B 16.9																										
Reducer	ASME B 16.9																										
Cap	ASME B 16.9																										
Coupling	-																										
Plug	-																										
Union	-																										
Nippolet	-																										
Sockolet	-																										
Weldolet	ASTM A182 F316 / MSS-SP-97																										
Nipple	Sch 80S (MOC Same as pipe)				-																						
Swage	Sch 80S				-																						
FLANGE DATA												ASME B16.5								TECHLOK CONNECTION (NOTE-5)							
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24											
Type	Weld neck, Blind											Weld neck, Blind															
MOC	ASTM A182 F316											ASTM A182 F316															
RATING , FACE	2500#, RTJ											As per TECHLOK catalogue															
STD	ASME B 16.5, Butt welding ends as per ASME B 16.25											As per manufacturer Standard															
SPECTACLE BLIND / SPADE & SPACER DATA (NOTE-2)																											
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24											
MOC	A240 Gr.316																										
Type	Spectacle blind, RTJ							Spade & spacer, RTJ					Note-6														
MECHANICAL JOINTS DATA																											
Stud Bolt	A 193 Gr. B7 / ASME B16.5 (Hot dip galvanized)											As per manufacturer Standard															
Hex Nuts	A 194 Gr. 2H / ASME B16.5 (Hot dip galvanized)											As per manufacturer Standard															
Gasket	2500#, TYPE R(Oval) - Ring joint, 316 SS - 160 BHN as per ASME B16.20											4140 (or) Equiv. PTFE coated Seal ring															
PRESSURE - TEMPERATURE RATING (NOTE-4)										Maximum Hydrostatic Pressure																	
Temp (°C)					Pressure (kg/cm ² g)					As per ASME B31.3																	
-29 to 38					378.63																						
80					378.63					Limited by flange considering flange as the weakest joint in piping system																	
NOTES RELATED TO PIPE, FITTINGS, FLANGES, GASKETS AND STUD BOLTS & NUTS																											
1) As an alternative , for size > 10", ASTM A 358 TP 316 Welded pipes / Fitting with 100% Radiography may be used.										5) Hub Connector Assembly (Hub Connector,Seal Ring and clamp shall be of the same manufacturer																	
2) Spectacle blind / Spade & spacer shall be in accordance with ASME B16.48.										6) Spade & Spacer shall be used as per TECHLOK catalogue.																	
3) Two jackscrew, 180 degree apart shall be provided in one of the flanges for all orifice flange and specified spectacle blind assemblies																											
4) Pipe thickness has been selected for the DE-RATED condition.																											

TITLE	 ऑयल इंडिया लिमिटेड Oil India Limited  KAVIN™	DOCUMENT. No. :
PROJECT		17039-EK-M-SP-2001
CREATION OF SURFACE PRODUCTION FACILITY GGS AT EAST KHAGORIJAN		

PIPING MATERIAL SPECIFICATION						
Piping Class	Rating	Material	CA	Spec No	Rev No.	B
FS20	#2500	SS	0 mm	-	Sheet No.	31 of 33
Design Code	ASME B31.3					
Service	Potable water (WD), Nitrogen gas (GN), Demulsifier (CE), Oil Scale Inhibitor (CO), Corrosion Inhibitor (CK), Wax Inhibitor (CV), Flow Improver (CF), Process HC Liquid (PL), Process Hydrocarbon Vapor (PV), Deoiler (CD), Water Scale Inhibitor (CS).					

BRANCH TABLES AS PER API RP 14E																		
RUN PIPE	0.5	T																
	0.75	T	T															
	1	T	T	T														
	1.5	T	T	T	T													
	2	W	W	T	T	T												
	3	W	W	W	T	T	T											
	4	W	W	W	W	T	T	T										
	6	W	W	W	W	W	T	T	T									
	8	W	W	W	W	W	W	T	T	T								
	10	W	W	W	W	W	W	W	T	T	T							
	12	W	W	W	W	W	W	W	T	T	T	T						
	14	W	W	W	W	W	W	W	W	T	T	T	T					
	16	W	W	W	W	W	W	W	W	T	T	T	T	T				
	18	W	W	W	W	W	W	W	W	W	T	T	T	T	T			
	20	W	W	W	W	W	W	W	W	W	T	T	T	T	T	T		
	24	W	W	W	W	W	W	W	W	W	W	T	T	T	T	T	T	
		0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24	
BRANCH PIPE																		

VALVE DATA																					
Size (in)	0.5	0.75	1	1.5	2	3	4	6	8	10	12	14	16	18	20	24	-	-	-	-	
BALL VALVE																					
Tag	BFFS20J				BFFS20J, BRFS20J							BFFS20H, BRFS20H					-				
GLOBE VALVE																					
Tag	GVFS20J										-										
CHECK VALVE																					
Tag	-				CDFS20J, CSFS20J							-									
DOUBLE BLOCK AND BLEED VALVE																					
Tag	DBFS20C, DBFS20J										-										

TITLE PIPING MATERIAL SPECIFICATION							DOCUMENT. No. : 17039-EK-M-SP-2001			
PROJECT CREATION OF SURFACE PRODUCTION FACILITY GGs AT EAST KHAGORIJAN										
PIPING MATERIAL SPECIFICATION										
Piping Class	Rating	Material			CA	Spec No	Rev No.	B		
GT20	3000 psi	SS TUBING			0 mm	-	Sheet No.	33 of 33		
Design Code	ASME B31.3									
Service	Demulsifier (CE), Oil Scale Inhibitor (CO), Corrosion Inhibitor (CK), Wax Inhibitor (CV), Flow Improver (CF), Process HC Liquid (PL), Process Hydrocarbon Vapor (PV), Deoiler (CD), Water Scale Inhibitor (CS).									
BRANCH TABLES										
ALL BRANCH CONNECTIONS SHALL BE COMPRESSION FITTINGS ; INCLUDES TEE,CROSS,LATERAL , ETC.BY MANUFACTURER STANDARD.										
VALVE DATA										
ND(mm)	1/4	3/8	1/2	3/4	1	-	-	-	-	-
BALL VALVE										
Tag	BFGT20S				-					
CHECK VALVE										
Tag	CLGT20S				-					
NEEDLE VALVE										
Tag	NVGT20S				-					
GLOBE VALVE										
Tag	GVGT20S				-					

CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN

Document Title : VALVE MATERIAL SPECIFICATION

Kavin Document No : 17039-EK-M-SP-2002

B	06-Feb-18	ISSUED FOR BID	SN	APRK / JB	MSR/MSB
A	29-Nov-17	ISSUED FOR REVIEW	SN	APRK / JB	MSR/MSB
REV.	DATE	DESCRIPTION	BY	CHECKED	APPROVED

**PROJECT DOCUMENTS ARE CONTROLLED DOCUMENTS.
REVISION CHANGES ARE DENOTED AS Δ IN RIGHT HAND MARGIN**

COMPANY :

OIL INDIA LIMITED

EPCM CONSULTANT :

KAVIN ENGINEERING AND SERVICES PRIVATE LIMITED

TITLE	 	DOCUMENT No.
PROJECT		17039-EK-M-SP-2002
CREATION OF SURFACE PRODUCTION FACILITY GGS AT EAST KHAGORIJAN		Rev. B

GENERAL DESCRIPTION

EXECUTIVE SUMMARY

This specification defines the valve requirements for each valve designation identified on the piping material specification sheets.

BASIS

The valves shall be designed, fabricated and tested in accordance with EPCM approved industry codes and standards.

REFERENCES

Valves shall be in accordance with the latest edition of the codes and standards listed below. "Latest edition" meaning the edition published by the originating organization at the time of a contract or purchase order acceptance by the Supplier.

INDUSTRY CODES & STANDARDS

CODES & STANDARDS	DESCRIPTION
API 6A	Specification for Wellhead and Christmas Tree Equipment
API 6D	Pipeline Valves (Steel Gate, Plug, Ball and Check Valves)
API 6FA	Specification for fire test for valves
API 598	Valve Inspection and Testing
API Bull 6F1	Bulletin on Performance of API and ASME End Connections in a Fire Test According to API Spec 6FA
API Bull 6F2	Bulletin on Fire Resistance Improvements for API Flanges
API Std 607	Fire Test for Soft-Seated Quarter-Turn Valves
ASME B16.10	Face-to-Face and End-to-End Dimensions of Valves
ASME B16.20	Metallic Gaskets for Pipe Flanges
ASME B16.34	Valves – Flanged, Threaded, and Welding End
ASME B31.3	Process Piping inclusive of addenda
ASTM A123	Zinc (Hot Galvanized) Coating on Products Fabricated from Rolled Pressed and Forged Steel Shapes Plates Bars and Strips
API RP 14E	Recommended practice for design and installation of offshore production platform piping systems.
API 594	Check valves: Flanged, Lug, Wafer and Butt-welding
MSS SP-6	Standard finishes for contact faces of pipe flanges and connecting ends flanges of valves and fittings
ISO 17292	Metal ball valves for petroleum, petrochemicals and allied industries
API 600	Steel gate valves-Flange and butt-welding ends, bolted bonnets
API 602	Steel gate, globe and check valves for sizes NPS 4 (DN 100) and smaller for the petroleum and natural gas industries
API 609	Butterfly valves: Double flanged, Lug and Wafer type
ASME B16.5	Pipe flanges and flanged fittings NPS 1/2 through NPS 24
BS 1868	Specification for check valves (flanged and butt-welding ends) for the petroleum, petrochemical and allied industries
BS 1873	Specification for steel gate and globe stop and check valves (flanged and butt-welding ends) for the petroleum, petrochemical and allied industries

GENERAL

The Supplier shall select the seating materials suitable for the design service temperatures at full valve working pressure.

In special service applications if materials differ from the materials listed on the specification sheets are required, the Supplier shall select only approved, suitable valves, and notify the EPCM of the selection.

All valves shall be fitted with a locking device.

Unless otherwise approved by the company, small flanged valves shall not have bodies that screw apart.

Blasting and painting of valves shall comply with the following:

- 1) During blasting and painting of valves, suitable flange covers shall be installed to prevent internal valve damage.
- 2) Valve flange sealing surfaces and identification tags shall be suitably protected during blasting and painting.
- 3) Identification tags shall be clearly legible after blasting and painting.
- 4) Flange face surfaces shall be lightly buffed and greased after blasting and painting of valves and prior to flange mating.
- 5) Flange bolt holes shall be blasted and painted.

API valves, 5,000# and 10,000#, shall meet the requirements of API 6A and 6D.

API valves shall be of fire-safe design, properly certified for each size to API Bull 6F1 and 6F2, Spec. 6FA, or Std.

TITLE	 	DOCUMENT No.
VALVE MATERIAL SPECIFICATION		17039-EK-M-SP-2002
PROJECT		Rev.
CREATION OF SURFACE PRODUCTION FACILITY GGs AT EAST KHAGORIJA		B

GENERAL DESCRIPTION

607 fire test standards. Where pressure testing by the manufacturer is required by specification or purchase order, testing shall comply with API 598. Except for check valves, each valve shall come equipped with a compatible handle or gear operator.

BALL VALVES

- 1) Ball valves shall have bolted body with end or top entry. Ball valves shall be split body design.
- 2) Double block and bleed valves shall have a body cavity port equipped with a 316 stainless steel valve.
- 3) Ball shall be solid. Hollow and split two-piece balls are not acceptable
- 4) Stem shall be blowout proof
- 5) All ball valves should have bi-directional sealing
- 6) Valves shall be of a "Long pattern" face to face length per ASME B16.10, unless otherwise specified.
- 7) Valves shall be of fire-safe design, properly certified for each size to API Bull 6F1 and 6F2, Spec. 6FA, or Std. 607 fire test standards.
- 8) Ball valves shall be designed to seal in both directions against all pressure upto the maximum service pressure rating for the class, unless otherwise specified.
- 9) Uncertified valves shall not be allowed.
- 10) Ball valves used in Methanol service shall have Elast-o-Lion 101 seats and seals.
- 11) Body cavity shall be self-relieving to the low pressure side of the valve. Seal relief shall be provided in seal design, unless otherwise specified. Holes in obturator shall not be used to satisfy the self-relieving requirements.
- 12) Ball valves shall be fitted with anti-static device in accordance with API 6D to ensure electrical continuity between the ball, stem and body of the valve.
- 13) All ball valve 4" and greater shall be provided with sealant injection fixtures for both seal rings and the stem, sealant kit shall be provided for each valve type fitted with the injection ports.
- 14) Any valves subject to high differential pressure shall have Elast-o-Lion 101 seats and seals.

CHECK VALVES

Dual plate check valve (Lug type):

- 1) Dual plate check valves shall be retainerless design, heavy spring loaded and suitable for vertical (upward flow) and horizontal installation
- 2) Dual plate check valve shall have metal to metal seating surface.
- 3) Lug holes shall be drilled through (not threaded) to allow the stud bolts to slide through (except for valve centering holes, ie top, bottom or sides).

Swing check valves:

- 1) Check valve with swing type obturator shall be regular type, straight through port.
- 2) Swing check valve shall have metal to metal seating surface.
- 3) Swing check valve shall have in-line removable seat. Seat shall be press-fit and provided with welded seat stoppers. Supplier shall ensure that welding does not damage the seats.
- 4) Swing check valves in higher pressure (ASME 900 & above) service shall have a pressure seal bonnet.

Piston check valve:

- 1) Piston check valve (lift check) shall be regular type and be spring loaded.
- 2) Piston check valve shall have metal to metal seating surface.
- 3) Piston check valve shall not be used in erosive (sand) service.
- 4) Lift check valve shall only be used in horizontal installation.
- 5) Piston check valve in high pressure (ASME 900 & above) service shall have a pressure seal cover.

Nozzle (Axial flow) check valve:

- 1) Nozzle check (non-slam) valve shall be short pattern.
- 2) Nozzle check (non-slam) valve shall have metal to metal seating surfaces.
- 3) Nozzle check (non-slam) valve shall have a quick dynamic response to reduce reverse velocity, Supplier shall submit dynamic characteristics of valve together with quotation.
- 4) Nozzle check (non-slam) valve shall be suitable for vertical (upward flow) and horizontal installation.

General guidelines for selecting the check valve type:

In unusually erosive (sandy) service, check valves shall have removable seats. Seats and disc shall be stellite or stellite faced.

TITLE	 ऑयल इंडिया लिमिटेड Oil India Limited  KAVIN™	DOCUMENT No.
PROJECT		17039-EK-M-SP-2002
CREATION OF SURFACE PRODUCTION FACILITY GGS AT EAST KHAGORIJAN		Rev. B

GENERAL DESCRIPTION

Low Pressure Drop	Dual plate lug type
2-inch and larger	Swing type
1-½-inch and smaller	Piston type
Centrifugal pumps	Swing type
Reciprocating pumps	Piston type / non-slamming type
Centrifugal compressors	Piston type / non-slamming type
Reciprocating compressors	Piston type / non-slamming type

GLOBE VALVES

- Globe valves shall be of Outside Screw and Yoke (OS&Y) design with provision for lubrication of stem threads.
- Stem shall be blowout proof.
- Globe valves shall have metal-to-metal seating surfaces. The seat shall be inline replaceable.
Seats shall be press-fit and provided with welded seat stoppers.
Supplier shall ensure that welding does not damage the seats.
- Globe valves in high pressure (ASME 900 and above) service shall have pressure seal bonnet
- Globe valves shall have back seated stem.
- Non-asbestos graphite packing with corrosion inhibitor shall be used, unless otherwise specified.
- Disc shall be swivel type.
- Globe valve stem design shall also allow for tightness at intermediate obturator position when the valve is intended for flow control.
- Globe valves shall be suitable for re-packing under pressure in the fully open position.
- Globe valve shall be provided with a lockable device.

GATE VALVES

If gate valves are to be actuated, only valves with slab gates shall be used.
Valves shall be of a “regular pattern” face to face length per ASME B16.10, unless otherwise specified.

BUTTERFLY VALVES

Butterfly valves shall be bi-directional. Where there is a preferred sealing direction this shall be indicated on the valve body. Butterfly valves shall be furnished with the following features:

- Bi-directional flow
- Suitable for dead-end service
- Through drilling bolt holes
- Lockable device (opened and closed)

Valve disks shall be positively secured to the shaft. Threaded fasteners shall be locked or tack welded.
The disk shall not interfere with the connecting piping at any shaft rotation.

Wrench operators shall be capable of holding the disc in at least five equally spaced intermediate positions between fully opened and fully closed.

NEEDLE VALVE

Needle Valve shall be hard seated valves.

VALVE OPERATION

Except for check valves, each valve shall come with a compatible handle or gear operator. However, the Supplier is to guarantee that the maximum force to operate the valve shall not exceed 350N under maximum differential pressure, (Note that the maximum lever length shall be 450mm, and maximum handwheel diameter shall be 750mm). The supplier shall confirm the operating force and recommend a geared operator when the maximum allowable force is exceeded with lever/hand wheel operation. Consideration should be given to the "Breakout" torque (the torque required to unseat a valve) required to open a valve under maximum differential pressure, to ensure that it is within the maximum forces allowed as stated above. Similarly the closing torque must be considered.

If levers are fitted they shall be parallel with pipeline with the valve in the open position. Note"square top" stem section shall not be used. The stem shall be a pattern to prevent mis-orientation.

As a general guide, valves in the following sizes and larger shall be gear operated.

TITLE	 	DOCUMENT No.
VALVE MATERIAL SPECIFICATION		17039-EK-M-SP-2002
PROJECT		Rev.
CREATION OF SURFACE PRODUCTION FACILITY GGs AT EAST KHAGORIJAN		B

GENERAL DESCRIPTION

Class	150	300	600	900	1500	2500
Globe	8"	8"	4"	4"	3"	3"
Butterfly	6"	6"	-	-	-	-
Gate	8"	8"	6"	6'	4"	4"
Ball	6"	6"	4"	4"	4"	2"

Valves shall be capable of satisfactory operation with the valve stems in any position i.e. vertical, horizontal or inclined. The company will define any valves required to have stems below the horizontal. Valves shall be capable of operating in both the vertical and horizontal position unless stated . Where such designs have been agreed by the company, uni-directional valves, check valves, and any valves with a preferred flow direction, shall have a directional arrow integrally cast on the body. Where valves have a limit on flow direction, or valve orientation, details shall be provided in the bid-stage.

All valve operators shall be permanently marked with "Open" and "Closed" positions with an arrow to indicate the direction of rotation.

Wherver required extended stem shall be provided for the insulated valves by considering the insulation thickness.

GEARED OPERATORS

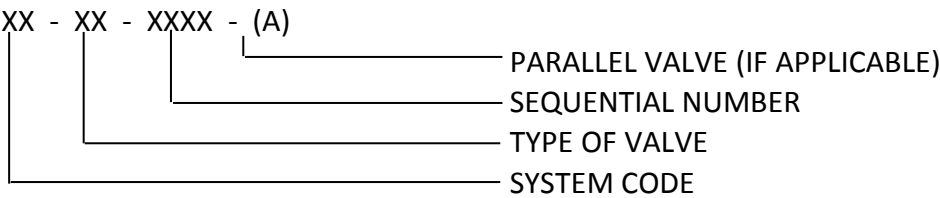
Bevel type gearing shall be supplied unless specified otherwise. The supplier shall include details of the proposed gearing at bid-stage.

Gear operators must be capable of being rotated through 90-degree increments.

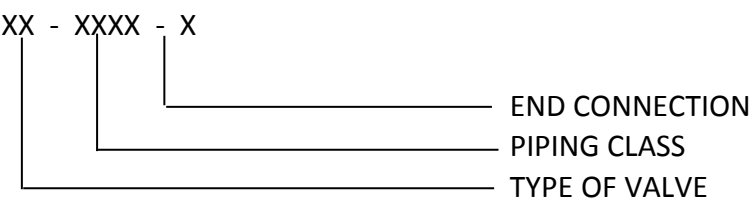
Components manufactured from grey cast iron or aluminium alloys are not acceptable.

Other grades of cast iron shall be subject to approval by the company.

MANUAL VALVE TAG NUMBERING (REFER P&ID LEGEND-PIPING AND VALVES-DWG NO: 17039-ND-P-DW-0200-01)



VALVE TAG IDENTIFICATION



TYPE OF VALVE	TYPE OF VALVE	PIPING CLASS	END CONNECTION
BF - BALL FULL BORE	FV - BUTTERFLY	AC01, AS20, AG01	R - RF FLANGED
BR - BALL REDUCED BORE	GT - GATE	BC01, BS20	Z - SOCKET WELD
CA - AXIAL CHECK (NON SLAM)	GV - GLOBE	CC01, CS20	J - RTJ FLANGED
CD - DUAL PLATE CHECK	PV - PLUG	DC01, DS20	S - NPTF
CL - PISTON CHECK	NV - NEEDLE	EC01, ES20	C - RTJ x NPTF
CS - SWING CHECK		FC01, FS20, FD20	H - HUB END
DB - DOUBLE BLOCK & BLEED		GT20	A - RF x NPTF

TITLE VALVE MATERIAL SPECIFICATION		 Oil India Limited 	DOC. No. : 17039-EK-M-SP-2002
PROJECT CREATION OF SURFACE PRODUCTION FACILITY GGs AT EAST KHAGORIJA			REV. B
VALVE MATERIAL SPECIFICATION			
Service	Fuel Gas (FG), Drain Open (DO), HP Flare (HF), Heating Medium(HM)- Hot Oil, Produced Water (PW), Process Hydrocarbon Vapor (PV), LP Flare (LF),		
	Process Hydrocarbon Liquid (PL), Drain Closed (DC), Raw/Fresh Water (WP), Potable Water (WD), Atmospheric Vent (VA).		
Piping Class	AC01		
	150#, RF, 3 mm Corrosion Allowance		
TAG NO.	SIZE	DESCRIPTION	
BALL VALVE			
BFAC01R	1/2"- 1 1/2"	Design code : ISO 17292, ASME 150 # RF, Split Body , Bolted , A105 Body , A182 F 316 Stem & ball, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Floating Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 19.9 kg/cm ² g & 250 °C @ 12.3 kg/cm ² g.	
BFAC01R	2"- 4"	Design code : API 6D, ASME 150 # RF, Split Body , Bolted, A216 WCB / A105 Body , A182 F 316 Stem , F316 SS (or) ENP A105 carbon steel ball, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Floating Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 19.9 kg/cm ² g & 250 °C @ 12.3 kg/cm ² g.	
BFAC01R	6"-24"	Design code : API 6D, ASME 150 # RF, Split Body , Bolted, A216 WCB body , A182 F 316 Stem , F316 SS (or) ENP A105 carbon steel ball, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Trunnion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10, -29 °C @ 19.9 kg/cm ² g & 250 °C @ 12.3 kg/cm ² g.	
BRAC01R	2"- 4"	Design code : API 6D, ASME 150 # RF, Split Body , Bolted, A216 WCB / A105 Body , A182 F 316 Stem , F316 SS (or) ENP A105 carbon steel ball, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Reduced Bore , Floating Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 19.9 kg/cm ² g & 250 °C @ 12.3 kg/cm ² g.	
BRAC01R	6"-24"	Design code : API 6D, ASME 150 # RF, Split Body , Bolted, A216 WCB body , A182 F 316 Stem , F316 SS (or) ENP A105 carbon steel ball, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Reduced Bore , Trunnion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10, -29 °C @ 19.9 kg/cm ² g & 250 °C @ 12.3 kg/cm ² g.	
GLOBE VALVE			
GVAC01R	1/2"- 1 1/2"	Design code : API 602, ASME 150 # RF, Straight Pattern , Bolted, A105 Body , Rising Stem , Outside Screw and Yoke , A182 F316 Stem, Seats and Disc , Swivelling plug as disc, Expanded Graphite not less than 98% Purity as Stem Packing , Stellite hard faced seat-disc sealing surface, End to End standard as per ASME B 16.10 , Packed Gland for stem sealing , -29 °C @ 19.9 kg/cm ² g & 250 °C @ 12.3 kg/cm ² g.	
GVAC01R	2"-24"	Design code : BS 1873, ASME 150 # RF, Straight Pattern , Bolted, A216 WCB Body , Rising Stem , Outside Screw and Yoke , A182 F316 Stem, Seats and disc, Swivelling Plug as Disc , Expanded Graphite not less than 98% Purity as Stem Packing, Stellite hard faced seat-disc sealing surface, End to End standard as per ASME B 16.10 , Packed Gland for stem sealing, -29 °C @ 19.9 kg/cm ² g & 250 °C @ 12.3 kg/cm ² g.	
CHECK VALVE			
CLAC01R	1/2" - 1 1/2"	Design code : API 602, 150 # RF, Piston check, Bolted cover, Integral seats, A105 Body, A182 F316 piston and seats, Stellite hard faced seat-disc sealing surface, X-750 Spring, Non-graphite packing , -29 °C @ 19.9 kg/cm ² g & 200 °C @ 14 kg/cm ² g.	
CDAC01R	2"-24"	Design code : API 594, ASME 150 # RF (Solid lug), Dual plate (Lugged), Body with hinge and stop pin , Integral seat, A216 WCB / A105 Body , Metal to Metal Seating, A182 F 316 Plates, X-750 Spring, Stellite hard faced seat-plate sealing surface, Trim : API #12, End To End Standard as per API 594 , -29 °C @ 19.9 kg/cm ² g & 250 °C @ 12.3 kg/cm ² g.	
CSAC01R	2"-24"	Design code : API 594, ASME 150 # RF, Swing check, Bolted bonnet, Replaceable seats, A216 WCB / A105 Body , Metal to Metal Seating , A182 F 316 Disc and hinge , A182 F316 seats, Stellite hard faced seat-disc sealing surface, Trim : API #12, End To End Standard as per API 594 , -29 °C @ 19.9 kg/cm ² g & 250 °C @ 12.3 kg/cm ² g.	

TITLE VALVE MATERIAL SPECIFICATION		 	DOC. No. : 17039-EK-M-SP-2002
PROJECT CREATION OF SURFACE PRODUCTION FACILITY GGs AT EAST KHAGORIJA			REV. B
VALVE MATERIAL SPECIFICATION			
Service	Fuel Gas (FG), Drain Open (DO), HP Flare (HF), Heating Medium(HM)- Hot Oil, Produced Water (PW), Process Hydrocarbon Vapor (PV), LP Flare (LF),		
	Process Hydrocarbon Liquid (PL), Drain Closed (DC), Raw/Fresh Water (WP), Potable Water (WD), Atmospheric Vent (VA).		
Piping Class	AC01		
	150#, RF, 3 mm Corrosion Allowance		
TAG NO.	SIZE	DESCRIPTION	
GATE VALVE			
GTAC01R	1/2"- 24"	Design code : API 602 (3/4" & less) / API 600 (1" & above), ASME 150 # RF, Bolted Bonnet, Flexible wedge, Rising & back seat stem, Replaceable seat, Outside screw and yoke, Expanded Graphite not less than 98% Purity as Stem Packing, , Packed gland for stem sealing, A216 WCB / A105 Body, A182 F316 stem. Trim shall be stellite coated, End To End Standard as per ASME B16.10, -29 °C @ 19.9 kg/cm ² g & 250 °C @ 12.3 kg/cm ² g.	
NEEDLE VALVE			
NVAC01R	1/2"- 1 1/2"	ASME 150# RF, A105 Body & Bonnet, A182 F316 trims, Graphite gland packing, End To End dimension as per manufacturer standard, -29 °C @ 19.9 kg/cm ² g & 250 °C @ 12.3 kg/cm ² g.	

TITLE		 ऑयल इंडिया लिमिटेड Oil India Limited  KAVIN™		DOC. No. : 17039-EK-M-SP-2002
PROJECT CREATION OF SURFACE PRODUCTION FACILITY GGs AT EAST KHAGORIJA				REV. B
VALVE MATERIAL SPECIFICATION				
Service	Potable water (WD), Nitrogen gas (GN), Demulsifier (CE), Oil Scale Inhibitor (CO), Corrosion Inhibitor (CK), Wax Inhibitor (CV), Flow Improver (CF), Process HC Liquid (PL),			
	Process Hydrocarbon Vapor (PV), Deoiler (CD), Water Scale Inhibitor (CS).			
Piping Class	AS20			
	150#, RF, 0 mm Corrosion Allowance			
TAG NO.		SIZE	DESCRIPTION	
BALL VALVE				
BFAS20R		1/2"- 1 1/2"	Design code : ISO 17292, ASME 150 # RF, Split Body , Bolted ,A182 F316 Body , A182 F 316 Ball and Stem , Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Floating Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 19.3 kg/cm ² g & 250 °C @ 12.3 kg/cm ² g.	
BFAS20R		2"- 4"	Design code : API 6D, ASME 150 # RF, Split Body , Bolted ,ASTM A351 CF8M / A182 F316 Body , A182 F 316 Ball and Stem , Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Floating Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 19.3 kg/cm ² g & 250 °C @ 12.3 kg/cm ² g.	
BFAS20R		6"-24"	Design code : API 6D, ASME 150 # RF, Split Body , Bolted, ASTM A351 CF8M Body , A182 F 316 Ball and Stem , Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Trunnion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 19.3 kg/cm ² g & 250 °C @ 12.3 kg/cm ² g.	
BRAS20R		2"- 4"	Design code : API 6D, ASME 150 # RF, Split Body , Bolted ,ASTM A351 CF8M / A182 F316 Body , A182 F 316 Ball and Stem , Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Reduced Bore , Floating Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 19.3 kg/cm ² g & 250 °C @ 12.3 kg/cm ² g.	
BRAS20R		6"-24"	Design code : API 6D, ASME 150 # RF, Split Body , Bolted, ASTM A351 CF8M Body , A182 F 316 Ball and Stem , Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Reduced Bore , Trunnion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 19.3 kg/cm ² g & 250 °C @ 12.3 kg/cm ² g.	
GLOBE VALVE				
GVAS20R		1/2"- 1 1/2"	Design code : API 602, ASME 150 # RF, Straight Pattern , Bolted, A182 F316 Body , Rising Stem , Outside Screw and Yoke , A182 F 316 Stem, Seats and disc , Swivelling plug as disc, Expanded Graphite not less than 98% Purity as Stem Packing , Stellite hard faced seat-disc sealing surface, End to End standard as per ASME B 16.10 , Packed Gland for stem sealing , -29 °C @ 19.3 kg/cm ² g & 250 °C @ 12.3 kg/cm ² g.	
GVAS20R		2"-24"	Design code : BS 1873, ASME 150 # RF, Straight Pattern , Bolted, ASTM A351 CF8M Body , Rising Stem , Outside Screw and Yoke , A182 F 316 Stem, Seats and disc , Swivelling Plug as Disc , Expanded Graphite not less than 98% Purity as Stem Packing , Stellite hard faced seat-disc sealing surface, End to End standard as per ASME B 16.10 , Packed Gland for stem sealing , -29 °C @ 19.3 kg/cm ² g & 250 °C @ 12.3 kg/cm ² g.	
CHECK VALVE				
CLAS20R		1/2" - 1 1/2"	Design code : API 602, 300 # solid, Piston check, Bolted cover, Integral seats, A182 F316 Body, A182 F316 piston and seats, Stellite hard faced seat-disc sealing surface, X-750 Spring, Non-graphite packing , -29 °C @ 19.3 kg/cm ² g & 200 °C @ 14 kg/cm ² g.	
CDAS20R		2"-24"	Design code : API 594, ASME 150 # RF (Solid lug), Dual plate (Lugged) Body with hinge and stop pin , Integral seat, ASTM A351 CF8M / A182 F316 Body , Metal to Metal Seating, A182 F 316 Plates, X-750 Spring, Stellite hard faced seat-plate sealing surface, End To End Standard as per API 594 , -29 °C @ 19.3 kg/cm ² g & 250 °C @ 12.3 kg/cm ² g.	
CSAS20R		2"-24"	Design code : API 594, ASME 150 # RF, Swing check, Bolted bonnet, Replaceable seats, ASTM A351 CF8M / A182 F316 Body , Metal to Metal Seating , A182 F 316 Disc and hinge , A182 F316 seats, Stellite hard faced seat-disc sealing surface, End To End Standard as per API 594 , -29 °C @ 19.3 kg/cm ² g & 250 °C @ 12.3 kg/cm ² g.	

TITLE VALVE MATERIAL SPECIFICATION		 	DOC. No. : 17039-EK-M-SP-2002
PROJECT CREATION OF SURFACE PRODUCTION FACILITY GGS AT EAST KHAGORIJAN			REV. B
VALVE MATERIAL SPECIFICATION			
Service	Instrument air (IA), Utility Air (UA), Atmospheric Air- Vent (VA), Fire Water (WF), Nitrogen Gas (GN).		
Piping Class	AG01		
	150#, RF, 3 mm Corrosion Allowance		
TAG NO.	SIZE	DESCRIPTION	
BALL VALVE			
BFAG01S	1/2"- 1 1/2"	Design code : ISO 17292, 800 # Threaded (NPTF), Split Body , Bolted , A105 Body , A182 F316 Ball and Stem , Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Floating Ball , Fire test as per API 6FA , End to End standard as per manufacturer standard , -29 °C @ 19.9 kg/cm ² g & 200 °C @ 14 kg/cm ² g.	
BFAG01R	2"- 4"	Design code : API 6D, ASME 150 # RF, Split Body , Bolted, A216 WCB / A105 Body , A182 F316 Stem , F316 SS (or) ENP A105 carbon steel ball, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Floating Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 19.9 kg/cm ² g & 200 °C @ 14 kg/cm ² g.	
BFAG01R	6"-24"	Design code : API 6D, ASME 150 # RF, Split Body , Bolted, A216 WCB Body , A182 F316 Stem , F316 SS (or) ENP A105 carbon steel ball, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Trunnion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10, -29 °C @ 19.9 kg/cm ² g & 200 °C @ 14 kg/cm ² g.	
BRAG01R	2"-4"	Design code : API 6D, ASME 150 # RF, Split Body , Bolted, A216 WCB / A105 Body , A182 F316 Stem , F316 SS (or) ENP A105 carbon steel ball, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Reduced Bore , Floating Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 19.9 kg/cm ² g & 200 °C @ 14 kg/cm ² g.	
BRAG01R	6"-24"	Design code : API 6D, ASME 150 # RF, Split Body , Bolted, A216 WCB Body , A182 F316 Stem , F316 SS (or) ENP A105 carbon steel ball, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Reduced Bore , Trunnion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10, -29 °C @ 19.9 kg/cm ² g & 200 °C @ 14 kg/cm ² g.	
GLOBE VALVE			
GVAG01S	1/2"- 1 1/2"	Design code : API 602, 800 # Threaded, Straight Pattern , Bolted, A105 Body , Rising Stem , Outside Screw and Yoke , A182 F316 Stem, Seats and disc , Swivelling Plug as Disc, Expanded Graphite not less than 98% Purity as Stem Packing , Packed Gland for stem sealing , Stellite hard faced seat-disc sealing surface, End to End dimension shall be as per manufacturer standard, -29 °C @ 19.9 kg/cm ² g & 200 °C @ 14 kg/cm ² g.	
GVAG01R	2"- 24"	Design code : BS 1873, ASME 150 # RF, Straight Pattern , Bolted, A216 WCB Body , Rising Stem , Outside Screw and Yoke , A182 F316 Stem, Seats and disc, Swivelling Plug as Disc, Expanded Graphite not less than 98% Purity as Stem Packing , Stellite hard faced seat-disc sealing surface, End to End standard as per ASME B 16.10 , Packed Gland for stem sealing , -29 °C @ 19.9 kg/cm ² g & 200 °C @ 14 kg/cm ² g.	
CHECK VALVE			
CLAC01R	1/2" - 1 1/2"	Design code : API 602, 150 # RF, Piston check, Bolted cover, Integral seats, A105 Body, A182 F316 piston and seats, Stellite hard faced seat-disc sealing surface, X-750 Spring, Non-graphite packing , -29 °C @ 19.9 kg/cm ² g & 200 °C @ 14 kg/cm ² g.	
CDAG01R	2"- 24"	Design code : API 594, ASME 150 # RF (Solid lug), Dual plate (Lugged) Body with hinge and stop pin , Integral seat , ASTM A216 WCB / A105 Body , Metal to Metal Seating, A182 F 316 Plates, X-750 Spring, Stellite hard faced seat-plate sealing surface, Trim : API #12, End To End Standard as per API 594 , -29 °C @ 19.9 kg/cm ² g & 200 °C @ 14 kg/cm ² g.	
CSAG01R	2"-24"	Design code : API 594, ASME 150 # RF, Swing check, Bolted bonnet, Replaceable seats, ASTM A216 WCB / A105 Body , Metal to Metal Seating , A182 F 316 Disc and hinge , A182 F316 seats, Stellite hard faced seat-disc sealing surface, Trim : API #12, End To End Standard as per API 594 , -29 °C @ 19.9 kg/cm ² g & 200 °C @ 14 kg/cm ² g.	

TITLE VALVE MATERIAL SPECIFICATION		 	DOC. No. : 17039-EK-M-SP-2002
PROJECT CREATION OF SURFACE PRODUCTION FACILITY GGs AT EAST KHAGORIJAN			REV. B
VALVE MATERIAL SPECIFICATION			
Service	Fuel Gas (FG), Drain Open (DO), HP Flare (HF), Heating Medium(HM)- Hot Oil, Produced Water (PW), Process Hydrocarbon Vapor (PV), LP Flare (LF), Process Hydrocarbon Liquid (PL), Drain Closed (DC), Raw/Fresh Water (WP), Potable Water (WD), Atmospheric Vent (VA).		
Piping Class	BC01 300#, RF, 3 mm Corrosion Allowance		
TAG NO.	SIZE	DESCRIPTION	
BALL VALVE			
BFBC01R	1/2"- 1 1/2"	Design code : ISO 17292, ASME 300 # RF, Split Body , Bolted , A105 Body , A182 F 316 Ball and Stem , Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Floating Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 52.1 kg/cm ² g & 250 °C @ 42.7 kg/cm ² g.	
BFBC01R	2"- 4"	Design code : API 6D, ASME 300 # RF, Split Body , Bolted , A216 WCB / A105 Body , A182 F 316 Stem , F316 SS (or) ENP A105 carbon steel ball, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Floating Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 52.1 kg/cm ² g & 250 °C @ 42.7 kg/cm ² g.	
BFBC01R	6"-24"	Design code : API 6D, ASME 300 # RF, Split Body , Bolted, A216 WCB Body , A182 F 316 Stem , F316 SS (or) ENP A105 carbon steel ball, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Trunnion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 52.1 kg/cm ² g & 250 °C @ 42.7 kg/cm ² g.	
BRBC01R	2"- 4"	Design code : API 6D, ASME 300 # RF, Split Body , Bolted , A216 WCB / A105 Body , A182 F 316 Stem , F316 SS (or) ENP A105 carbon steel ball, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Reduced Bore , Floating Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 52.1 kg/cm ² g & 250 °C @ 42.7 kg/cm ² g.	
BRBC01R	6"-24"	Design code : API 6D, ASME 300 # RF, Split Body , Bolted, A216 WCB Body , A182 F 316 Stem , F316 SS (or) ENP A105 carbon steel ball, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Reduced Bore , Trunnion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 52.1 kg/cm ² g & 250 °C @ 42.7 kg/cm ² g.	
GLOBE VALVE			
GVBC01R	1/2"- 1 1/2"	Design code : API 602, ASME 300 # RF, Straight Pattern , Bolted, A105 Body , Rising Stem , Outside Screw and Yoke , A182 F316 Stem, Seats and Disc , Swivelling Plug as Disc, Expanded Graphite not less than 98% Purity as Stem Packing , Stellite hard faced seat-disc sealing surface, End to End standard as per ASME B 16.10 , Packed Gland for stem sealing , -29 °C @ 52.1 kg/cm ² g & 250 °C @ 42.7 kg/cm ² g..	
GVBC01R	2"-24"	Design code : BS 1873, ASME 300 # RF, Straight Pattern , Bolted, A216 WCB Body , Rising Stem , Outside Screw and Yoke , A182 F316 Stem, Seats and Disc , Swivelling Plug as Disc , Expanded Graphite not less than 98% Purity as Stem Packing , Stellite hard faced seat-disc sealing surface, End to End standard as per ASME B 16.10 , Packed Gland for stem sealing , -29 °C @ 52.1 kg/cm ² g & 250 °C @ 42.7 kg/cm ² g.	
CHECK VALVE			
CLBC01R	1/2"- 1 1/2"	Design code : API 602, 300 # RF, Piston check, Bolted cover, Integral seats, A105 Body, A182 F316 piston and seats, Stellite hard faced seat-disc sealing surface, X-750 Spring, Non-graphite packing , -29 °C @ 52.1 kg/cm ² g & 250 °C @ 42.7 kg/cm ² g.	
CDBC01R	2"-24"	Design code : API 594, ASME 300 # RF (Solid lug), Dual plate (Lugged) Body with hinge and stop pin , Integral seat, A216 WCB / A105 Body , Metal to Metal Seating, A182 F 316 Plates, X-750 Spring, Stellite hard faced seat-plate sealing surface, Trim : API #12, End To End Standard as per API 594 , -29 °C @ 52.1 kg/cm ² g & 250 °C @ 42.7 kg/cm ² g.	
CSBC01R	2"-24"	Design code : API 594, ASME 300 # RF, Swing check, Bolted bonnet, Replaceable seats, A216 WCB / A105 Body , Metal to Metal Seating , A182 F 316 Disc and hinge , A182 F316 seats, Stellite hard faced seat-disc sealing surface, Trim : API #12, End To End Standard as per API 594 , -29 °C @ 52.1 kg/cm ² g & 250 °C @ 42.7 kg/cm ² g.	

TITLE		 		DOC. No. : 17039-EK-M-SP-2002
PROJECT CREATION OF SURFACE PRODUCTION FACILITY GGs AT EAST KHAGORIJJAN				REV. B
VALVE MATERIAL SPECIFICATION				
Service	Fuel Gas (FG), Drain Open (DO), HP Flare (HF), Heating Medium(HM)- Hot Oil, Produced Water (PW), Process Hydrocarbon Vapor (PV), LP Flare (LF), Process Hydrocarbon			
	Liquid (PL), Drain Closed (DC), Raw/Fresh Water (WP), Potable Water (WD), Atmospheric Vent (VA).			
Piping Class	BC01			
	300#, RF, 3 mm Corrosion Allowance			
TAG NO.		SIZE	DESCRIPTION	
GATE VALVE				
GTBC01R		1/2"- 24"	Design code : API 602 (3/4" & less) / API 600 (1" & above), ASME 300 # RF, Bolted Bonnet, Flexible wedge, Rising & back seat stem, Replaceable seat, Outside screw and yoke, Expanded Graphite not less than 98% Purity as Stem Packing, , Packed gland for stem sealing, A216 WCB / A105 Body, A182 F316 stem. Trim shall be stellite coated, End To End Standard as per ASME B16.10, -29 °C @ 19.9 kg/cm ² g & 250 °C @ 12.3 kg/cm ² g.	
NEEDLE VALVE				
NVBC01R		1/2"- 1 1/2"	ASME 300# RF, A105 Body & Bonnet, A182 F316 trims, Graphite gland packing, End To End dimension as per manufacturer standard, -29 °C @ 52.1 kg/cm ² g & 250 °C @ 42.7 kg/cm ² g.	

TITLE VALVE MATERIAL SPECIFICATION		 	DOC. No. : 17039-EK-M-SP-2002
PROJECT CREATION OF SURFACE PRODUCTION FACILITY GGs AT EAST KHAGORIJA			REV. B
VALVE MATERIAL SPECIFICATION			
Service	Potable water (WD), Nitrogen gas (GN), Demulsifier (CE), Oil Scale Inhibitor (CO), Corrosion Inhibitor (CK), Wax Inhibitor (CV), Flow Improver (CF), Process HC Liquid (PL), Process Hydrocarbon Vapor (PV), Deoiler (CD), Water Scale Inhibitor (CS).		
Piping Class	BS20		
	300#, RF, 0 mm Corrosion Allowance		
TAG NO.	SIZE	DESCRIPTION	
BALL VALVE			
BFBS20R	1/2"- 1 1/2"	Design code : ISO 17292, ASME 300 # RF, Split Body , Bolted , A182 F316 Body , A182 F 316 Ball and Stem , Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Floating Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 50.5 kg/cm ² g & 250 °C @ 34 kg/cm ² g.	
BFBS20R	2"- 4"	Design code : API 6D, ASME 300 # RF, Split Body , Bolted , ASTM A351 CF8M / A182 F316 Body , A182 F 316 Ball and Stem , Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Floating Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 50.5 kg/cm ² g & 250 °C @ 34 kg/cm ² g.	
BFBS20R	6"-24"	Design code : API 6D, ASME 300 # RF, Split Body , Bolted, ASTM A351 CF8M Body , A182 F 316 Ball and Stem, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Trunnion Mounted Ball , Fire test as per API 6FA , End to end standard as per ASME B 16.10, -29 °C @ 50.5 kg/cm ² g & 250 °C @ 34 kg/cm ² g..	
BRBS20R	2"- 4"	Design code : API 6D, ASME 300 # RF, Split Body , Bolted , ASTM A351 CF8M / A182 F316 Body , A182 F 316 Ball and Stem , Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Reduced Bore , Floating Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 50.5 kg/cm ² g & 250 °C @ 34 kg/cm ² g.	
BRBS20R	6"-24"	Design code : API 6D, ASME 300 # RF, Split Body , Bolted, ASTM A351 CF8M Body , A182 F 316 Ball and Stem, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Reduced Bore , Trunnion Mounted Ball , Fire test as per API 6FA , End to end standard as per ASME B 16.10, -29 °C @ 50.5 kg/cm ² g & 250 °C @ 34 kg/cm ² g..	
GLOBE VALVE			
GVBS20R	2"-24"	Design code : BS 1873, ASME 300 # RF, Straight Pattern , Bolted, ASTM A351 CF8M Body , Rising Stem , Outside Screw and Yoke , A182 F 316 Seats, Disc & Stem , Swivelling Plug as Disc , Expanded Graphite not less than 98% Purity as Stem Packing , Stellite hard faced seat-disc sealing surface, End to End standard as per ASME B 16.10 , Packed Gland for stem sealing , -29 °C @ 50.5 kg/cm ² g & 250 °C @ 34 kg/cm ² g.	
CHECK VALVE			
CLBS20R	1/2" - 1 1/2"	Design code : API 602, 300 # solid, Piston check, Bolted cover, Integral seats, A182 F316 Body, A182 F316 piston and seats, Stellite hard faced seat-disc sealing surface, X-750 Spring, Non-graphite packing , -29 °C @ 50.5 kg/cm ² g & 250 °C @ 34 kg/cm ² g.	
CDBS20R	2"-24"	Design code : API 594, ASME 300 # RF (Solid lug), Dual plate (Lugged) Body with hinge and stop pin, Integral seat, ASTM A351 CF8M / A182 F316 Body , Metal to Metal Seating, A182 F 316 Plates, X-750 Spring, Stellite hard faced seat-plate sealing surface, End To End Standard as per API 594 , -29 °C @ 50.5 kg/cm ² g & 250 °C @ 34 kg/cm ² g.	
CSBS20R	2"-24"	Design code : API 594, ASME 300 # RF, Swing check, Bolted bonnet, Replaceable seats, ASTM A351 CF8M / A182 F316 Body , Metal to Metal Seating , A182 F 316 Disc and hinge , A182 F316 seats, Stellite hard faced seat-disc sealing surface, End To End Standard as per API 594 , -29 °C @ 50.5 kg/cm ² g & 250 °C @ 34 kg/cm ² g.	

TITLE		 ऑयल इंडिया लिमिटेड Oil India Limited  KAVIN™		DOC. No. : 17039-EK-M-SP-2002
VALVE MATERIAL SPECIFICATION				REV. B
PROJECT CREATION OF SURFACE PRODUCTION FACILITY GGs AT EAST KHAGORIJAN				
VALVE MATERIAL SPECIFICATION				
Service	Produced Water (PW), Process Two Phase (PT), Process Hydrocarbon Vapor (PV), Process Hydrocarbon Liquid (PL).			
Piping Class	CC01			
	600#, RTJ, 3 mm Corrosion Allowance			
TAG NO.		SIZE	DESCRIPTION	
BALL VALVE				
BFCC01J		1/2"- 1 1/2"	Design code : ISO 17292, ASME 600 # RTJ, Split Body , Bolted, A105 Body , A182 F 316 Ball and Stem , Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Floating Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 104.1 kg/cm ² g & 250 °C @ 85.5 kg/cm ² g.	
BFCC01J		2"- 3"	Design code : API 6D, ASME 600 # RTJ, Split Body , Bolted , A216 WCB / A105 Body , A182 F 316 Stem , F316 SS (or) ENP A105 carbon steel ball, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Trunnion Mounted Ball, Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 104.1 kg/cm2g & 250 °C @ 85.5 kg/cm2g.	
BFCC01J		4"-24"	Design code : API 6D, ASME 600 # RTJ, Split Body , Bolted, A216 WCB Body , A182 F 316 Stem , F316 SS (or) ENP A105 carbon steel ball, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Trunnion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 104.1 kg/cm2g & 250 °C @ 85.5 kg/cm2g.	
BRCC01J		2"- 3"	Design code : API 6D, ASME 600 # RTJ, Split Body , Bolted , A216 WCB / A105 Body , A182 F 316 Stem , F316 SS (or) ENP A105 carbon steel ball, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Reduced Bore , Trunnion Mounted Ball, Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 104.1 kg/cm2g & 250 °C @ 85.5 kg/cm2g.	
BRCC01J		4"-24"	Design code : API 6D, ASME 600 # RTJ, Split Body , Bolted, A216 WCB Body , A182 F 316 Stem , F316 SS (or) ENP A105 carbon steel ball, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Reduced Bore , Trunnion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 104.1 kg/cm2g & 250 °C @ 85.5 kg/cm2g.	
GLOBE VALVE				
GVCC01J		1/2"- 1 1/2"	Design code : API 602, ASME 600 # RTJ, Straight Pattern , Bolted, A105 Body , Rising Stem , Outside Screw and Yoke , A182 F316 Disc, Seats and Stem , Swivelling Plug as Disc, Expanded Graphite not less than 98% Purity as Stem Packing , Stellite hard faced seat-disc sealing surface, End to end standard as per ASME B 16.10 , Packed Gland for stem sealing , -29 °C @ 104.1 kg/cm2g & 250 °C @ 85.5 kg/cm2g.	
GVCC01J		2"-24"	Design code : BS 1873, ASME 600 # RTJ, Straight Pattern , Bolted, A216 WCB Body , Rising Stem , Outside Screw and Yoke , A182 F316 Stem, Seats and disc , Swivelling Plug as Disc , Expanded Graphite not less than 98% Purity as Stem Packing , Stellite hard faced seat-disc sealing surface, End to end standard as per ASME B 16.10 , Packed Gland for stem sealing , -29 °C @ 104.1 kg/cm2g & 250 °C @ 85.5 kg/cm2g.	
CHECK VALVE				
CACC01J		2"-24"	Design code : API 594, ASME 600 # RTJ, Non-slam (axial flow) check valve, Short pattern, A216 WCB Body, A182 F316 (or) carbon steel + 316 overlay disc, A182 F316 seats, Stellite hard faced seat-disc sealing surface, Alloy 718 spring, Trim : API #12, End To End Standard as per ASME B16.10 , -29 °C @ 104.1 kg/cm2g & 250 °C @ 85.5 kg/cm2g.	
CDCC01J		2"-24"	Design code : API 594, ASME 600 # RTJ (Solid lug), Dual plate (Lugged) Body with hinge and stop pin, Integral seat, A216 WCB / A105 Body , Metal to Metal Seating, A182 F 316 Plates, X-750 Spring, Stellite hard faced seat-plate sealing surface, Trim : API #12, End To End Standard as per API 594 , -29 °C @ 104.1 kg/cm2g & 250 °C @ 85.5 kg/cm2g.	

TITLE VALVE MATERIAL SPECIFICATION		 	DOC. No. : 17039-EK-M-SP-2002
PROJECT CREATION OF SURFACE PRODUCTION FACILITY GGS AT EAST KHAGORIJAN			REV. B
VALVE MATERIAL SPECIFICATION			
Service	Produced Water (PW), Process Two Phase (PT), Process Hydrocarbon Vapor (PV), Process Hydrocarbon Liquid (PL).		
Piping Class	CC01		
	600#, RTJ, 3 mm Corrosion Allowance		
TAG NO.	SIZE	DESCRIPTION	
CSCC01J	2"-24"	Design code : API 594, ASME 600 # RTJ, Swing check, Bolted bonnet, Replaceable seats, A216 WCB / A105 Body , Metal to Metal Seating , A182 F 316 Disc and hinge , A182 F316 seats, Stellite hard faced seat-disc sealing surface, Trim : API #12, End To End Standard as per API 594 , -29 °C @ 104.1 kg/cm2g & 250 °C @ 85.5 kg/cm2g.	
NEEDLE VALVE			
NVCC01J	1/2"-1 1/2"	ASME 600# RTJ, A105 Body & Bonnet, A182 F316 trims, Graphite gland packing, End To End dimension as per manufacturer standard, -29 °C @ 104.1 kg/cm ² g & 250 °C @ 85.5 kg/cm ² g.	
DOUBLE BLOCK AND BLEED VALVE			
DBCC01J	1/2"-24"	Design code : EEMUA 182, ASME 600 # RTJ on both sides, Isolation: Ball valve type (Full bore), Vent: Needle valve type, A216 WCB / A105 Body , A182 F316 Trims, PEEK seats , Fire Test as per API 6FA , End to End standard as per Manufacturers Standard , Expanded graphite not less than 98% purity as per stuffing box, Lip seal and fire seal for stem sealing , Valves 2" and above shall be trunnion mounted type , -29 °C @ 104.1 kg/cm2g & 250 °C @ 85.5 kg/cm2g.	
DBCC01C	1/2"-24"	Design code : EEMUA 182, ASME 600 # RTJ x 1/2" NPTF, Isolation: Ball valve type (Full bore), Vent: Needle valve type, A216 WCB / A105 Body , A182 F316 Trims, PEEK seats , Fire Test as per API 6FA , End to End standard as per Manufacturers Standard , Expanded graphite not less than 98% purity as per stuffing box, Lip seal and fire seal for stem sealing , Valves 2" and above shall be trunnion mounted type , -29 °C @ 104.1 kg/cm2g & 250 °C @ 85.5 kg/cm2g.	

TITLE VALVE MATERIAL SPECIFICATION		 	DOC. No. : 17039-EK-M-SP-2002
PROJECT CREATION OF SURFACE PRODUCTION FACILITY GGs AT EAST KHAGORIJAN			REV. B
VALVE MATERIAL SPECIFICATION			
Service	Potable water (WD), Nitrogen gas (GN), Demulsifier (CE), Oil Scale Inhibitor (CO), Corrosion Inhibitor (CK), Wax Inhibitor (CV), Flow Improver (CF), Process HC Liquid (PL),		
	Process Hydrocarbon Vapor (PV), Deoiler (CD), Water Scale Inhibitor (CS).		
Piping Class	CS20		
	600#, RTJ, 0 mm Corrosion Allowance		
TAG NO.	SIZE	DESCRIPTION	
BALL VALVE			
BFCS20J	1/2"- 1 1/2"	Design code : ISO 17292, ASME 600 # RTJ, Split Body , Bolted, A182 F316 Body , A182 F 316 Ball and Stem , Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Floating Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 101.2 kg/cm2g & 250 °C @ 68.1 kg/cm2g.	
BFCS20J	2"- 3"	Design code : API 6D, ASME 600 # RTJ, Split Body , Bolted , ASTM A351 CF8M / A182 F316 Body , A182 F 316 Ball and Stem , Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Trunnion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 101.2 kg/cm2g & 250 °C @ 68.1 kg/cm2g.	
BFCS20J	4"-24"	Design code : API 6D, ASME 600 # RTJ, Split Body , Bolted, ASTM A351 CF8M Body , A182 F316 Ball and Stem , Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Trunnion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10, -29 °C @ 101.2 kg/cm2g & 250 °C @ 68.1 kg/cm2g.	
BRCS20J	2"- 3"	Design code : API 6D, ASME 600 # RTJ, Split Body , Bolted , ASTM A351 CF8M / A182 F316 Body , A182 F 316 Ball and Stem , Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Reduced Bore , Trunnion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 101.2 kg/cm2g & 250 °C @ 68.1 kg/cm2g.	
BRCS20J	4"-24"	Design code : API 6D, ASME 600 # RTJ, Split Body , Bolted, ASTM A351 CF8M Body , A182 F316 Ball and Stem , Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Reduced Bore , Trunnion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10, -29 °C @ 101.2 kg/cm2g & 250 °C @ 68.1 kg/cm2g.	
GLOBE VALVE			
GVCS20J	1/2"- 1 1/2"	Design code : API 602, ASME 600 # RTJ, Straight Pattern , Bolted, A182 F316 Body , Rising Stem , Outside Screw and Yoke , A182 F316 Stem, Seats and disc , Swivelling Plug as Disc, Expanded Graphite not less than 98% Purity as Stem Packing , Stellite hard faced seat-disc sealing surface, End to End standard as per ASME B 16.10 , Packed Gland for stem sealing , -29 °C @ 101.2 kg/cm2g & 250 °C @ 68.1 kg/cm2g.	
GVCS20J	2"-12"	Design code : BS 1873, ASME 600 # RTJ, Straight Pattern , Bolted, ASTM A351 CF8M Body , Rising Stem and disc , Outside Screw and Yoke , A182 F316 Stem, Seats and disc , Swivelling Plug as Disc , Expanded Graphite not less than 98% Purity as Stem Packing , Stellite hard faced seat-disc sealing surface, End to End standard as per ASME B 16.10 , Packed Gland for stem sealing , -29 °C @ 101.2 kg/cm2g & 250 °C @ 68.1 kg/cm2g.	
CHECK VALVE			
CDCS20J	2"-24"	Design code : API 594, ASME 600 # RTJ (Solid lug), Dual plate (Lugged) Body with hinge and stop pin , Integral seat, ASTM A351 CF8M / A182 F316 Body , Metal to Metal Seating, A182 F 316 Plates, X-750 Spring, Stellite hard faced seat-plate sealing surface, End To End Standard as per API 594 , -29 °C @ 101.2 kg/cm2g & 250 °C @ 68.1 kg/cm2g.	
CSCS20J	2"-24"	Design code : API 594, ASME 600 # RTJ, Swing check, Bolted bonnet, Replaceable seats, ASTM A351 CF8M / A182 F316 Body , Metal to Metal Seating , A182 F 316 Disc and hinge , A182 F316 seats, Stellite hard faced seat-disc sealing surface, End To End Standard as per API 594 , -29 °C @ 101.2 kg/cm2g & 250 °C @ 68.1 kg/cm2g.	

TITLE VALVE MATERIAL SPECIFICATION		 ऑयल इंडिया लिमिटेड Oil India Limited  KAVIN™		DOC. No. : 17039-EK-M-SP-2002
PROJECT CREATION OF SURFACE PRODUCTION FACILITY GGs AT EAST KHAGORIJAN				REV. B
VALVE MATERIAL SPECIFICATION				
Service	Potable water (WD), Nitrogen gas (GN), Demulsifier (CE), Oil Scale Inhibitor (CO), Corrosion Inhibitor (CK), Wax Inhibitor (CV), Flow Improver (CF), Process HC Liquid (PL),			
	Process Hydrocarbon Vapor (PV), Deoiler (CD), Water Scale Inhibitor (CS).			
Piping Class	CS20			
	600#, RTJ, 0 mm Corrosion Allowance			
TAG NO.		SIZE	DESCRIPTION	
DOUBLE BLOCK AND BLEED VALVE				
DBCS20J		1/2"-24"	Design code : EEMUA 182, ASME 600 # RTJ on both sides, Isolation: Ball valve type (Full bore), Vent: Needle valve type, A351 CF8M / A182 F316 Body , A182 F316 Trims, PEEK seats , Fire Test as per API 6FA , End to End standard as per Manufacturers Standard , Expanded graphite not less than 98% purity as per stuffing box, Lip seal and fire seal for stem sealing , Valves 2" and above shall be trunnion mounted type , -29 °C @ 101.2 kg/cm2g & 250 °C @ 68.1 kg/cm2g.	
DBCS20C		1/2"-24"	Design code : EEMUA 182, ASME 600 # RTJ x 1/2" NPTF, Isolation: Ball valve type (Full bore), Vent: Needle valve type, A351 CF8M / A182 F316 Body , A182 F316 Trims, PEEK seats , Fire Test as per API 6FA , End to End standard as per Manufacturers Standard , Expanded graphite not less than 98% purity as per stuffing box, Lip seal and fire seal for stem sealing , Valves 2" and above shall be trunnion mounted type , -29 °C @ 101.2 kg/cm2g & 250 °C @ 68.1 kg/cm2g.	

TITLE		 	DOC. No. :
VALVE MATERIAL SPECIFICATION			17039-EK-M-SP-2002
PROJECT			REV.
CREATION OF SURFACE PRODUCTION FACILITY GGS AT EAST KHAGORIJAN			B
VALVE MATERIAL SPECIFICATION			
Service	Produced Water (PW), Process Two Phase (PT), Process Hydrocarbon Vapor (PV), Process Hydrocarbon Liquid (PL).		
Piping Class	DC01		
	900#, RTJ, 3 mm Corrosion Allowance		
TAG NO.	SIZE	DESCRIPTION	
BALL VALVE			
BFDC01J	1/2"- 1 1/2"	Design code : API 6D, ASME 1500 # RTJ, Split Body , Bolted, A105 Body , A182 F 316 Ball and Stem , Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Floating Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 156.2 kg/cm ² g & 250 °C @ 128.2 kg/cm ² g.	
BFDC01J	2"	Design code : API 6D, ASME 1500 # RTJ, Split Body , Bolted , A216 WCB / A105 Body , A182 F 316 Stem , F316 SS (or) ENP A105 carbon steel ball, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Trunnion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 156.2 kg/cm ² g & 250 °C @ 128.2 kg/cm ² g.	
BFDC01J	3"	Design code : API 6D, ASME 900 # RTJ, Split Body , Bolted , A216 WCB / A105 Body , A182 F 316 Stem , F316 SS (or) ENP A105 carbon steel ball, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Trunnion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 156.2 kg/cm ² g & 250 °C @ 128.2 kg/cm ² g.	
BFDC01J	4"-24"	Design code : API 6D, ASME 900 # RTJ, Split Body , Bolted, A216 WCB Body , A182 F 316 Stem , F316 SS (or) ENP A105 carbon steel ball, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Trunnion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10, -29 °C @ 156.2 kg/cm ² g & 250 °C @ 128.2 kg/cm ² g.	
BRDC01J	2"	Design code : API 6D, ASME 1500 # RTJ, Split Body , Bolted , A216 WCB / A105 Body , A182 F 316 Stem , F316 SS (or) ENP A105 carbon steel ball, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Reduced Bore , Trunnion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 156.2 kg/cm ² g & 250 °C @ 128.2 kg/cm ² g.	
BRDC01J	3"	Design code : API 6D, ASME 900 # RTJ, Split Body , Bolted , A216 WCB / A105 Body , A182 F 316 Stem , F316 SS (or) ENP A105 carbon steel ball, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Reduced Bore , Trunnion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 156.2 kg/cm ² g & 250 °C @ 128.2 kg/cm ² g.	
BRDC01J	4"-24"	Design code : API 6D, ASME 900 # RTJ, Split Body , Bolted, A216 WCB Body , A182 F 316 Stem , F316 SS (or) ENP A105 carbon steel ball, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Reduced Bore , Trunnion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10, -29 °C @ 156.2 kg/cm ² g & 250 °C @ 128.2 kg/cm ² g.	
GLOBE VALVE			
GVDC01J	1/2"- 2"	Design code : API 602, ASME 1500 # RTJ, Straight Pattern , Pressure seal bonnet, A105 / A216 WCB Body , Rising Stem , Outside Screw and Yoke , A182 F316 Disc, Seats and Stem , Swivelling Plug as Disc , Expanded Graphite not less than 98% Purity as Stem Packing ,Stellite hard faced seat-disc sealing surface, End to end standard as per ASME B 16.10 , Packed Gland for stem sealing , -29 °C @ 156.2 kg/cm ² g & 250 °C @ 128.2 kg/cm ² g.	
GVDC01J	3"-24"	Design code : BS 1873, ASME 900 # RTJ, Straight Pattern , Pressure seal bonnet, A216 WCB Body , Rising Stem , Outside Screw and Yoke , A182 F316 Stem, Seats and disc , Swivelling Plug as Disc , Expanded Graphite not less than 98% Purity as Stem Packing , Stellite hard faced seat-disc sealing surface, End to end standard as per ASME B 16.10 , Packed Gland for stem sealing , -29 °C @ 156.2 kg/cm ² g & 250 °C @ 128.2 kg/cm ² g.	

TITLE VALVE MATERIAL SPECIFICATION		 	DOC. No. : 17039-EK-M-SP-2002
PROJECT CREATION OF SURFACE PRODUCTION FACILITY GGs AT EAST KHAGORIJA			REV. B
VALVE MATERIAL SPECIFICATION			
Service	Produced Water (PW), Process Two Phase (PT), Process Hydrocarbon Vapor (PV), Process Hydrocarbon Liquid (PL).		
Piping Class	DC01		
	900#, RTJ, 3 mm Corrosion Allowance		
TAG NO.	SIZE	DESCRIPTION	
CHECK VALVE			
CADC01J	2"-24"	Design code : API 594, ASME 1500 # RTJ for 2" & ASME 900 # RTJ for above 2", Non-slam (axial flow) check valve, Short pattern, A216 WCB Body, A182 F316 (or) carbon steel + 316 overlay disc, A182 F316 seats, Stellite hard faced seat-disc sealing surface, Alloy 718 spring, Trim : API #12, End To End Standard as per ASME B16.10 , -29 °C @ 156.2 kg/cm ² g & 250 °C @ 128.2 kg/cm ² g.	
CDDC01J	2"-24"	Design code : API 594, ASME 1500 # RTJ for 2" & ASME 900 # RTJ for above 2" (Solid lug), Dual plate (Lugged) Body with hinge and stop pin , Integral seat, A216 WCB / A105 Body , Metal to Metal Seating, A182 F 316 Plates, X-750 Spring, Stellite hard faced seat-plate sealing surface, Trim : API #12, End To End Standard as per API 594 , -29 °C @ 156.2 kg/cm ² g & 250 °C @ 128.2 kg/cm ² g.	
CSDC01J	2"-24"	Design code : API 594, ASME 1500 # RTJ for 2" & ASME 900 # RTJ for above 2", Swing check, Pressure seal cover, Replaceable seats, A216 WCB / A105 Body , Metal to Metal Seating , A182 F 316 Disc and hinge , A182 F316 seats, Stellite hard faced seat-disc sealing surface, Trim : API #12, End To End Standard as per API 594 , -29 °C @ 156.2 kg/cm ² g & 250 °C @ 128.2 kg/cm ² g.	
DOUBLE BLOCK AND BLEED VALVE			
DBDC01J	1/2"-24"	Design code : EEMUA 182, ASME 1500 # RTJ for upto 2" & ASME 900 # RTJ for above 2", Flanged on both sides, Isolation: Ball valve type (Full bore), Vent: Needle valve type, A216 WCB / A105 Body , A182 F316 Trims, PEEK seats , Fire Test as per API 6FA , End to End standard as per Manufacturers Standard , Expanded graphite not less than 98% purity as per stuffing box, Lip seal and fire seal for stem sealing , Valves 2" and above shall be trunnion mounted type , -29 °C @ 156.2 kg/cm ² g & 250 °C @ 128.2 kg/cm ² g.	
DBDC01C	1/2"-24"	Design code : EEMUA 182, ASME 1500 # RTJ for upto 2" & ASME 900 # RTJ for above 2", Flanged x 1/2" NPTF, Isolation: Ball valve type (Full bore), Vent: Needle valve type, A216 WCB / A105 Body , A182 F316 Trims, PEEK seats , Fire Test as per API 6FA , End to End standard as per Manufacturers Standard , Expanded graphite not less than 98% purity as per stuffing box, Lip seal and fire seal for stem sealing , Valves 2" and above shall be trunnion mounted type , -29 °C @ 156.2 kg/cm ² g & 250 °C @ 128.2 kg/cm ² g.	
NEEDLE VALVE			
NVDC01J	1/2"- 1 1/2"	ASME 1500# RTJ, A105 Body & Bonnet, A182 F316 trims, Graphite gland packing, End To End dimension as per manufacturer standard, -29 °C @ 156.2 kg/cm ² g & 250 °C @ 128.2 kg/cm ² g.	

TITLE VALVE MATERIAL SPECIFICATION		 	DOC. No. : 17039-EK-M-SP-2002
PROJECT CREATION OF SURFACE PRODUCTION FACILITY GGs AT EAST KHAGORIJA			REV. B
VALVE MATERIAL SPECIFICATION			
Service	Potable water (WD), Nitrogen gas (GN), Demulsifier (CE), Oil Scale Inhibitor (CO), Corrosion Inhibitor (CK), Wax Inhibitor (CV), Flow Improver (CF), Process HC Liquid (PL),		
	Process Hydrocarbon Vapor (PV), Deoiler (CD), Water Scale Inhibitor (CS).		
Piping Class	DS20		
	900#, RTJ, 0 mm Corrosion Allowance		
TAG NO.	SIZE	DESCRIPTION	
BALL VALVE			
BFDS20J	1/2"- 1 1/2"	Design code : API 6D, ASME 1500 # RTJ, Split Body , Bolted, A182 F316 Body , A182 F 316 Ball and Stem , Expanded Graphite not less than 98% Purity as Fire seal, PEEK seats, Full Bore , Floating Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 151.8 kg/cm ² g & 250 °C @ 102 kg/cm ² g.	
BFDS20J	2"	Design code : API 6D, ASME 1500 # RTJ, Split Body , Bolted , ASTM A351 CF8M / A182 F316 Body , A182 F 316 Ball and Stem , Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Trunnion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 151.8 kg/cm ² g & 250 °C @ 102 kg/cm ² g.	
BFDS20J	3"	Design code : API 6D, ASME 900 # RTJ, Split Body , Bolted , ASTM A351 CF8M / A182 F316 Body , A182 F 316 Ball and Stem , Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Trunnion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 151.8 kg/cm ² g & 250 °C @ 102 kg/cm ² g.	
BFDS20J	4"-24"	Design code : API 6D, ASME 900 # RTJ, Split Body , Bolted, ASTM A351 CF8M Body , A182 F 316 Ball and Stem , Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Trunnion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10, -29 °C @ 151.8 kg/cm ² g & 250 °C @ 102 kg/cm ² g.	
BRDS20J	2"	Design code : API 6D, ASME 1500 # RTJ, Split Body , Bolted , ASTM A351 CF8M / A182 F316 Body , A182 F 316 Ball and Stem , Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Reduced Bore , Trunnion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 151.8 kg/cm ² g & 250 °C @ 102 kg/cm ² g.	
BRDS20J	3"	Design code : API 6D, ASME 900 # RTJ, Split Body , Bolted , ASTM A351 CF8M / A182 F316 Body , A182 F 316 Ball and Stem , Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Reduced Bore , Trunnion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 151.8 kg/cm ² g & 250 °C @ 102 kg/cm ² g.	
BRDS20J	4"-24"	Design code : API 6D, ASME 900 # RTJ, Split Body , Bolted, ASTM A351 CF8M Body , A182 F 316 Ball and Stem , Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Reduced Bore , Trunnion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10, -29 °C @ 151.8 kg/cm ² g & 250 °C @ 102 kg/cm ² g.	
GLOBE VALVE			
GVDS20J	1/2"- 2"	Design code : API 602, ASME 1500 # RTJ, Straight Pattern , Pressure seal bonnet, ASTM A351 CF8M / A182 F316 Body , Rising Stem , Outside Screw and Yoke , A182 F316 Stem, Seats and disc , Swivelling Plug as Disc, Expanded Graphite not less than 98% Purity as Stem Packing , Stellite hard faced seat-disc sealing surface, End to End standard as per ASME B 16.10 , Packed Gland for stem sealing , -29 °C @ 151.8 kg/cm ² g & 250 °C @ 102 kg/cm ² g.	
GVDS20J	3"-8"	Design code : BS 1873, ASME 900 # RTJ, Straight Pattern , Pressure seal bonnet, ASTM A351 CF8M Body , Rising Stem and disc , Outside Screw and Yoke , A182 F316 Stem, Seats and disc , Swivelling Plug as Disc , Expanded Graphite not less than 98% Purity as Stem Packing , Stellite hard faced seat-disc sealing surface, End to End standard as per ASME B 16.10 , Packed Gland for stem sealing , -29 °C @ 151.8 kg/cm ² g & 250 °C @ 102 kg/cm ² g.	

TITLE VALVE MATERIAL SPECIFICATION		 	DOC. No. : 17039-EK-M-SP-2002
PROJECT CREATION OF SURFACE PRODUCTION FACILITY GGs AT EAST KHAGORIJAN			REV. B
VALVE MATERIAL SPECIFICATION			
Service	Potable water (WD), Nitrogen gas (GN), Demulsifier (CE), Oil Scale Inhibitor (CO), Corrosion Inhibitor (CK), Wax Inhibitor (CV), Flow Improver (CF), Process HC Liquid (PL),		
	Process Hydrocarbon Vapor (PV), Deoiler (CD), Water Scale Inhibitor (CS).		
Piping Class	DS20		
	900#, RTJ, 0 mm Corrosion Allowance		
TAG NO.	SIZE	DESCRIPTION	
CHECK VALVE			
CDDS20J	2"-24"	Design code : API 594, ASME 1500 # RTJ for 2" & ASME 900 # RTJ for above 2" (Solid lug), Dual plate (Lugged) Body with hinge and stop pin , Integral seat, ASTM A351 CF8M / A182 F316 Body , Metal to Metal Seating, A182 F 316 Plates, X-750 Spring, Stellite hard faced seat-plate sealing surface, End To End Standard as per API 594 , -29 °C @ 151.8 kg/cm ² g & 250 °C @ 102 kg/cm ² g.	
CSDS20J	2"-24"	Design code : API 594, ASME 1500 # RTJ for 2" & ASME 900 # RTJ for above 2" , Swing check, Pressure seal cover, Replaceable seats, ASTM A351 CF8M / A182 F316 Body , Metal to Metal Seating , A182 F 316 Disc and hinge , A182 F316 seats, Stellite hard faced seat-disc sealing surface, End To End Standard as per API 594 , -29 °C @ 151.8 kg/cm ² g & 250 °C @ 102 kg/cm ² g.	
DOUBLE BLOCK AND BLEED VALVE			
DBDS20J	1/2"-24"	Design code : EEMUA 182, ASME 1500 # RTJ for upto 2" & ASME 900 # RTJ for above 2" , Flanged on both sides, Isolation: Ball valve type (Full bore), Vent: Needle valve type, ASTM A351 CF8M / A182 F316 Body , A182 F316 Trims, PEEK seats , Fire Test as per API 6FA , End to End standard as per Manufacturers Standard , Expanded graphite not less than 98% purity as per stuffing box, Lip seal and fire seal for stem sealing , Valves 2" and above shall be trunnion mounted type , -29 °C @ 151.8 kg/cm ² g & 250 °C @ 102 kg/cm ² g.	
DBDS20C	1/2"-24"	Design code : EEMUA 182, ASME 1500 # RTJ for upto 2" & ASME 900 # RTJ for above 2" , Flanged x 1/2" NPTF, Isolation: Ball valve type (Full bore), Vent: Needle valve type, ASTM A351 CF8M / A182 F316 Body , A182 F316 Trims, PEEK seats , Fire Test as per API 6FA , End to End standard as per Manufacturers Standard , Expanded graphite not less than 98% purity as per stuffing box, Lip seal and fire seal for stem sealing , Valves 2" and above shall be trunnion mounted type , -29 °C @ 151.8 kg/cm ² g & 250 °C @ 102 kg/cm ² g.	

TITLE		 ऑयल इंडिया लिमिटेड Oil India Limited  KAVIN™		DOC. No. :
VALVE MATERIAL SPECIFICATION				17039-EK-M-SP-2002
PROJECT		REV.		
CREATION OF SURFACE PRODUCTION FACILITY GGs AT EAST KHAGORIJAN		B		
VALVE MATERIAL SPECIFICATION				
Service	Produced Water (PW), Process Two Phase (PT), Process Hydrocarbon Vapor (PV), Process Hydrocarbon Liquid (PL).			
Piping Class	EC01			
	1500#, RTJ, 3 mm Corrosion Allowance			
TAG NO.	SIZE	DESCRIPTION		
BALL VALVE				
BFEC01J	1/2"- 1 1/2"	Design code : API 6D, ASME 1500 # RTJ, Split Body , Bolted, A105 Body , A182 F 316 Ball and Stem , Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Floating Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 260.3 kg/cm ² g & 204 °C @ 222.55 kg/cm ² g.		
BFEC01J	2"- 4"	Design code : API 6D, ASME 1500 # RTJ, Split Body , Bolted , A216 WCB / A105 Body , A182 F 316 Stem , F316 SS (or) ENP A105 carbon steel ball, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Trunnion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 260.3 kg/cm ² g & 204 °C @ 222.55 kg/cm ² g.		
BFEC01J	6"-24"	Design code : API 6D, ASME 1500 # RTJ,, Split Body , Bolted, A216 WCB Body , A182 F 316 Stem , F316 SS (or) ENP A105 carbon steel ball, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Trunnion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10, -29 °C @ 260.3 kg/cm ² g & 204 °C @ 222.55 kg/cm ² g.		
BREC01J	2"- 4"	Design code : API 6D, ASME 1500 # RTJ, Split Body , Bolted , A216 WCB / A105 Body , A182 F 316 Stem , F316 SS (or) ENP A105 carbon steel ball, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Reduced Bore , Trunnion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 260.3 kg/cm ² g & 204 °C @ 222.55 kg/cm ² g.		
BREC01J	6"-24"	Design code : API 6D, ASME 1500 # RTJ,, Split Body , Bolted, A216 WCB Body , A182 F 316 Stem , F316 SS (or) ENP A105 carbon steel ball, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Reduced Bore , Trunnion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10, -29 °C @ 260.3 kg/cm ² g & 204 °C @ 222.55 kg/cm ² g.		
GLOBE VALVE				
GVEC01J	1/2"- 1 1/2"	Design code : API 602, ASME 1500 # RTJ, Straight Pattern , Pressure seal bonnet, A105 Body , Rising Stem , Outside Screw and Yoke , A182 F316 Disc, Seats and Stem , Swivelling Plug as Disc , Expanded Graphite not less than 98% Purity as Stem Packing ,Stellite hard faced seat-disc sealing surface, End to end standard as per ASME B 16.10 , Packed Gland for stem sealing , -29 °C @ 260.3 kg/cm ² g & 204 °C @ 222.55 kg/cm ² g.		
GVEC01J	2"-4"	Design code : BS 1873, ASME 1500 # RTJ, Straight Pattern , Pressure seal bonnet, A216 WCB Body , Rising Stem , Outside Screw and Yoke , A182 F316 Stem, Seats and disc , Swivelling Plug as Disc , Expanded Graphite not less than 98% Purity as Stem Packing , Stellite hard faced seat-disc sealing surface, End to end standard as per ASME B 16.10 , Packed Gland for stem sealing , -29 °C @ 260.3 kg/cm ² g & 204 °C @ 222.55 kg/cm ² g.		
CHECK VALVE				
CDEC01J	2"-24"	Design code : API 594, ASME 1500 # RTJ (Solid lug), Dual plate (Lugged) Body with hinge and stop pin , Integral seat, A216 WCB / A105 Body , Metal to Metal Seating, A182 F 316 Plates, X-750 Spring, Stellite hard faced seat-plate sealing surface, Trim : API #12, End To End Standard as per API 594 , -29 °C @ 260.3 kg/cm ² g & 204 °C @ 222.55 kg/cm ² g.		
CSEC01J	2"-24"	Design code : API 594, ASME 1500 # RTJ , Swing check, Pressure seal cover, Replaceable seats, A216 WCB / A105 Body , Metal to Metal Seating , A182 F 316 Disc and hinge , A182 F316 seats, Stellite hard faced seat-disc sealing surface, Trim : API #12, End To End Standard as per API 594 , -29 °C @ 260.3 kg/cm ² g & 204 °C @ 222.55 kg/cm ² g.		

TITLE		 ऑयल इंडिया लिमिटेड Oil India Limited  KAVIN™		DOC. No. : 17039-EK-M-SP-2002
VALVE MATERIAL SPECIFICATION				REV. B
PROJECT CREATION OF SURFACE PRODUCTION FACILITY GGs AT EAST KHAGORIJAN				
VALVE MATERIAL SPECIFICATION				
Service	Produced Water (PW), Process Two Phase (PT), Process Hydrocarbon Vapor (PV), Process Hydrocarbon Liquid (PL).			
Piping Class	EC01			
	1500#, RTJ, 3 mm Corrosion Allowance			
TAG NO.		SIZE	DESCRIPTION	
DOUBLE BLOCK AND BLEED VALVE				
DBEC01J		1/2"-24"	Design code : EEMUA 182, ASME 1500 # RTJ, Flanged on both sides, Isolation: Ball valve type (Full bore), Vent: Needle valve type, A216 WCB / A105 Body , A182 F316 Trims, PEEK seats , Fire Test as per API 6FA , End to End standard as per Manufacturers Standard , Expanded graphite not less than 98% purity as per stuffing box, Lip seal and fire seal for stem sealing , Valves 2" and above shall be trunnion mounted type , -29 °C @ 260.3 kg/cm ² g & 204 °C @ 222.55 kg/cm ² g.	
DBEC01C		1/2"-24"	Design code : EEMUA 182, ASME 1500 # RTJ, Flanged x 1/2" NPTF, Isolation: Ball valve type (Full bore), Vent: Needle valve type, A216 WCB / A105 Body , A182 F316 Trims, PEEK seats , Fire Test as per API 6FA , End to End standard as per Manufacturers Standard , Expanded graphite not less than 98% purity as per stuffing box, Lip seal and fire seal for stem sealing , Valves 2" and above shall be trunnion mounted type , -29 °C @ 260.3 kg/cm ² g & 204 °C @ 222.55 kg/cm ² g.	
NEEDLE VALVE				
NVEC01J		1/2"- 1 1/2"	ASME 1500# RTJ, A105 Body & Bonnet, A182 F316 trims, Graphite gland packing, End To End dimension as per manufacturer standard, -29 °C @ 260.3 kg/cm ² g & 204 °C @ 222.55 kg/cm ² g.	

TITLE VALVE MATERIAL SPECIFICATION		 	DOC. No. : 17039-EK-M-SP-2002
PROJECT CREATION OF SURFACE PRODUCTION FACILITY GGs AT EAST KHAGORIJA			REV. B
VALVE MATERIAL SPECIFICATION			
Service	Potable water (WD), Nitrogen gas (GN), Demulsifier (CE), Oil Scale Inhibitor (CO), Corrosion Inhibitor (CK), Wax Inhibitor (CV), Flow Improver (CF), Process HC Liquid (PL),		
	Process Hydrocarbon Vapor (PV), Deoiler (CD), Water Scale Inhibitor (CS).		
Piping Class	ES20		
	1500 #, RTJ, 0 mm Corrosion Allowance		
TAG NO.	SIZE	DESCRIPTION	
BALL VALVE			
BFES20J	1/2"- 1 1/2"	Design code : API 6D, ASME 1500 # RTJ, Split Body , Bolted, A182 F316 Body , A182 F 316 Ball and Stem , Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Floating Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10 , -29 °C @ 253 kg/cm2g & 204 °C @ 180.8 kg/cm2g.	
BFES20J	2"- 4"	Design code : API 6D, ASME 1500 # RTJ, Split Body , Bolted , ASTM A351 CF8M / A182 F316 Body , A182 F 316 Ball and Stem , Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Trunnion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10, -29 °C @ 253 kg/cm2g & 204 °C @ 180.8 kg/cm2g.	
BFES20J	6"-24"	Design code : API 6D, ASME 1500 # RTJ,, Split Body , Bolted, ASTM A351 CF8M Body , A182 F 316 Ball and Stem , Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Trunnion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10, -29 °C @ 253 kg/cm2g & 204 °C @ 180.8 kg/cm2g.	
BRES20J	2"- 4"	Design code : API 6D, ASME 1500 # RTJ, Split Body , Bolted , ASTM A351 CF8M / A182 F316 Body , A182 F 316 Ball and Stem , Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Reduced Bore , Trunnion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10, -29 °C @ 253 kg/cm2g & 204 °C @ 180.8 kg/cm2g.	
BRES20J	6"-24"	Design code : API 6D, ASME 1500 # RTJ,, Split Body , Bolted, ASTM A351 CF8M Body , A182 F 316 Ball and Stem , Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Reduced Bore , Trunnion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B 16.10, -29 °C @ 253 kg/cm2g & 204 °C @ 180.8 kg/cm2g.	
GLOBE VALVE			
GVES20J	1/2"- 1 1/2"	Design code : API 602, ASME 1500 # RTJ, Straight Pattern , Pressure seal bonnet, A182 F316 Body , Rising Stem , Outside Screw and Yoke , A182 F316 Stem, Seats and disc , Swivelling Plug as Disc, Expanded Graphite not less than 98% Purity as Stem Packing , Stellite hard faced seat-disc sealing surface, End to End standard as per ASME B 16.10 , Packed Gland for stem sealing , -29 °C @ 253 kg/cm2g & 204 °C @ 180.8 kg/cm2g.	
GVES20J	2"-4"	Design code : BS 1873, ASME 1500 # RTJ, Straight Pattern , Pressure seal bonnet, ASTM A351 CF8M Body , Rising Stem and disc , Outside Screw and Yoke , A182 F316 Stem, Seats and disc , Swivelling Plug as Disc , Expanded Graphite not less than 98% Purity as Stem Packing , Stellite hard faced seat-disc sealing surface, End to End standard as per ASME B 16.10 , Packed Gland for stem sealing , -29 °C @ 253 kg/cm2g & 204 °C @ 180.8 kg/cm2g.	
CHECK VALVE			
CDES20J	2"-24"	Design code : API 594, ASME 1500 # RTJ (Solid lug), Dual plate (Lugged) Body with hinge and stop pin , Integral seat, ASTM A351 CF8M / A182 F316 Body , Metal to Metal Seating, A182 F 316 Plates, X-750 Spring, Stellite hard faced seat-plate sealing surface, End To End Standard as per API 594 , -29 °C @ 253 kg/cm2g & 204 °C @ 180.8 kg/cm2g.	
CSES20J	2"-24"	Design code : API 594, ASME 1500 # RTJ, Swing check, Pressure seal cover, Replaceable seats, ASTM A351 CF8M / A182 F316 Body , Metal to Metal Seating , A182 F 316 Disc and hinge , A182 F316 seats, Stellite hard faced seat-disc sealing surface, End To End Standard as per API 594 , -29 °C @ 253 kg/cm2g & 204 °C @ 180.8 kg/cm2g.	

TITLE VALVE MATERIAL SPECIFICATION			DOC. No. : 17039-EK-M-SP-2002
PROJECT CREATION OF SURFACE PRODUCTION FACILITY GGs AT EAST KHAGORIJA			REV. B
VALVE MATERIAL SPECIFICATION			
Service	Potable water (WD), Nitrogen gas (GN), Demulsifier (CE), Oil Scale Inhibitor (CO), Corrosion Inhibitor (CK), Wax Inhibitor (CV), Flow Improver (CF), Process HC Liquid (PL),		
	Process Hydrocarbon Vapor (PV), Deoiler (CD), Water Scale Inhibitor (CS).		
Piping Class	ES20		
	1500 #, RTJ, 0 mm Corrosion Allowance		
TAG NO.	SIZE	DESCRIPTION	
DOUBLE BLOCK AND BLEED VALVE			
DBES20J	1/2"-24"	Design code : EEMUA 182, ASME 1500 # RTJ, Flanged on both sides, Isolation: Ball valve type (Full bore), Vent: Needle valve type, ASTM A351 CF8M / A182 F316 Body , A182 F316 Trims, PEEK seats , Fire Test as per API 6FA , End to End standard as per Manufacturers Standard , Expanded graphite not less than 98% purity as per stuffing box, Lip seal and fire seal for stem sealing , Valves 2" and above shall be trunnion mounted type , -29 °C @ 253 kg/cm2g & 204 °C @ 180.8 kg/cm2g.	
DBES20C	1/2"-24"	Design code : EEMUA 182, ASME 1500 # RTJ, Flanged x 1/2" NPTF, Isolation: Ball valve type (Full bore), Vent: Needle valve type, ASTM A351 CF8M / A182 F316 Body , A182 F316 Trims, PEEK seats , Fire Test as per API 6FA , End to End standard as per Manufacturers Standard , Expanded graphite not less than 98% purity as per stuffing box, Lip seal and fire seal for stem sealing , Valves 2" and above shall be trunnion mounted type , -29 °C @ 253 kg/cm2g & 204 °C @ 180.8 kg/cm2g.	

TITLE VALVE MATERIAL SPECIFICATION		 	DOC. No. : 17039-EK-M-SP-2002
PROJECT CREATION OF SURFACE PRODUCTION FACILITY GGs AT EAST KHAGORIJAN			REV. B
VALVE MATERIAL SPECIFICATION			
Service	Produced Water (PW), Process Two Phase (PT), Process Hydrocarbon Vapor (PV), Process Hydrocarbon Liquid (PL).		
Piping Class	FC01		
	2500# RTJ (or) HUB ENDS, 3 mm Corrosion Allowance		
TAG NO.	SIZE	DESCRIPTION	
BALL VALVE			
BFFC01J	1/2" - 1 1/2"	Design code : API 6D, ASME 2500# RTJ , Split Body , A105 Body , A182 F316 Ball and Stem, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Floating Ball , Fire test as per API 6FA, End to End standard as per ASME B16.10 , 130 °C @ 388.17 kg/cm ² g	
BFFC01J	2" - 12"	Design code : API 6D, ASME 2500# RTJ, Split Body, A216 WCB Body, A182 F316 Stem, F316 SS (or) ENP A105 carbon steel ball, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Trunion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B16.10 , 130 °C @ 388.17 kg/cm ² g	
BFFC01H	14" - 24"	Design code : API 6D, Hub ends, Split Body, A216 WCB Body, A182 F316 Stem, F316 SS (or) ENP A105 carbon steel ball, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Trunion Mounted Ball , Fire test as per API 6FA , End to End standard as per Manufacturers standard , 130 °C @ 388.17 kg/cm ² g	
BRFC01J	2" - 12"	Design code : API 6D, ASME 2500# RTJ, Split Body, A216 WCB Body, A182 F316 Stem, F316 SS (or) ENP A105 carbon steel ball, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Reduced Bore , Trunion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B16.10 , 130 °C @ 388.17 kg/cm ² g	
BRFC01H	14" - 24"	Design code : API 6D, Hub ends, Split Body, A216 WCB Body, A182 F316 Stem, F316 SS (or) ENP A105 carbon steel ball, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Reduced Bore , Trunion Mounted Ball , Fire test as per API 6FA , End to End standard as per Manufacturers standard , 130 °C @ 388.17 kg/cm ² g	
GLOBE VALVE			
GVFC01J	1/2" - 1 1/2"	Design code : ASME B16.34, ASME 2500 # RTJ, Straight Pattern , Pressure seal bonnet, A105 Body , Rising Stem , Outside Screw and Yoke , A182 F316 Disc, Seats and Stem , Swivelling Plug as Disc , Expanded Graphite not less than 98% Purity as Stem Packing ,Stellite hard faced seat-disc sealing surface, End to end standard as per ASME B 16.10 , Packed Gland for stem sealing , 130 °C @ 388.17 kg/cm ² g.	
GVFC01J	2" - 12"	Design code : BS 1873, ASME 2500 # RTJ, Straight Pattern , Pressure seal bonnet, A216 WCB Body , Rising Stem , Outside Screw and Yoke , A182 F316 Stem, Seats and disc , Swivelling Plug as Disc , Expanded Graphite not less than 98% Purity as Stem Packing , Stellite hard faced seat-disc sealing surface, End to end standard as per ASME B 16.10 , Packed Gland for stem sealing , 130 °C @ 388.17 kg/cm ² g.	
CHECK VALVE			
CDFC01J	2" - 12"	Design code : API 594, ASME 2500 # RTJ (Solid lug), Dual plate (Lugged) Body with hinge and stop pin , Integral seat, A216 WCB / A105 Body , Metal to Metal Seating, A182 F 316 Plates, X-750 Spring, Stellite hard faced seat-plate sealing surface, Trim : API #12, End To End Standard as per API 594 , 130 °C @ 388.17 kg/cm ² g.	
CSFC01J	2" - 12"	Design code : API 594, ASME 2500 # RTJ , Swing check, Pressure seal cover, Replaceable seats, A216 WCB / A105 Body , Metal to Metal Seating , A182 F 316 Disc and hinge , A182 F316 seats, Stellite hard faced seat-disc sealing surface, Trim : API #12, End To End Standard as per API 594 , 130 °C @ 388.17 kg/cm ² g.	

TITLE VALVE MATERIAL SPECIFICATION		 ऑयल इंडिया लिमिटेड Oil India Limited  KAVIN™	DOC. No. : 17039-EK-M-SP-2002
PROJECT CREATION OF SURFACE PRODUCTION FACILITY GGs AT EAST KHAGORIJAN			REV. B
VALVE MATERIAL SPECIFICATION			
Service	Produced Water (PW), Process Two Phase (PT), Process Hydrocarbon Vapor (PV), Process Hydrocarbon Liquid (PL).		
Piping Class	FC01 2500# RTJ (or) HUB ENDS, 3 mm Corrosion Allowance		
TAG NO.	SIZE	DESCRIPTION	
DOUBLE BLOCK AND BLEED			
DBFC01J	1/2" - 12"	Design code : EEMUA 182, ASME 2500 # RTJ, Flanged on both sides, Isolation: Ball valve type (Full bore), Vent: Needle valve type, A216 WCB / A105 Body , A182 F316 Trims, PEEK seats , Fire Test as per API 6FA , End to End standard as per Manufacturers Standard , Expanded graphite not less than 98% purity as per stuffing box, Lip seal and fire seal for stem sealing , Valves 2" and above shall be trunnion mounted type , 130 °C @ 388.17 kg/cm ² g.	
DBFC01C	1/2" - 12"	Design code : EEMUA 182, ASME 2500 # RTJ, Flanged x 1/2" NPTF, Isolation: Ball valve type (Full bore), Vent: Needle valve type, A216 WCB / A105 Body , A182 F316 Trims, PEEK seats , Fire Test as per API 6FA , End to End standard as per Manufacturers Standard , Expanded graphite not less than 98% purity as per stuffing box, Lip seal and fire seal for stem sealing , Valves 2" and above shall be trunnion mounted type , 130 °C @ 388.17 kg/cm ² g.	
NEEDLE VALVE			
NVFC01J	1/2" - 1 1/2"	ASME 2500# RTJ, A105 Body & Bonnet, A182 F316 trims, Graphite gland packing, End To End dimension as per manufacturer standard, 130 °C @ 388.17 kg/cm ² g.	

TITLE VALVE MATERIAL SPECIFICATION		 	DOC. No. : 17039-EK-M-SP-2002
PROJECT CREATION OF SURFACE PRODUCTION FACILITY GGs AT EAST KHAGORIJA			REV. B
VALVE MATERIAL SPECIFICATION			
Service	Potable water (WD), Nitrogen gas (GN), Demulsifier (CE), Oil Scale Inhibitor (CO), Corrosion Inhibitor (CK), Wax Inhibitor (CV), Flow Improver (CF), Process HC Liquid (PL),		
	Process Hydrocarbon Vapor (PV), Deoiler (CD), Water Scale Inhibitor (CS).		
Piping Class	FS20		
	2500#, RTJ (or) HUB ENDS, 0 mm Corrosion Allowance		
TAG NO.	SIZE (inch)	DESCRIPTION	
BALL VALVE			
BFFS20J	1/2" - 1 1/2"	Design code : API 6D, ASME 2500# RTJ , Split Body , A182 F316 Body , A182 F316 Ball and Stem, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Floating Ball , Fire test as per API 6FA, End to End standard as per ASME B16.10 , 80 °C @ 378.63 kg/cm ² g	
BFFS20J	2" - 12"	Design code : API 6D, ASME 2500# RTJ, Split Body, ASTM A351 CF8M Body, A182 F316 Ball and Stem, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Trunion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B16.10 , 80 °C @ 378.63 kg/cm ² g	
BFFS20H	14" - 24"	Design code : API 6D, Hub ends, Split Body, ASTM A351 CF8M Body, A182 F316 Ball and Stem, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Full Bore , Trunion Mounted Ball , Fire test as per API 6FA , End to End standard as per Manufacturers standard , 80 °C @ 378.63 kg/cm ² g	
BRFS20J	2" - 12"	Design code : API 6D, ASME 2500# RTJ, Split Body, ASTM A351 CF8M Body, A182 F316 Ball and Stem, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Reduced Bore , Trunion Mounted Ball , Fire test as per API 6FA , End to End standard as per ASME B16.10 , 80 °C @ 378.63 kg/cm ² g	
BRFS20H	14" - 24"	Design code : API 6D, Hub ends, Split Body, ASTM A351 CF8M Body, A182 F316 Ball and Stem, Expanded Graphite not less than 98% Purity as Fire seal , PEEK seats, Reduced Bore , Trunion Mounted Ball , Fire test as per API 6FA , End to End standard as per Manufacturers standard , 80 °C @ 378.63 kg/cm ² g	
GLOBE VALVE			
GVFS20J	1/2" - 1 1/2"	Design code : ASME B16.34, ASME 2500 # RTJ, Straight Pattern , Pressure seal bonnet, A182 F316 Body , Rising Stem , Outside Screw and Yoke , A182 F316 Stem, Seats and disc , Swivelling Plug as Disc, Expanded Graphite not less than 98% Purity as Stem Packing , Stellite hard faced seat-disc sealing surface, End to End standard as per ASME B 16.10 , Packed Gland for stem sealing , 80 °C @ 378.63 kg/cm ² g.	
GVFS20J	2" - 12"	Design code : BS 1873, ASME 2500 # RTJ, Straight Pattern , Pressure seal bonnet, ASTM A351 CF8M Body , Rising Stem and disc , Outside Screw and Yoke , A182 F316 Stem, Seats and disc , Swivelling Plug as Disc , Expanded Graphite not less than 98% Purity as Stem Packing , Stellite hard faced seat-disc sealing surface, End to End standard as per ASME B 16.10 , Packed Gland for stem sealing , 80 °C @ 378.63 kg/cm ² g.	
CHECK VALVE			
CDFS20J	2" - 12"	Design code : API 594, ASME 2500 # RTJ (Solid lug), Dual plate (Lugged) Body with hinge and stop pin , Integral seat, ASTM A351 CF8M / A182 F316 Body , Metal to Metal Seating, A182 F 316 Plates, X-750 Spring, Stellite hard faced seat-plate sealing surface, End To End Standard as per API 594 , 80 °C @ 378.63 kg/cm ² g.	
CSFS20J	2" - 12"	Design code : API 594, ASME 2500 # RTJ, Swing check, Pressure seal cover, Replaceable seats, ASTM A351 CF8M / A182 F316 Body , Metal to Metal Seating , A182 F 316 Disc and hinge , A182 F316 seats, Stellite hard faced seat-disc sealing surface, End To End Standard as per API 594 , 80 °C @ 378.63 kg/cm ² g.	

TITLE VALVE MATERIAL SPECIFICATION		 ऑयल इंडिया लिमिटेड Oil India Limited  KAVIN™	DOC. No. : 17039-EK-M-SP-2002
PROJECT CREATION OF SURFACE PRODUCTION FACILITY GGs AT EAST KHAGORIJAN			REV. B
VALVE MATERIAL SPECIFICATION			
Service	Potable water (WD), Nitrogen gas (GN), Demulsifier (CE), Oil Scale Inhibitor (CO), Corrosion Inhibitor (CK), Wax Inhibitor (CV), Flow Improver (CF), Process HC Liquid (PL),		
	Process Hydrocarbon Vapor (PV), Deoiler (CD), Water Scale Inhibitor (CS).		
Piping Class	FS20		
	2500#, RTJ (or) HUB ENDS, 0 mm Corrosion Allowance		
TAG NO.	SIZE (inch)	DESCRIPTION	
DOUBLE BLOCK AND BLEED			
DBFS20J	1/2" - 12"	Design code : EEMUA 182, ASME 2500 # RTJ, Flanged on both sides, Isolation: Ball valve type (Full bore), Vent: Needle valve type, ASTM A351 CF8M / A182 F316 Body , A182 F316 Trims, PEEK seats , Fire Test as per API 6FA , End to End standard as per Manufacturers Standard , Expanded graphite not less than 98% purity as per stuffing box, Lip seal and fire seal for stem sealing , Valves 2" and above shall be trunnion mounted type , 80 °C @ 378.63 kg/cm ² g.	
DBFS20C	1/2" - 12"	Design code : EEMUA 182, ASME 2500 # RTJ, Flanged x 1/2" NPTF, Isolation: Ball valve type (Full bore), Vent: Needle valve type, ASTM A351 CF8M / A182 F316 Body , A182 F316 Trims, PEEK seats , Fire Test as per API 6FA , End to End standard as per Manufacturers Standard , Expanded graphite not less than 98% purity as per stuffing box, Lip seal and fire seal for stem sealing , Valves 2" and above shall be trunnion mounted type , 80 °C @ 378.63 kg/cm ² g.	

TITLE VALVE MATERIAL SPECIFICATION		 ऑयल इंडिया लिमिटेड Oil India Limited  KAVINTM		DOC. No. : 17039-EK-M-SP-2002
PROJECT CREATION OF SURFACE PRODUCTION FACILITY GGS AT EAST KHAGORIJAN				REV. B
VALVE MATERIAL SPECIFICATION				
Service	Demulsifier (CE), Oil Scale Inhibitor (CO), Corrosion Inhibitor (CK), Wax Inhibitor (CV), Flow Improver (CF), Process HC Liquid (PL), Process Hydrocarbon Vapor (PV),			
	Deoiler (CD), Water Scale Inhibitor (CS).			
Piping Class	GT20			
	3000 PSI, 0 mm Corrosion Allowance			
TAG NO.		SIZE	DESCRIPTION	
BALL VALVE				
BFGT20S		1/4" - 1"	Full bore, ASTM A182 F316 swagelok valves. Elastomers seals shall be Elast-O-Lion 101 or approved equal.	
CHECK VALVE				
CLGT20S		1/4" - 1"	Piston check, ASTM A182 F316 Swagelok valves.	
NEEDLE VALVE				
NVGT20S		1/4" - 1"	ASTM A182 F316 Swagelok Valves.	
GLOBE VALVE				
GVGT20S		1/4" - 1"	ASTM A182 F316 Swagelok valves. Elastomers seals shall be Elast-O-Lion 101 or approved equal.	

CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN

Document Title : PIPE STRESS PHILOSOPHY

Kavin Document No. : 17039-EK-M-SP-2003

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OIL INDIA LIMITED

EPCM CONSULTANT:

**KAVIN ENGINEERING AND SERVICES
PRIVATE LIMITED**

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	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJA	Doc No : 17039-EK-M-SP-2003 Rev : B
	PIPE STRESS PHILOSOPHY	Page : 4 of 33

TABLE OF CONTENTS

1	INTRODUCTION	6
	1.1 PURPOSE.....	6
	1.2 ENVIRONMENTAL DATA.....	6
2	DEFINITIONS	6
3	DESIGN LIFE.....	6
4	REFERENCE DOCUMENT	7
	4.1 Codes and standards.....	7
	4.2 Reference Project Documents and Specifications	8
5	ABBREVIATION.....	9
6	GENERAL.....	9
	6.1 Methodology	10
	6.1.1 Classification of lines	10
	6.2 Methods of Analysis	11
	6.2.1 Category 1 Lines – Exempted from Analysis.....	11
	6.2.2 Category 2 Lines – Comprehensive Analysis	12
	6.3 Critical Lines	12
7	DESIGN PARAMETERS AND ASSUMPTION.....	12
	7.1 Temperature.....	12
	7.2 Pressure	12
	7.3 Wind loads	12
	7.4 Fatigue.....	13
	7.5 Seismic load.....	13
	7.6 Corrosion	13
	7.7 Weight of pipe	13
	7.8 Friction	13
	7.9 Slug load	13
	7.10 Other loads.....	13
	7.11 Differential settlement	14
	7.12 Equipment Modelling.....	14
	7.13 Support Lift off case	14
	7.14 Co-ordinate system	14
	7.15 Unit system.....	14
	7.16 Expansion joints	15
	7.17 PSV Reaction force	15
	7.18 Load case.....	15
8	ACCEPTANCE CRITERIA.....	15
	8.1 Piping stresses	15
	8.2 Piping load	16
	8.2.1 Tie in loads	16
	8.2.2 Equipment nozzle load	16
	8.2.3 Support load.....	16
	8.3 Flange leakage	16
	8.4 Local stresses	16
	8.5 Piping deformation	16
	8.5.1 Sustained loads.....	16
	8.5.2 Piping natural frequency	17
	8.6 Verification of design deliverables	17
9	PRESENTATION OF RESULTS	17

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	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJA PIPE STRESS PHILOSOPHY	Doc No : 17039-EK-M-SP-2003 Rev : B
		Page : 5 of 33

1.	CRITICAL LINE SELECTION CRITERIA.....	20
1.1	Table A1 : Critical line selection criteria.....	20
1.	LOAD CASES.....	22
1.1	Onsite Condition	22
1.2	Transit condition	24
1.	GENERAL REQUIREMENTS	27
2.	ALLOWABLE NOZZLE LOADS FOR PRESSURE VESSEL AND SHELL & TUBE HEAT EXCHANGERS	27
3.	API 610 PUMPS.....	32
4.	API 650 TANK	32
5.	API 674 PUMP	32
6.	API 676 PUMP	32
7.	API 618 COMPRESSOR.....	33
8.	HEATERS (API 560)	33

APPENDIX

APPENDIX 1	CRITICAL LINES SELECTION CRITERIA
APPENDIX 2	LOAD CASE
APPENDIX 3	ALLOWABLE NOZZLE LOADS

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJA PIPE STRESS PHILOSOPHY	Doc No : 17039-EK-M-SP-2003 Rev : B Page : 6 of 33
		

1 INTRODUCTION

This specification provides the general guidelines regarding the basic requirements for the design and review of piping stress analysis and flexibility calculation.

This Specification has been issued based upon the relevant Project Specifications requirements, in accordance with the applicable international Codes and Standards.

1.1 PURPOSE

In general, the purpose of pipe stress analysis can be summarized into two broad categories:

- a) Ensure structural integrity, which involves the calculation of stresses in the pipe due to all design loads and to keep the stress within the code allowable limits;
- b) Maintain system operability, limiting the stresses and the loads in the equipment nozzles, checking the flange leakage, selecting and locating the suitable restraints, verifying the loads and the supports types.

1.2 ENVIRONMENTAL DATA

All Mechanical equipment will be suitable for the overall climatic conditions, the position within the installation and the local environment, with particular attention to site ambient conditions. The conditions will include exposure to sunlight, monsoon rainfall, temperature, humidity, wind, fungal growth, vibration and shock, EMI and RFI. All equipment will also be able to withstand these conditions during shipment, storage and installation prior to commissioning. Refer to “17039-EK-P-GD-1002, Site Conditions and available utilities” for details.

2 DEFINITIONS

In this specification, the following terms and the respective definitions are used

Company / Owner	- Oil India Limited (OIL)
EPCM	- Kavin Engineering and Services Private Limited
MPC Contractor	- Package Contractor / Supplier / Vendor

The words “will”, “may”, “should” and “shall” have specific meanings as follows:-

- “Will” is used normally in connection with an action by the purchaser rather than by the supplier.
- “May” is used where alternatives are equally acceptable.
- “Should” is used where a provision is preferred.
- “Shall” is used where a provision is mandatory.

3 DESIGN LIFE

The minimum design life of the facilities is 20 years.

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJA PIPE STRESS PHILOSOPHY	Doc No : 17039-EK-M-SP-2003 Rev : B Page : 7 of 33
		

4 REFERENCE DOCUMENT

4.1 Codes and standards

The following standards include provisions, which through reference in this text, constitute provisions of this standard. Latest issue of the references shall be used unless otherwise agreed. Other recognized standards may be used provided it can be shown that they meet or exceed the requirements of this standard.

Codes / Standards	Description
ASME B31.3	Process piping
ASME B16.5	Steel Pipe Flanges And Flanged Fittings
ASME B16.9	Factory-Made Wrought Steel Butt welding Fittings
ASME B16.47	Large Diameter Steel Flanges – size above 24”
ASME B16.20	Metallic gaskets for pipe flanges : Ring joint, spiral wound and jacketed.
ASME B16.21	Nonmetallic flat gaskets for pipe flanges
ASME Section-VIII	ASME Boiler and Pressure Vessel Code – Rules for Construction of Pressure Vessels
WRC Bulletin 107	Local Stresses in Spherical and Cylindrical Shell Due to External Loadings
WRC Bulletin 297	Local Stresses in Cylindrical Shell Due to External Loadings On Nozzles – Supplement to WRC Bulletin 107 (Revision I)
API 610	Centrifugal Pumps for Petroleum, Petrochemical and Natural gas industries
API 650	Welded Tanks for Oil Storage
API 618	Reciprocating Compressors for Petroleum, chemical and gas industry services
API 674	Positive Displacement Pumps – Reciprocating
API 675	Positive Displacement pumps – Controlled Volume
API 676	Positive Displacement Pumps – Rotary
IS 875	Code of practice for design loads

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	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJA PIPE STRESS PHILOSOPHY	Doc No : 17039-EK-M-SP-2003 Rev : B Page : 8 of 33
		

IS 1893	Criteria for earthquake resistant design of structures
API RP 520	Recommended Practice For Sizing, Selection And Installation Of Pressure – Relieving Devices In Refineries
OISD	Oil Industry Safety Directorate
MOEF	Ministry of Environment and Forest
PESO	Petroleum and Explosives safety organisation
ASME Sec II	Materials and Specifications
ASME Sec IX	Welding and Brazing Qualifications
TEMA	Tubular Exchanger Manufacturers Association.
OMR 2017	Oil Mines Regulations
ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
BS	British Standard
IS	Indian Standard
ISO	International Organization for Standardization

4.2 Reference Project Documents and Specifications

Document No.	Description
17039-EK-M-DB-2001	Mechanical Design Basis
17039-EK-M-SP-2001	Piping Material Specification
17039-EK-M-SP-2002	Valve Material Specification

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	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJA PIPE STRESS PHILOSOPHY	Doc No : 17039-EK-M-SP-2003 Rev : B Page : 9 of 33
		

Document No.	Description
17039-EK-M-SP-2006	Specification for Insulation
17039-EK-M-SP-2004	Specification for Packaged Equipment
17039-EK-M-SP-2007	Specification for unfired pressure vessel
17039-EK-M- SP-2008	Specification for Shell & tube Heat Exchanger
17039-EK-M- SP-2009	Specification for API 610 Centrifugal Pump
17039-EK-M- SP-2010	Specification for Gas Compression Package
17039-EK-M- SP-2011	Specification for Gas Engine Driven Power Generation System
17039-EK-L-DB-4001	Piping Design Basis
17039-EK-S-DB-5001	Civil / Structural Design Basis
17039-EK-P-DB-1001	Process Design basis
17039-EK-P-GD-1002	Site conditions and available utilities

5 ABBREVIATION

BDV	Blow Down Valve
PTFE	Poly Tetra Fluoro Ethylene
ID	Inside Diameter
NPS	Nominal Pipe Size
OD	Outside Diameter
P&ID	Piping and Instrumentation Diagram
AFC	Approved For Construction
EPCM	Engineering, Procurement and Construction Management
MPC	Modular Package Construction
CS	Carbon Steel
SS	Stainless Steel
DSS	Duplex Stainless Steel

6 GENERAL

All piping systems will be evaluated and analysed when required for adequate flexibility and stress level in accordance with the applicable codes and standards referenced herein, and with the present stress analysis criteria.

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN PIPE STRESS PHILOSOPHY	Doc No : 17039-EK-M-SP-2003 Rev : B Page : 10 of 33
		

The criteria are intended to establish the range of piping to be analyzed and the equipment loadings required. It outlines the responsibilities of the pipe stress engineer and the list of documentations to be prepared for the project.

Pipe stress analysis shall be carried out in accordance with the requirements of the codes, standards and specifications defined in section 4 and shall take into consideration of the following:

- Weight of pipe, which includes bare pipe, service fluid, valves, flanges, jacketing etc.
- Pressure effects
- Thermal expansion or contraction of piping
- Effect of support and anchor
- Friction effects
- Occasional loads (e.g. wind, relief valve reaction forces, etc)
- Seismic loadings
- Weight of online equipments
- Weight of instrument
- Weight of insulation

The main objectives of pipe stress analysis are to:

- Confirm that system stresses are within those allowed by ASME B31.3 (as applicable).
- Confirm that the forces and moments acting at tie-in are within the specified allowable limits.
- Identify the appropriate type and locations of pipe support, size of spring hangers and other special pipe support items as required.
- Provide design loads for sizing of pipe supports and restraints to structural.
- Evaluate and confirm that there will be no leakage at flange joints.
- Determine piping displacement for interference/clash checks.
- Confirm that force and moments acting at equipment nozzles are within the allowable limit (as specified in Appendix-3 / Equipment GA)

All skid mounted package piping end connections shall be self-supported with no load/moments passed on to off-skid piping. In cases where this is not achievable by skid vendor, this shall be discussed between skid vendor and off-skid piping contractor to mutually agree. The off-skid piping is to be re-stress-analyzed by fabrication contractor.

6.1 Methodology

6.1.1 Classification of lines

The following critical features are reviewed for the classification of the piping system.

- Pipe material
- Service

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJA PIPE STRESS PHILOSOPHY	Doc No : 17039-EK-M-SP-2003 Rev : B Page : 11 of 33
		

- Equipment connections
- Design and differential temperature
- Design pressure
- Pipe diameter
- Displacement
- External loads
- Occasional loads

In general, formal computer analysis shall be performed for critical lines. However, after having reviewed a particular piping layout, the Piping Stress Engineer may apply engineering judgment and past experience to qualify a piping system by simple calculations using nomograph charts or by visual inspection method. A stress calculation needs not to be performed on the piping systems that meet one of the following requirements:

- Piping systems which are duplicates, or replaces without significant changes of successfully operating system.
- Piping systems which can be readily judged adequate by comparison with previously analyzed systems.

The main basis for categorizing lines is based on critical line selection criteria attached in Appendix-1. As per critical line list, the comprehensive analysis (Computer calculation using CAESAR – II Ver.8.0 or higher) for particular mentioned piping system shall be carried out.

The classification of lines involves a degree of judgement of the stress criteria to ensure that other factors such as geometry and critical service are considered. The project line list prepared for the project will be utilized for preparing the critical line list. This document is updated throughout the design period.

6.2 Methods of Analysis

The two methods of pipe flexibility assessment are described below;

6.2.1 Category 1 Lines – Exempted from Analysis

All lines under this category are first reviewed for material properties and services to ensure that they are non-critical lines.

The lines that fall within this category are generally as follows;

- Non-hydrocarbon lines such as air and utility water <20” with exception of GRE pipe.
- All lines which discharge to atmosphere.
- All piping connected to open drains.
- All piping connected to closed drains.

Lines that have similar configuration or mirror image to those that have been analyzed and satisfy the pipe flexibility for the same project are also exempted from analysis. The methodology of evaluation will select the most stringent output result to ensure that the deflection / movement and other related stresses are considered in the design of the piping system. The modelling procedure shall consist of the following lines;

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	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJA PIPE STRESS PHILOSOPHY	Doc No : 17039-EK-M-SP-2003 Rev : B Page : 12 of 33
		

- Shortest pipe routing
- Average pipe routing
- Longest pipe routing

With the above criteria, output results can be evaluated and the most conservative result will be used for the piping design.

Review under this category does not require any specific documentation; however the review shall be undertaken by an experienced stress engineer. Particular attention shall be paid to small bore lines that tie in to headers, which may be subjected to large displacement to ensure that they have adequate flexibility.

6.2.2 Category 2 Lines – Comprehensive Analysis

All lines under this category shall be computerized analysis. Piping geometry will be modelled based on the latest piping isometrics. Where possible, the complete piping system shall be modelled to ensure that all interactions have been taken into account. In case the pipe isometrics change after the stress analysis, then the system will be re-analyzed.

6.3 Critical Lines

The criteria for selecting the lines for analysis are defined in Appendix-1. Reclassification of certain lines to a lower category of required analysis from that specified in Appendix-1 is permissible, provided that:

- The stress engineer has to review the lines and has to demonstrate that the code requirements will be met using the reduced level of analysis.
- Approval for this reclassification is secured by the EPCM.

7 DESIGN PARAMETERS AND ASSUMPTION

The following design parameters and assumptions shall be used as a basis for the pipe stress analysis for this project.

7.1 Temperature

The maximum and minimum design temperatures specified in the project line list shall be used for stress analysis in conjunction with the worst case ambient temperature for piping code compliance for all systems. These temperatures shall take due account of any upset condition.

7.2 Pressure

All systems shall be analyzed using the system design pressure and hydro test pressure from the project line list.

7.3 Wind loads

All piping shall be designed to withstand the forces of wind pressure, assumed in any horizontal direction with no allowance for the effect of shielding by other adjacent structures, in accordance with the appropriate provisions of IS: 875 (Part 3) : 1987.

Wind shape factor shall be 0.7

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN PIPE STRESS PHILOSOPHY	Doc No : 17039-EK-M-SP-2003 Rev : B Page : 13 of 33
		

7.4 Fatigue

The fatigue analysis will be done, if the number of cycles is more than 7000 for the minimum design life.

7.5 Seismic load

All critical piping, and its support shall be designed to resist the effects of earthquake in accordance with IS 1893 (Part-1), IS 1893 (Part-4) and IS 13920.

The Seismic zone factor (Z) shall be considered based on the seismic zone specified in “site condition and available utilities”. The seismic acceleration shall be given in terms of gravitational constant(g’s). “g” value calculation shall be performed and submitted for EPCM approval.

7.6 Corrosion

Corrosion allowance shall be based on the “Piping material specification, (Doc. No. 17039-EK-M-SP-2001)”.

7.7 Weight of pipe

In addition to the weight of major piping components, the following items shall be included:

- Bare pipes, service fluid, valves, flanges, Jacketing etc.
- Insulation thickness shall be as per the line list and densities shall be in accordance with project specifications.
- Weight of contents shall be included and shall be as per the line list. All future operational scenarios should be considered.
- Weight of miscellaneous components, e.g., instrumentation valves, etc., shall be considered based on vendor document.

7.8 Friction

The following coefficient of friction shall be used:

- Carbon steel to Carbon Steel = 0.3
- Stainless Steel to PTFE = 0.1
- Stainless steel to Stainless steel = 0.2

7.9 Slug load

Lines shall be adequately supported for slug / two-phase flow to avoid vibrations. Slug reaction forces at elbow shall be calculated and incorporated into the stress analysis of the system. Pipe stress engineer should consult with process engineer and identify the slug (or) two phase line and perform the stress analysis. Lines which have two phase service shall be accounted in the critical line list.

7.10 Other loads

The design of piping system will take into account the different conditions expected during operation, steam out / dry out, start-up, shut down, cold branch in the case of spare pump, pressure surge / water hammer.

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJA PIPE STRESS PHILOSOPHY	Doc No : 17039-EK-M-SP-2003 Rev : B Page : 14 of 33
		

7.11 Differential settlement

Differential settlement between two foundations shall be considered in the pipe stress calculations. When large, long-term settlement is expected for equipment vessels, tanks, module, etc. the flexibility of the connecting piping and support scheme shall be carefully considered to minimize stresses and loads in the system.

7.12 Equipment Modelling

As a general approach, equipment shall be included within the piping stress models as pipe weightless rigid elements. The same shall be suitably fixed by full anchor and/or individual rigid restraints by considering the equipment support. Equipment thermal expansion shall be considered by imposing design temperatures to the corresponding pipe weightless rigid elements.

7.13 Support Lift off case

Pipe supports lifting off during operation shall be checked. When piping lifts off a support due to thermal movements, either that support shall be removed for sustained stress calculation or spring supports shall be considered.

The use of spring supports will be reduced as far as possible. Where springs are used, they are to be designed for normal operating conditions.

7.14 Co-ordinate system

The following coordinate systems shall be used in pipe stress calculations.

Plant East Direction +X
 Vertical (UP) +Z
 Plant North direction +Y

7.15 Unit system

Dimension	Units	Symbol
Piping nominal diameter	Millimeter	mm
Piping thickness	Millimeter	mm
Density	Kilogram per cubic metre	kg/m ³
Insulation thickness	MilliMeter	mm
Flowrate (Liquid)	Kilo Litres Per Day	KLPD
Flowrate (gas)	Million Metric Standard Cubic Metre per day / Million Metric Standard Cubic feet per day	MMSCMD/MMSCFD
Equipment dimensions size	Millimeter	mm
Forces	newton	N

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJA PIPE STRESS PHILOSOPHY	Doc No : 17039-EK-M-SP-2003 Rev : B Page : 15 of 33
		

Dimension	Units	Symbol
Moments	Newton-meter	Nm
Stress	Kilopascal	KPa
Length	Millimeter	mm
Momentum	Kilogram per metre square second	kg/ms ²
Pressure	Kilogram per square centimetre	kg/cm ²
Specific Heat Capacity	Kilojoule per kilogram Celsius	kJ/kg °C
Thermal Conductivity	Watt per metre kelvin	W/ m K
Temperature	Celsius	° C
Velocity	Metre per second	m/s
Viscosity	Centipoise	cP
Volume	Cubic Metre	m ³

7.16 Expansion joints

Expansion joints will be used in agreement with EPCM when space or pressure drop limitation does not permit pipe bends. Expansion joints must be equipped with adequate tie rods or restraints to permit testing of the piping system without removal or blanking of the joint. The axial joint will be avoided. The use of expansion joint will be avoided as far as possible.

Bellow expansion joint will not be installed in piping systems that are subject to water hammer, slug flow or pressure surges. The installation arrangement of expansion joint will be subject to EPCM approval and will be reviewed by the joint manufacturer. This approval and review will consider service conditions, anchors, guides, supports, piping configurations and all necessary calculations.

7.17 PSV Reaction force

Reaction forces at relief valves shall be considered in the analysis and piping shall be adequately restrained for relief valve reaction forces.

7.18 Load case

The design case for onsite condition shall be as per Appendix-2.

8 ACCEPTANCE CRITERIA

8.1 Piping stresses

Piping systems stresses shall satisfy the requirements of the applicable code B31.3.

Selection of design and analysing code shall be as per project piping material specification based on the selected piping class.

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJA PIPE STRESS PHILOSOPHY	Doc No : 17039-EK-M-SP-2003 Rev : B Page : 16 of 33
		

8.2 Piping load

8.2.1 Tie in loads

Interface tie-in between two parties, a fixed point is to be provided (fixed point = Piping support with all direction blocked, free rotations). Location and position of the fixed point is to be defined and agreed between two parties and specified in an interface document (drawing or specification). If fixed point cannot be installed and must be moved to the scope of other party mutual agreement shall be made.

Owner of the fixed point shall consider the tie-in loads for designing the support structures. In absence of information (tie-in load), loads will be considered as two times of static equipment flange loads (as per appendix-3, Sec. 2 of this document). The other party shall verify the risk of flange leakage ensuring that load acting on the tie-in flange assembly is less than allowable load. For tie-in flange size 24" and larger, calculated loads from one party must be necessarily sent to the other party as input data to avoid the over design of the supporting structure.

8.2.2 Equipment nozzle load

Nozzle load shall be checked after the equipment modelling as per Clause 7.12 in CAESAR II and kept less than the allowable limit (as specified in appendix-3). If actual nozzle loads exceeds the allowable limit, and not possible to restrict, then the equipment manufacturers approval shall be submitted along with the pipe stress analysis report.

Maximum operating temperature shall be used to check the nozzle load for rotating equipments (Pumps, Compressors, etc.).

8.2.3 Support load

Foundation and structures should be carefully designed by considering the worst case pipe support loads. Pipe stress engineer shall provide the support loads to structural / civil engineer for foundation / structure design. Design temperature shall be used to check the support loads.

8.3 Flange leakage

Flange leakage shall be performed for 600# and above.

The leakage in the flange joints shall be checked in Caesar II using Pressure Equivalent Method. If failure, then flange rigidity method per ASME Sec.VIII Div-1 shall be used for qualifying the leakage check. If both case (as specified above) fail, then the flange rating shall be increased. Design temperature shall be used to check the flange leakage.

8.4 Local stresses

Local Stresses in the pipe wall shall be checked at the location of welded Appendices (e.g. trunnions and welding lugs) and where thin wall, large diameter piping is resting directly on support steel. Normally the check shall be carried out according to the Kellogg line load method.

8.5 Piping deformation

8.5.1 Sustained loads

Under sustained load in design condition (W+P1+H) vertical deformation of piping shall not be counter-slope. Supports must be arranged so that the deflection of the piping span is limited to 3mm and deflection near the storage tanks shall be limited to 6 mm.

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJA PIPE STRESS PHILOSOPHY	Doc No : 17039-EK-M-SP-2003 Rev : B Page : 17 of 33
		

8.5.2 Piping natural frequency

Piping natural frequency of all calculated lines shall not be less than 4HZ for the systems connected to rotating equipments and PSV.

8.6 Verification of design deliverables

As a final check, upon completion of all pipe stress analysis, piping stress modelling shall be reviewed against Approved for Construction (AFC) isometrics, pipe support location plans and pipe support details to ensure that the following requirements have been met.

- The pipe stress isometrics are dimensionally equivalent to the AFC piping isometric.
- Restraints and support locations are matching.
- Pipe supports details match the pipe stress analysis and items such as springs are specified as per stress analysis requirements.
- Structural loads have been accommodated by the structural framing design as reflected on the structural drawings. Structural review is required for pipe supports having higher loads.
- External loads over the allowable loads (if any) have been transmitted for an acceptance by adjacent skid supplier.

The preceding items shall be checked and signed off by the stress engineer, where significant variations exist the pipe stress analysis shall be repeated using revised data.

9 PRESENTATION OF RESULTS

A report shall be generated and submitted for EPCM approval with each piping system analyzed. Each report shall include the following which are applicable.

- 1) Introduction (Introduction shall include the assumptions made for the stress analysis).
- 2) Stress critical line list indicating/highlighting the respective system
- 3) Overall P&ID mark up of the system.
- 4) PMS used in the analysis.
- 5) Over all 3D snap of the system.
- 6) Fabrication isometric and supports marking with node numbers.
- 7) Load Case Description
- 8) Miscellaneous Data
- 9) CAESAR II input.
- 10) Extended Stress Summary.
- 11) Restraint Summary Extended.
- 12) Displacement report : (SUS) W+P1, (OPE) W+T1+P1, (OPE) W+T2+P1, (OPE) W+T3+P1
- 13) Flange leakage check report.
- 14) Nozzle allowable loads and confirmation sheet in case loads are exceeding allowable.
- 15) Vendor drawings, (Equipment, PSV, etc.,)
- 16) Trunnion load calculations.

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJA PIPE STRESS PHILOSOPHY	Doc No : 17039-EK-M-SP-2003 Rev : B Page : 18 of 33
		

17) Miscellaneous Calculations

18) Hanger table.

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN PIPE STRESS PHILOSOPHY	Doc No : 17039-EK-M-SP-2003 Rev : B Page : 19 of 33
		

APPENDIX 1 **CRITICAL LINES SELECTION CRITERIA**

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJA PIPE STRESS PHILOSOPHY	Doc No : 17039-EK-M-SP-2003 Rev : B Page : 20 of 33
		

1. CRITICAL LINE SELECTION CRITERIA

Critical line list shall be prepared by stress engineer based on the following criteria and get approval from EPCM.

1.1 Table A1 : Critical line selection criteria

Line description	Design Temperature range°C	Diameter range (DN)	Analysis category	Notes
Connections to Pressure Vessel, Shell & Tube Heat Exchangers, (process connections)	All	≤ 80	1	
	≥ 100	≥ 100	2	
Connections to Reciprocating and Rotating Equipment (Process Connections)	All	≤ 50	1	
	All	≥ 80	2	
Connection to heaters	All	≤ 50	1	
	All	≥ 80	2	
Differential settlement equipments	All	≤ 80	1	
	All	≥ 100	2	
Pressure Relief/Blow down/Vent Systems (Except for direct atmosphere discharge Vents)	All	≤ 50	1	
	All	≥ 80	2	
Low Temperature Service	-30 and below	≤ 80	1	
		≥ 100	2	
High Temperature Service (General Piping)	150 and above	≥ 100	2	
High pressure service (Class 900 and above)	All	≥ 100	2	
Large diameter lines	All	≥ 450	2	
Lines subject to large terminal displacements including bridge piping and wellhead piping (flow lines)	All	All	2	
Lines with expansion joints	All	All	2	
GRE Piping	All	All	2	
Branch connections at angles other than 90°	All	≥ 100	2	

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APPENDIX 2

LOAD CASE

 ऑयल इंडिया लिमिटेड Oil India Limited	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN PIPE STRESS PHILOSOPHY	Doc No : 17039-EK-M-SP-2003
		Rev : B Page : 22 of 33

1. LOAD CASES

The calculation load cases are summarized as mentioned in the table below:

The individual calculation load cases are:

WW	-	Water filled weight
WNC	-	Weight with no-contents
W	-	Weight with operating fluid
P1	-	Design Pressure
HP	-	Hydro test Pressure
T2	-	Operating Temperature
T1	-	Max. Design Temperature
T3	-	Min. Design Temperature / Min. Ambient Temperature
WIN 1	-	Wind in “ X “ directions
WIN 2	-	Wind in “ Y “ directions
U1	-	Seismic acceleration in “X“ direction (Onsite condition) /Transit acceleration in “X” direction (Transit condition).
U2	-	Seismic acceleration in “Y“ direction (Onsite condition) /Transit acceleration in “Y” direction(Transit condition).
U3	-	Transit Acceleration in “Z” direction (Transit condition)
F	-	External forces (Ex. PSV reaction force, slug force, surge force, etc.)
H	-	Spring Hanger
D1	-	Displacement due to soil settlement

Load case shown in this specification is for general guidelines only. If any specific requirement such as working / stand-by conditions, load cases shall be modified along these guidelines.

1.1 Onsite Condition

Load No.	Caesar Load case	Case Type	Comb.	Output	Description
L1	WW+HP	HYD	-	D / F / S	Hydro-Test
L2	W+P1	SUS	-	D / F / S	Sustain with design press.
L3	W+T1+P1	OPE	-	D/F	Max. Design Temp
L4	W+T2+P1	OPE	-	D/F	Operating Temp
L5	W+T3+P1	OPE	-	D/F	Min. Design Temperature / Min. Amb Temp
L6	W+T1+P1+WIN1	OPE	-	D/F	Design Temp, press. + WIN 1 (+X direction)
L7	W+T1+P1-WIN1	OPE	-	D/F	Design Temp, press. + WIN 1 (-X direction)
L8	W+T1+P1+WIN2	OPE	-	D/F	Design Temp, press. + WIN 1 (+Y direction)

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	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJA PIPE STRESS PHILOSOPHY	Doc No : 17039-EK-M-SP-2003 Rev : B Page : 23 of 33
		

Load No.	Caesar Load case	Case Type	Comb.	Output	Description
L9	W+T1+P1-WIN2	OPE	-	D/F	Design Temp, press. + WIN 1 (-Y direction)
L10	W+T1+P1+U1	OPE	-	D/F	Design Temp, press. + seismic 1 (+X direction)
L11	W+T1+P1-U1	OPE	-	D/F	Design Temp, press. + seismic 1 (-X direction)
L12	W+T1+P1+U2	OPE	-	D/F	Design Temp, press. + seismic 2 (+Y direction)
L13	W+T1+P1-U2	OPE	-	D/F	Design Temp, press. + seismic 2 (-Y direction)
L14	L6-L3	OCC	ALG	F/S	Occasional with WIND 1) (+X direction @ T1)
L15	L7-L3	OCC	ALG	F/S	Occasional with (WIND 1) (-X direction @ T1)
L16	L8-L3	OCC	ALG	F/S	Occasional with WIND 2) (+Y direction @ T1)
L17	L9-L3	OCC	ALG	F/S	Occasional with WIND 2) (-Y direction @ T1)
L18	L10-L3	OCC	ALG	F/S	Occasional with (Seismic 1) (+X direction @ T1)
L19	L11-L3	OCC	ALG	F/S	Occasional with (Seismic 1) (-X direction @ T1)
L20	L12-L3	OCC	ALG	F/S	Occasional with (Seismic 2) (+Y direction @ T1)
L21	L13-L3	OCC	ALG	F/S	Occasional with (Seismic 2) (-Y direction @ T1)
L22	L14+L2	OCC	Scalar	S	Wind 1 (+X direction) + Sustain
L23	L15+L2	OCC	Scalar	S	Wind 1 (-X direction) + Sustain
L24	L16+L2	OCC	Scalar	S	Wind 2 (+Y direction) + Sustain
L25	L17+L2	OCC	Scalar	S	Wind 2 (-Y direction) + Sustain
L26	L18+L2	OCC	Scalar	S	Seismic 1 (+X direction) + Sustain
L27	L19+L2	OCC	Scalar	S	Seismic 1 (-X direction) + Sustain
L28	L20+L2	OCC	Scalar	S	Seismic 2 (+Y direction) + Sustain
L29	L21+L2	OCC	Scalar	S	Seismic 2 (-Y direction) + Sustain

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	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJA PIPE STRESS PHILOSOPHY	Doc No : 17039-EK-M-SP-2003 Rev : B Page : 24 of 33
		

Load No.	Caesar Load case	Case Type	Comb.	Output	Description
L30	L3-L2	EXP	ALG	S	Thermal with Max. Design Case
L31	L4-L2	EXP	ALG	S	Thermal with Operating Case
L32	L5-L2	EXP	ALG	S	Thermal with Min.Design /Min.Amb case
L33	L30-L32	EXP	ALG	S	Full thermal stress range between Max.Design temperature and Min. Design / Min. Amb Temperature

NOTES :

- 1) Displacement “D1” shall be added in the loadcases L1 to L13 for the soil settlement stress systems.
- 2) Hanger “H” shall be added in the loadcases L1 to L13 when hanger support is used.

1.2 Transit condition

Load No.	Caesar Load case	Case Type	Comb.	Output	Description
L1	WNC	SUS	-	D/F/S	Weight No Content
L2	WNC+U1	SUS	-	D/F/S	Weight No Content with transport acceleration X Direction
L3	WNC+U2	SUS	-	D/F/S	Weight No Content with transport acceleration Y Direction
L4	WNC+U3	SUS	-	D/F/S	Weight No Content with transport acceleration Z Direction
L5	WNC+WIN1	SUS	-	D/F/S	Weight No Content with Wind in +X Direction
L6	WNC+WIN2	SUS	-	D/F/S	Weight No Content with Wind in -X Direction
L7	WNC+WIN3	SUS	-	D/F/S	Weight No Content with Wind in +Y Direction
L8	WNC+WIN4	SUS	-	D/F/S	Weight No Content with Wind in -Y Direction
L9	L2-L1	OCC	ALG	D/F/S	Transit acceleration X Direction

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	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN PIPE STRESS PHILOSOPHY	Doc No : 17039-EK-M-SP-2003 Rev : B Page : 25 of 33
		

Load No.	Caesar Load case	Case Type	Comb.	Output	Description
L10	L3-L1	OCC	ALG	D/F/S	Transit acceleration Y Direction
L11	L4-L1	OCC	ALG	D/F/S	Transit acceleration Z Direction
L12	L5-L1	OCC	ALG	D/F/S	Wind in +X direction
L13	L6-L1	OCC	ALG	D/F/S	Wind in -X direction
L14	L7-L1	OCC	ALG	D/F/S	Wind in +Y direction
L15	L8-L1	OCC	ALG	D/F/S	Wind in -Y direction
L16	L9+L10+L11	OCC	SRSS	S	Transit accelerations in all directions
L17	L1+L16	OCC	ABS	S	Sustained + Accelerations in all directions

NOTES :

- 1) Hanger “H” shall be added in the loadcases L1 to L13 when hanger support is used.

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APPENDIX 3

ALLOWABLE NOZZLE LOADS

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN PIPE STRESS PHILOSOPHY	Doc No : 17039-EK-M-SP-2003 Rev : B Page : 27 of 33
		

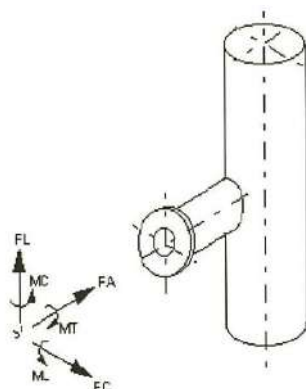
1. GENERAL REQUIREMENTS

Allowable forces and moments as stated in this specification are applicable to steel equipment at the connecting interface nozzle.

The allowable forces and moments on equipment nozzles at maximum design temperature shall comply with the table below. Whenever these loads are exceeded, then the equipment manufacturers approval shall be submitted along with the pipe stress analysis report.

2. ALLOWABLE NOZZLE LOADS FOR PRESSURE VESSEL AND SHELL & TUBE HEAT EXCHANGERS

Unless specified otherwise, the allowable moments and forces shall be estimated based on the formula:



FORCES	MOMENTS
$F_A = K_1 * 1250 * D$ in Newton	$M_T = K_2 * 125 * D^2$ in Newton-meter
$F_C = K_1 * 1300 * D$ in Newton	$M_L = K_2 * 100 * D^2$ in Newton-meter
$F_L = K_1 * 1300 * D$ in Newton	$M_C = K_2 * 100 * D^2$ in Newton-meter

Where “ D ” is nominal nozzle size in inch; and the value of “ K1 & K2 ” shall be as per table below.

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJA PIPE STRESS PHILOSOPHY	Doc No : 17039-EK-M-SP-2003 Rev : B Page : 28 of 33
		

FLANGE RATING	“ K “ Value Shall be taken based on Pipe Size					
	From 1.5” to 8” Pipe		From 10” to 12” Pipe		From 14” & above Pipe	
	“ K ₁ “	“ K ₂ “	“ K ₁ “	“ K ₂ “	“ K ₁ “	“ K ₂ “
150 #	1.00	1.00	1.00	1.00	1.00	1.00
300 #	1.10	1.10	1.25	1.25	1.25	1.25
600 #	1.25	1.25	1.50	1.50	1.50	1.50
900 #	1.50	1.50	2.00	2.00	2.00	2.00
1500 #	1.80	1.80	2.25	2.25	2.50	2.50
2500 #	2.00	2.00	2.50	2.50	3.50	3.00

Axis A	-	Nozzle centreline.
Axis L	-	Longitudinal Axis
Axis C	-	Circumferential Axis
FA, FL & FC	-	Component allowable forces.
MA, MC & ML	-	Component allowable moments (Nm)
FR and MR	-	Resultant force (N) and resultant moment (Nm)
Flange ratings	-	In accordance with ASME B16.5

The following gives the allowable nozzle loads for pressure vessels, columns, drums, flare stack, filters, strainers, shell & tube heat exchangers etc.,

Allowable nozzle loads							
Nozzle Size (inch)	Flange Rating	Forces (N)			Moments (Nm)		
		F _A	F _L & F _C	F _R	M _A	M _C & M _L	M _R
1.5 “	150 #	1875	1950	3335	281	225	425
	300 #	2063	2145	3668	309	248	467
	600 #	2344	2438	4169	352	281	531
	900 #	2813	2925	5002	422	338	638
	1500 #	3375	3510	6003	506	405	764
	2500 #	3750	3900	6670	563	450	850

	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJA PIPE STRESS PHILOSOPHY	Doc No : 17039-EK-M-SP-2003 Rev : B Page : 29 of 33
		

Allowable nozzle loads							
Nozzle Size (inch)	Flange Rating	Forces (N)			Moments (Nm)		
		F _A	F _L & F _C	F _R	M _A	M _C & M _L	M _R
2 "	150 #	2500	2600	4446	500	400	755
	300 #	2750	2860	4891	550	440	830
	600 #	3125	3250	5558	625	500	944
	900 #	3750	3900	6670	750	600	1132
	1500 #	4500	4680	8003	900	720	1359
	2500 #	5000	5200	8893	1000	800	1510
3 "	150 #	3750	3900	6670	1125	900	1699
	300 #	4125	4290	7336	1238	990	1869
	600 #	4688	4875	8337	1406	1125	2123
	900 #	5625	5850	10004	1688	1350	2548
	1500 #	6750	7020	12005	2025	1620	3058
	2500 #	7500	7800	13339	2250	1800	3397
4 "	150 #	5000	5200	8893	2000	1600	3020
	300 #	5500	5720	9782	2200	1760	3322
	600 #	6250	6500	11116	2500	2000	3775
	900 #	7500	7800	13339	3000	2400	4530
	1500 #	9000	9360	16007	3600	2880	5436
	2500 #	10000	10400	17785	4000	3200	6040
6 "	150 #	7500	7800	13339	4500	3600	6795
	300 #	8250	8580	14673	4950	3960	7474
	600 #	9375	9750	16674	5625	4500	8494

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Allowable nozzle loads							
Nozzle Size (inch)	Flange Rating	Forces (N)			Moments (Nm)		
		F _A	F _L & F _C	F _R	M _A	M _C & M _L	M _R
	900 #	11250	11700	20009	6750	5400	10192
	1500 #	13500	14040	24010	8100	6480	12231
	2500 #	15000	15600	26678	9000	7200	13590
8 "	150 #	10000	10400	17785	8000	6400	12080
	300 #	11000	11440	19564	8800	7040	13288
	600 #	12500	13000	22232	10000	8000	15100
	900 #	15000	15600	26678	12000	9600	18120
	1500 #	18000	18720	32014	14400	11520	21744
	2500 #	20000	20800	35571	16000	12800	24159
10 "	150 #	12500	13000	22232	12500	10000	18875
	300 #	15625	16250	27790	15625	12500	23593
	600 #	18750	19500	33348	18750	15000	28312
	900 #	25000	26000	44463	25000	20000	37749
	1500 #	28125	29250	50021	28125	22500	42468
	2500 #	31250	32500	55579	31250	25000	47186
12 "	150 #	15000	15600	26678	18000	14400	27179
	300 #	18750	19500	33348	22500	18000	33974
	600 #	22500	23400	40017	27000	21600	40769
	900 #	30000	31200	53356	36000	28800	54359
	1500 #	33750	35100	60026	40500	32400	61154
	2500 #	37500	39000	66695	45000	36000	67949

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Allowable nozzle loads							
Nozzle Size (inch)	Flange Rating	Forces (N)			Moments (Nm)		
		F _A	F _L & F _C	F _R	M _A	M _C & M _L	M _R
14"	150 #	17500	18200	31124	24500	19600	36994
	300 #	21875	22750	38906	30625	24500	46243
	600 #	26250	27300	46687	36750	29400	55491
	900 #	35000	36400	62249	49000	39200	73988
	1500 #	43750	45500	77811	61250	49000	92485
	2500 #	61250	63700	108935	73500	58800	110983
16"	150 #	20000	20800	35571	32000	25600	48319
	300 #	25000	26000	44463	40000	32000	60399
	600 #	30000	31200	53356	48000	38400	72478
	900 #	40000	41600	71142	64000	51200	96638
	1500 #	50000	52000	88927	80000	64000	120797
	2500 #	70000	72800	124498	96000	76800	144957
18"	150 #	22500	23400	40017	40500	32400	61154
	300 #	28125	29250	50021	50625	40500	76442
	600 #	33750	35100	60026	60750	48600	91730
	900 #	45000	46800	80034	81000	64800	122307
	1500 #	56250	58500	100043	101250	81000	152884
	2500 #	78750	81900	140060	121500	97200	183461
20"	150 #	25000	26000	44463	50000	40000	75498
	300 #	31250	32500	55579	62500	50000	94373

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Allowable nozzle loads							
Nozzle Size (inch)	Flange Rating	Forces (N)			Moments (Nm)		
		F _A	F _L & F _C	F _R	M _A	M _C & M _L	M _R
	600 #	37500	39000	66695	75000	60000	113247
	900 #	50000	52000	88927	100000	80000	150997
	1500 #	62500	65000	111159	125000	100000	188746
	2500 #	87500	91000	155622	150000	120000	226495
24"	150 #	30000	31200	53356	72000	57600	108718
	300 #	37500	39000	66695	90000	72000	135897
	600 #	45000	46800	80034	108000	86400	163076
	900 #	60000	62400	106712	144000	115200	217435
	1500 #	75000	78000	133390	180000	144000	271794
	2500 #	105000	109200	186747	216000	172800	326153

3. API 610 PUMPS

For centrifugal pumps, the allowable nozzle loads shall be two (2) times of API 610, for the suction and discharge nozzles. Nozzle alignment check should be performed and it shall be limited with the value specified by pump manufacturer.

4. API 650 TANK

Allowable forces and moments for storage tank shall meet the requirement specified in Appendix-P of API 650.

5. API 674 PUMP

For positive displacement reciprocating pumps, the piping loads shall be checked as per API 674 latest edition for the suction and discharge nozzles. Nozzle alignment check should be performed and it shall be limited with the value specified by pump manufacturer.

6. API 676 PUMP

For positive displacement rotary pumps, the piping loads shall be checked as per API 676 latest edition for the suction and discharge nozzles. Nozzle alignment check should be performed and it shall be limited with the value specified by pump manufacturer.

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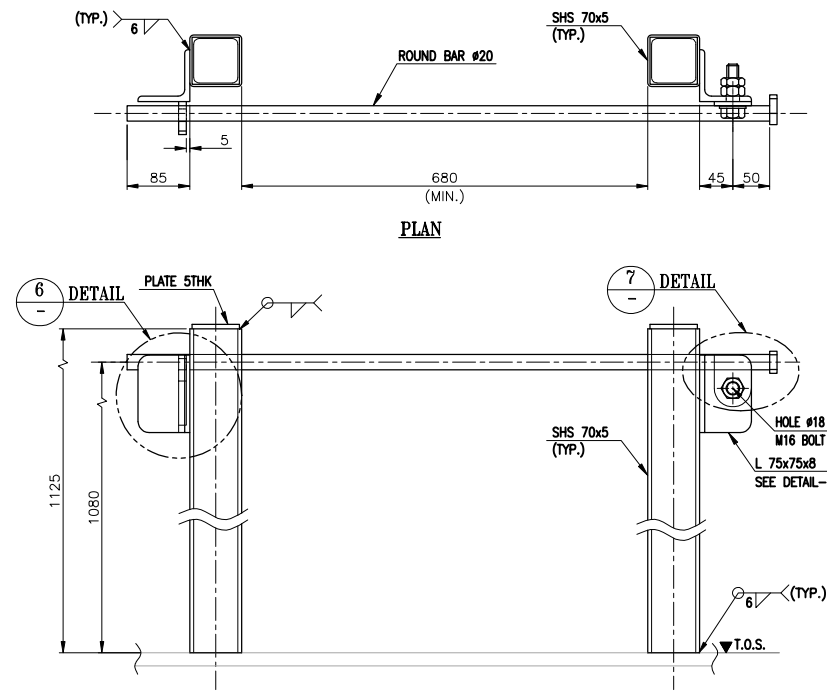
	CREATION OF SURFACE PRODUCTION FACILITIES (OCS & GGS) AT NADUA & EAST KHAGORIJAN PIPE STRESS PHILOSOPHY	Doc No : 17039-EK-M-SP-2003 Rev : B Page : 33 of 33
		

7. API 618 COMPRESSOR

For reciprocating compressors, the external piping loads and moments shall be checked as per vendor information. Nozzle alignment check should be performed and it shall be limited with the value specified by compressor manufacturer.

8. HEATERS (API 560)

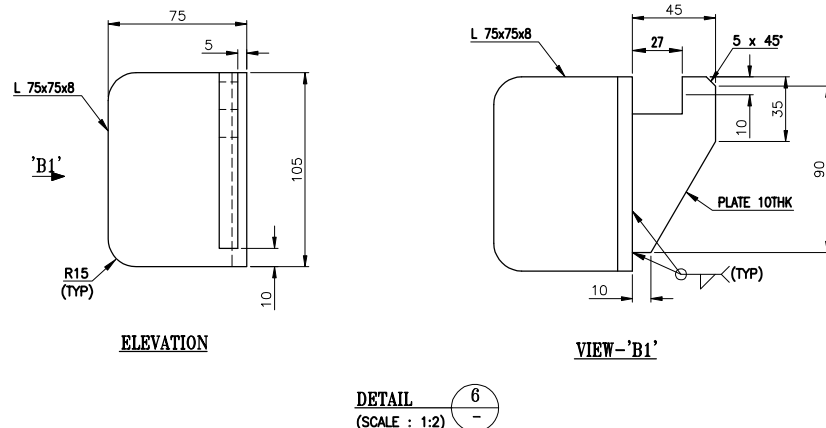
Minimum allowable loads for fired heater shall be 3 (three) times as per API 560 requirements. Allowable movements shall be as per API 560 requirements.



ELEVATION

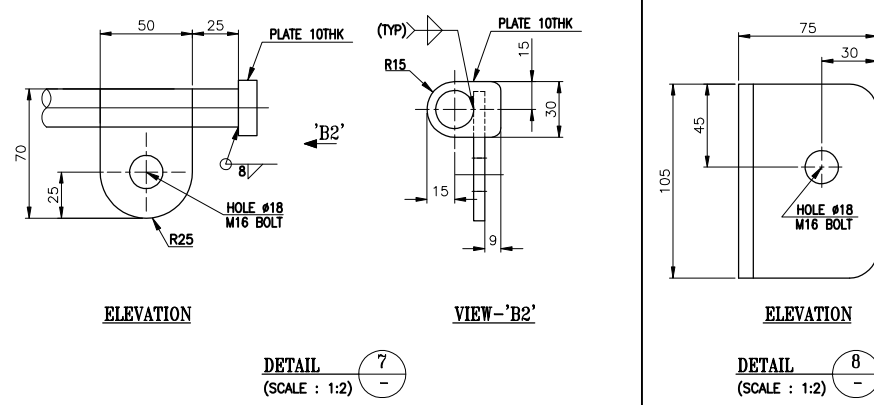
TYPICAL

SAFETY GATE DETAILS



ELEVATION SIDE VIEW

LADDER DETAILS-(FRONT ENTRY)
(FOR LADDER UPTO 2.5m HEIGHT.)
(SCALE : 1:20)



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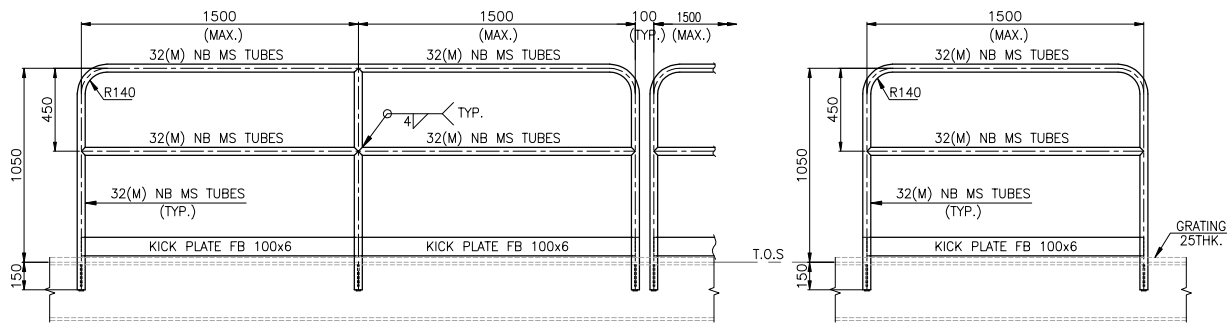
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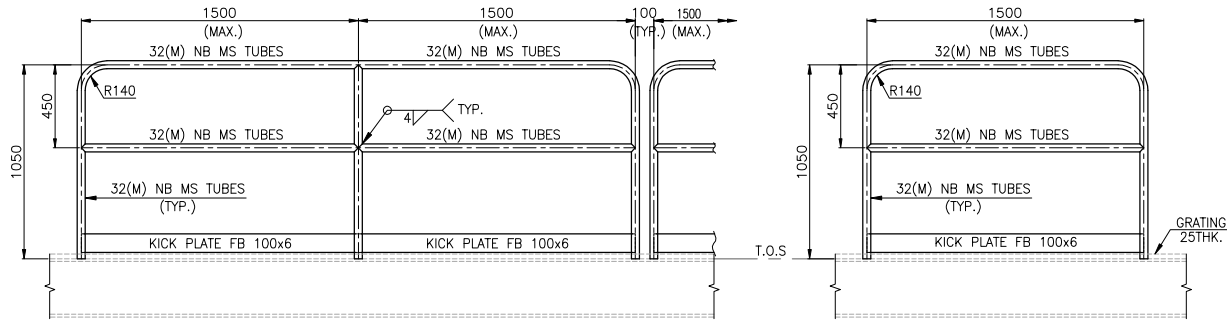
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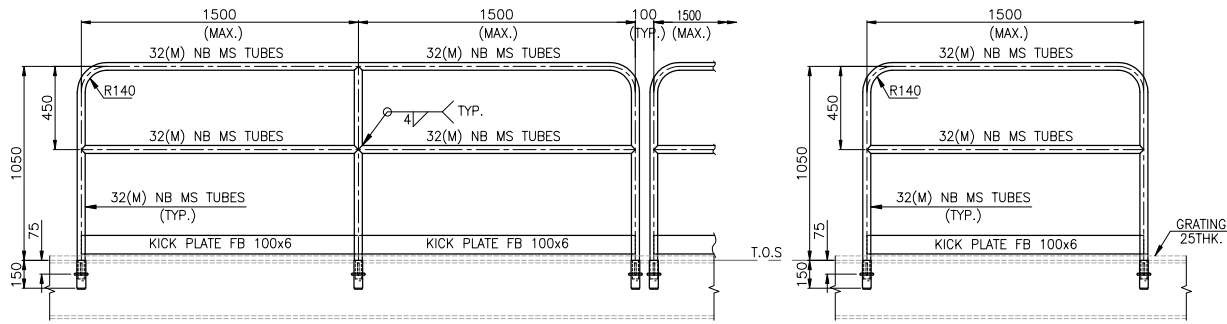
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DRAWING NO.:	17039-EK-S-DW-6088	REV: A	SHEET : 2 OF 2	SCALE : AS SHOWN



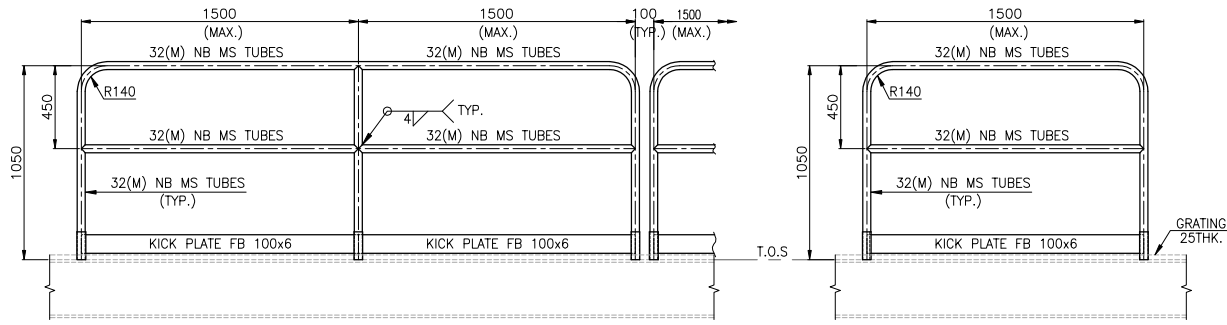
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ELEVATION (SINGLE PANEL)
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(SCALE 1:20)



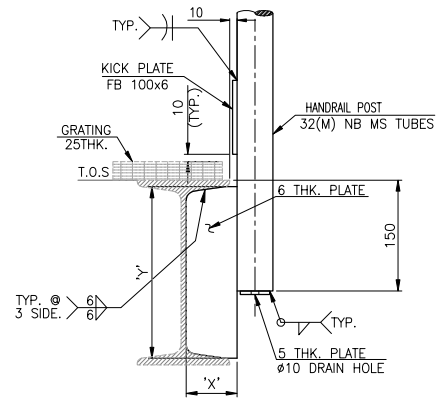
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TYPICAL FIXED HANDRAIL TOP MOUNTING DETAIL (TYPE-B)
(SCALE 1:20)



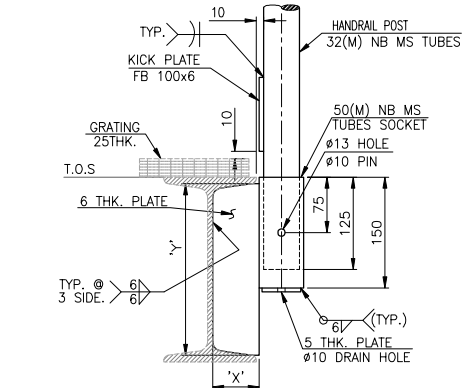
ELEVATION (DOUBLE PANEL)
ELEVATION (SINGLE PANEL)
TYPICAL REMOVABLE HANDRAIL SIDE MOUNTING DETAIL (TYPE-C)
(SCALE 1:20)



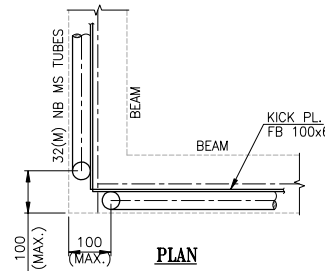
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ELEVATION (SINGLE PANEL)
TYPICAL REMOVABLE HANDRAIL TOP MOUNTING DETAIL (TYPE-D)
(SCALE 1:20)



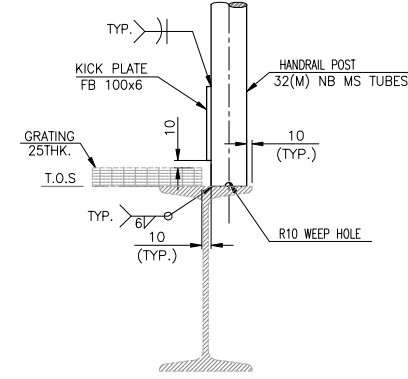
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(SCALE NTS)



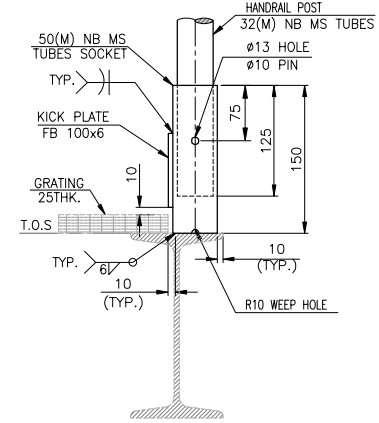
TYPICAL REMOVABLE HANDRAIL SIDE MOUNTING DETAIL
(SCALE NTS)



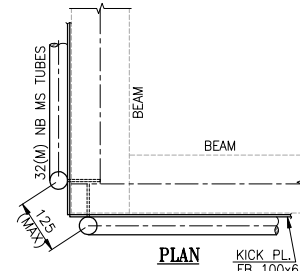
TYPICAL CORNER DETAIL FOR TOP MOUNTING
(SCALE NTS)



TYPICAL FIXED HANDRAIL TOP MOUNTING DETAIL
(SCALE NTS)



TYPICAL REMOVABLE HANDRAIL TOP MOUNTING DETAIL
(SCALE NTS)



TYPICAL CORNER DETAIL FOR SIDE MOUNTING
(SCALE NTS)

NOTES:

1. ALL DIMENSIONS ARE IN mm U.N.O

LEGEND:

1. T.O.S - TOP OF STEEL
2. THK - THICKNESS
3. NTS - NOT TO SCALE
4. TYP - TYPICAL
5. MAX. - MAXIMUM
6. FB. - FLAT BAR
7. PL. - PLATE
8. FGL. - FINISHED GROUND LEVEL
9. NB - NOMINAL BORE
10. (M) - MEDIUM(CLASS)
11. MS - MILD STEEL
12. MIN - MINIMUM
13. CHQD - CHEQUERED

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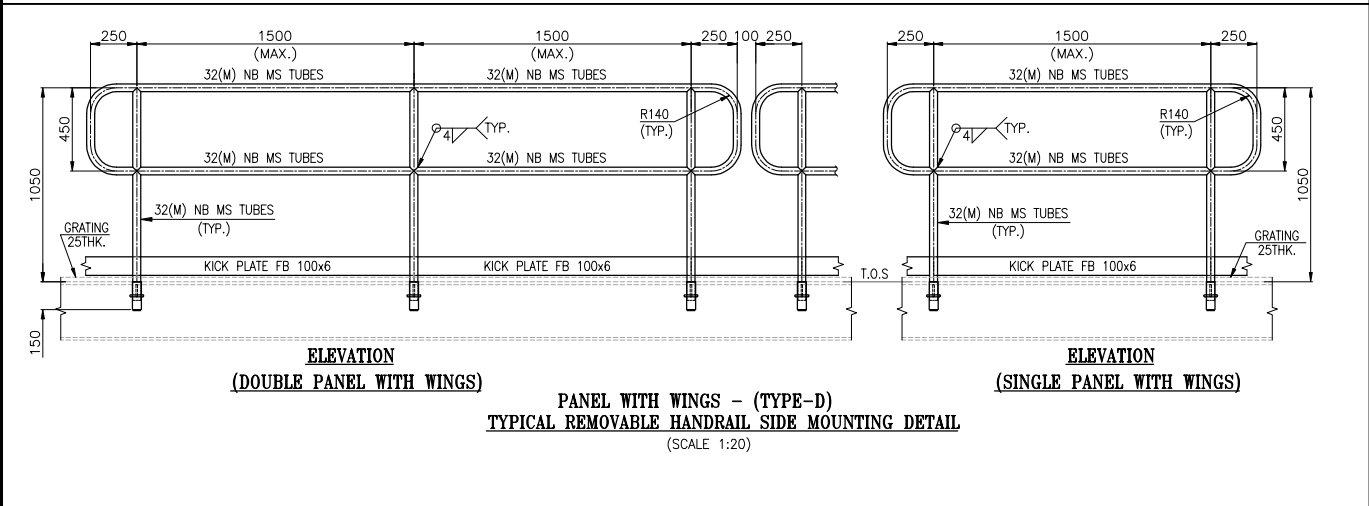
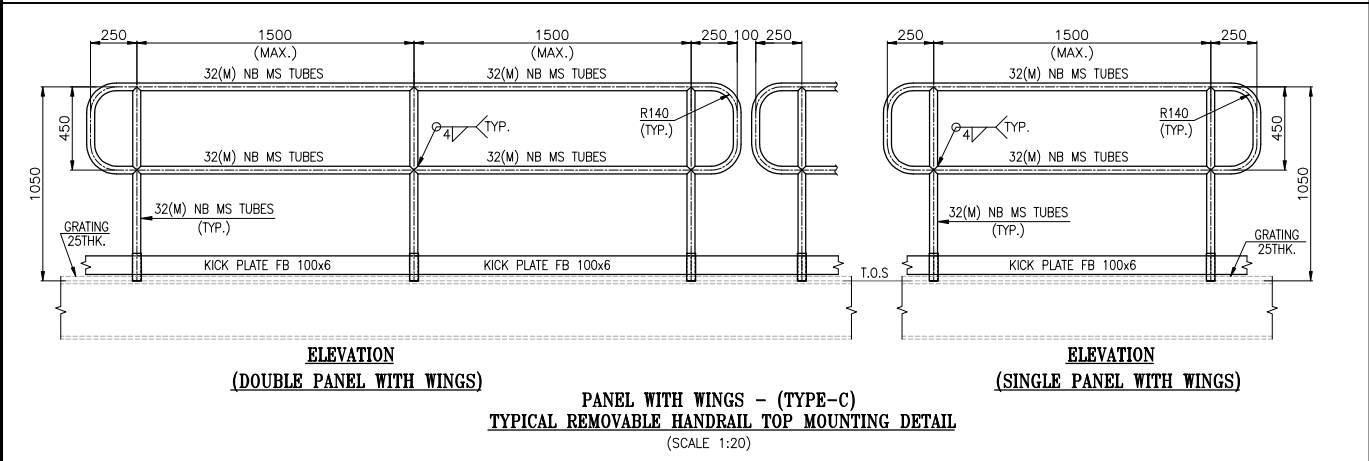
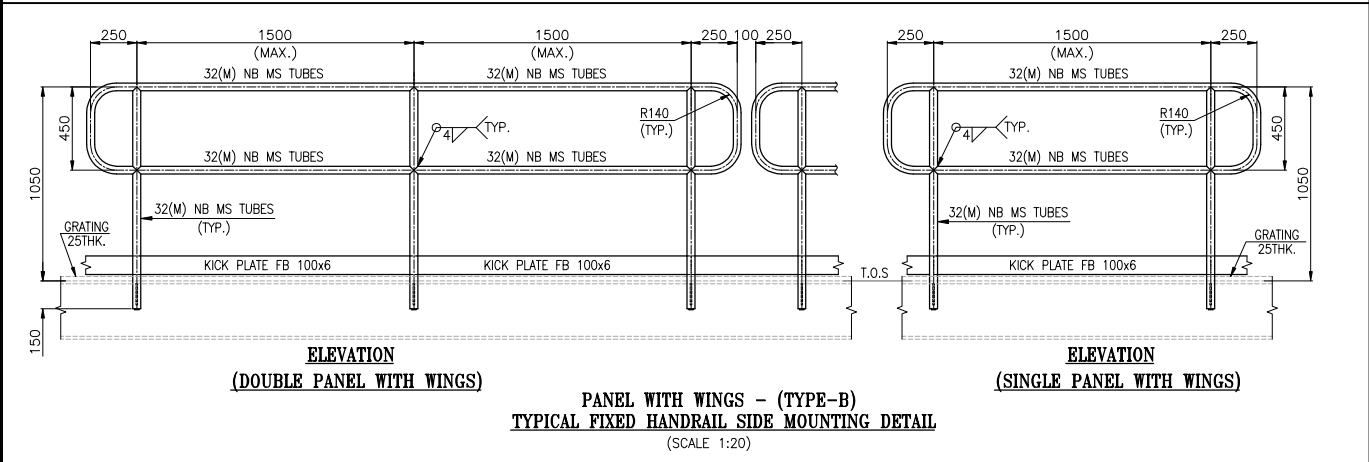
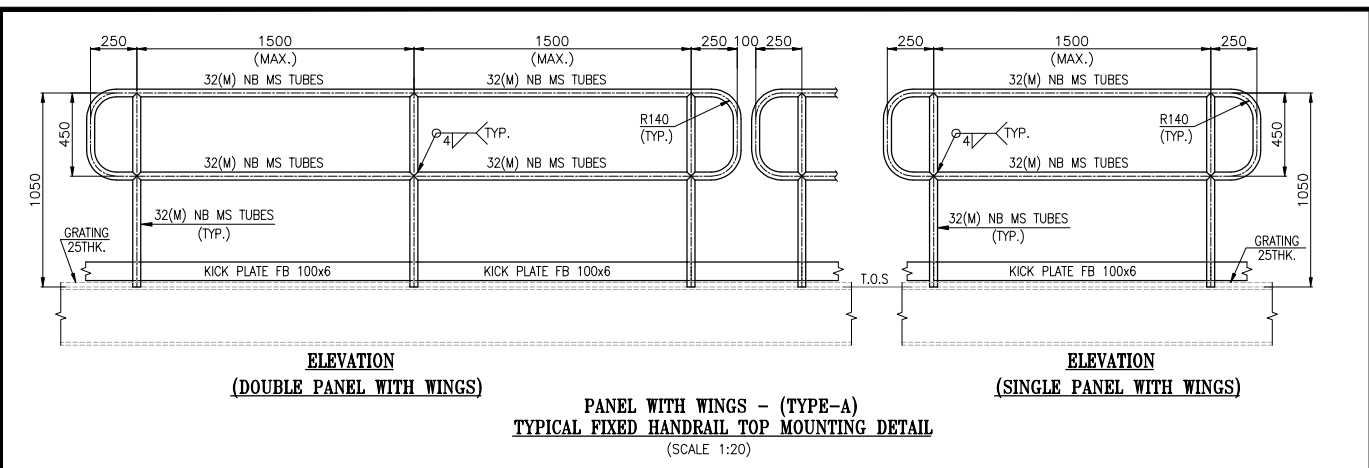


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PROJECT NO.: KIP-17039 PROJECT SITE: EAST KHAGORIJAN SIZE : A1
DRAWING NO.: 17039-EK-S-DW-6089 REV: A SHEET : 1 OF 2 SCALE : AS SHOWN



NOTES:
1. FOR NOTES & REFERENCE DRAWINGS PLEASE REFER SHEET-1 OF 2.

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								PROJECT SITE: EAST KHAGORIJJAN		
								SIZE : A1		
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								SHEET : 2 OF 2		
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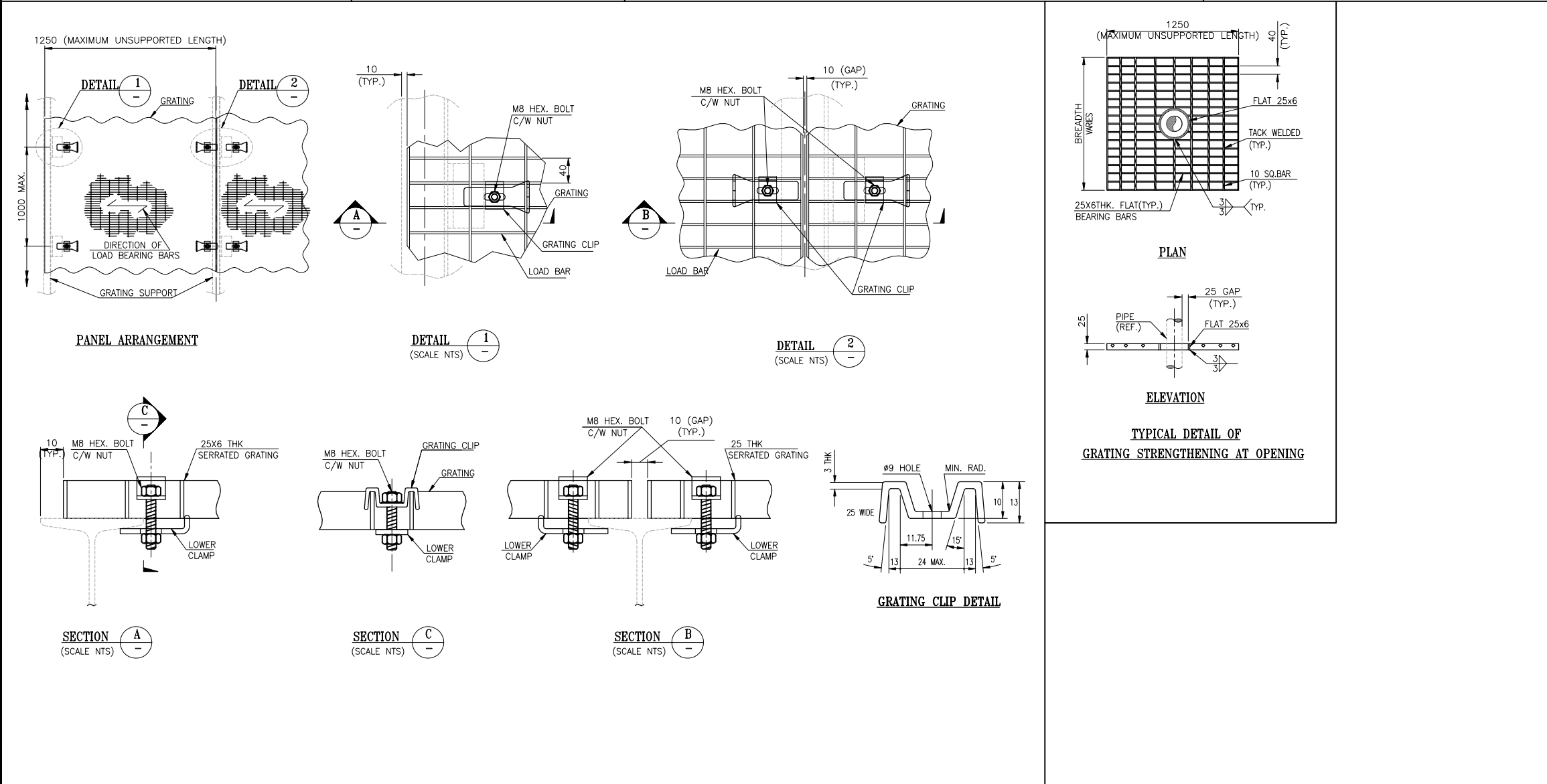
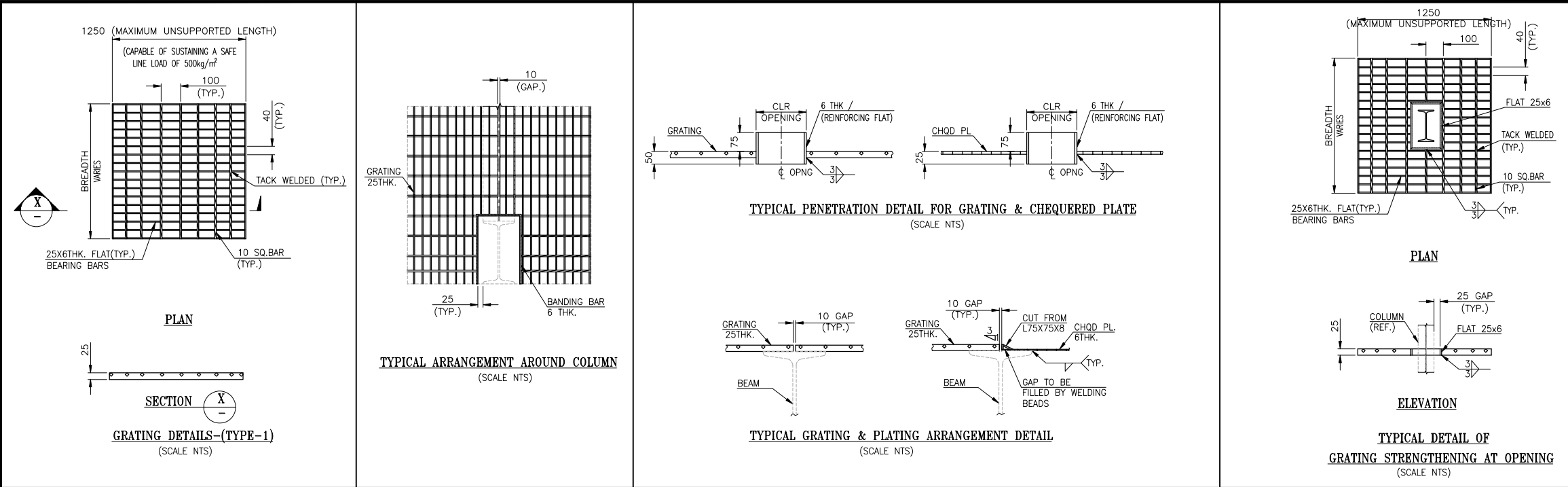
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					KAVIN™		PROJECT NO.: KIP-17039		
							DRAWING NO.: 17039-EK-S-DW-6090		
							REV: A SHEET : 1 OF 2		
							SCALE : AS SHOWN		

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