SPECIFICATION
FOR
HYDROSTATIC TESTING OF ONSHORE PIPELINE

SPECIFICATION NO.: MEC/S/05/21/03

(OIL & GAS SBU)
MECON LIMITED
DELHI 110 092

CONTENTS

1.0 SCOPE

1.1 This specification covers the minimum requirements of supply, works and operations to be performed by CONTRACTOR for hydrostatic testing of cross-country steel pipelines transporting hydrocarbons in liquid or gaseous phase under high pressure. This specification does not cover the requirements of drying/precommissioning of the tested pipelines. This specification shall be read in conjunction with the conditions of all specifications and documents included in the CONTRACT between COMPANY and CONTRACTOR.

2.0 REFERENCE CODES, STANDARDS AND SPECIFICATIONS

2.1 Reference has been made in this specification to the latest edition/ revision of the following codes, standards and specifications.

a)	ANSI B 31.8	Gas Transmission and Distribution Piping Systems.
b)	ANSI B 31.4	Liquid Petroleum Transportation Piping Systems.
c)	API RP 1110	Pressure Testing of Liquid Petroleum Pipelines.
d)	ASME Sec. VIII Div-1	Boiler & Pressure Vessel Code.
e)	OISD 226	Natural Gas Transmission Pipelines and City Gas Distribution Networks

2.2 In case of conflict between the requirements of this specification and that of the above referred coded, standards, and specifications, the requirements of this specifications shall govern.

2.3 For the purpose of this specification the following definitions shall hold:

- the words 'shall' and 'Must' are mandatory;

- the words 'Should', 'May', and 'Will' are non-mandatory, advisory or recommended.

3.0 GENERAL

3.1 Hydrostatic test shall be performed on the entire length of the pipeline. Hydrostatic test shall be performed in accordance with approved Hydrostatic Test Diagrams for each test section. The maximum length of each test section shall not exceed 50 kms.

3.2 For pipeline sections which in COMPANY's opinion, once installed would require an inordinate amount of effort for repair in case of a leak, a provisional pre-test shall be conducted. However, after installation, such pretested sections shall be tested again alongwith the entire pipeline.

3.3 Hydrostatic test shall commence only after mechanical and civil works completion, i.e., all welds have been accepted and the pipeline has been laid and backfilled according to the specifications. Hydrostatic test shall include those sections which have been previously tested, viz. Rail/ road crossing, major water crossings including test on banks and in place after installation, and scraper traps at the terminals. CONTRACTOR shall perform all works required for hydrostatic testing after obtaining prior written approval from the COMPANY.

3.4 The pipeline shall be tested in accordance with the requirements of the latest edition of ANSI B 31.8 or ANSI B 31.4, OISD 226 as applicable, and requirements laid down in this specification.

4.0 HYDROSTATIC TEST PROCEDURE MANUAL

CONTRACTOR shall prepare for COMPANY's approval a hydrostatic test procedure manual. The procedure shall strictly comply with the requirements of this specification and shall be submitted to COMPANY for approval well in advance. The procedure manual shall include all temporary materials & equipment, but not be limited to the following items:

a) For the systems to be tested, a diagram indicating all fittings, vents, valves, temporary connections, relevant elevations and ratings. The diagram shall also indicate injection locations and intake and discharge lines.

b) Estimated amount of test water, water sources, including required concentration of corrosion inhibitors and additives, procedure for inhibitor injection and control of concentration.

c) Filling and flushing procedures, including a complete description of all proposed equipment and instruments (including spares), their location and set-up.

d) The type and sequence of pigs and the pig tracking systems for cleaning and removal of air pockets. Pig inspection procedures, including procedure to be followed in case the calliper pig indicates damage.

e) Procedures for levelling and stabilization after filling and for pressurization and to allow for temperature stabilization.

f) Pressure testing procedure including a complete description of all proposed equipment and instruments (including spares), their location and set-up, and proposed system for observation and recording of data during the pressure test.

g) Procedure for detection and location of leaks.

h) Procedure for dewatering the pipeline section(s) after testing, including a complete description of all proposed equipment and instruments, (including spares), their location and set-up, the type and sequence of pigs and the pig tracking system along with the pig specifications.

i) Forms for recording the test data.

5.0 TEST DURATION AND PRESSURE

5.1 The duration of hydrostatic test shall be a minimum of 24 hours after stabilization and the test pressure shall be as indicated in the approved hydrostatic test diagram.

5.2 Unless specified otherwise in the CONTRACT, the hydrostatic test pressure shall be as follows :

For pipeline handling hydrocarbon in gaseous phase :

a) 1.25 times the design pressure for pipeline located in Class-1 and Class-2 locations as per ASME B 31.8.

b) 1.4 times the design pressure for pipeline located in Class-3 and Class-4 locations as per ASME B 31.8.

6.0 EQUIPMENT AND INSTRUMENTATION

The CONTRACTOR shall furnish all necessary equipment for performing the work as stated in cleaning, flushing, filling, levelling, stabilizing, testing and dewatering procedures. This shall include the following :

a) Pigs for filling , cleaning and gauging including

- Cleaning pigs with spring loaded steel wire brushes except for internal coated pipes. In this case pigs to be provided with nylon / polyurethane brushes.

- Four cup batching pigs

- Calliper pigs with gauge plate diameter equal to 95% of the heavy wall pipe in the pipe sections. Gauging pig fitted with gauge plate.

The CONTRACTOR shall provide sufficient number of pigs including spares.

b) Fill pumps : The CONTRACTOR shall determine the type and number of fill pumps in order to guarantee the following :

Differential head 20% greater than the maximum required.
Flow rate : 400m^3 / hr. min. ; 1000m^3 / hr. max.
If a single pump is used, a standby unit must be available.

c) Variable speed positive displacement pumps equipped with a stroke counter to pressurise the line with a known stroke and capable of exceeding the maximum test pressure by at least 20 bar.

d) Two positive displacement meters to measure the volume of water used for filling the line. These meters shall be provided with a callibration certificate not older than one month.

e) Portable tanks of sufficient size to provide a continuous supply of water to the pump during pressurizing.

f) Bourdon pressure gauges of sufficient pressure range and accuracy.

g) Dead weight testers with an accuracy of 0.01 bar measuring in increments of 0.05 bar provided with a calibration certificate not older than one month.

h) Two 48 hours recording pressure gauges tested with charts and ink gauges tested with dead weight tester prior to use. These shall be installed atp the test heads.

i) Pressure recording charts.

j) Two temperature recorders for fill water.

k) Thermocouples for measuring the pipe wall temperature.

l) Two laboratory thermometers 0°C to 60°C range, accuracy ± 0.1 degree to be used in thermowells.

m) Means to measure the volume of water necessary to drop the line pressure by 0.5 bar (container on scales or graduated cylinder).

n) Injection facilities to inject additives into the test medium in the required proportions.

o) Communication equipment suitable for a continuous connection between the beginning and the end of the test section and with the inspection team along the line, in accordance with the requirements of local Authorities.

p) The temporary scraper traps shall be installed according to the testing sections fixed in the test procedure manual. Proper piping and valuing arrangements shall be available to allow launching and receiving of each pig independently.

The test heads shall be sized in conformity with ASME specification Section VIII, Division 2 with particular reference to Appendices 4 and 5.

q) Thermocouples for assuring the temperature of the pipe wall shall be installed on the pipeline to be tested:

- 1 thermocouple at about 500m distance from the pumping head.
- 1 thermocouple every 2500m of the pipe the spacing may be increased to maximum 5000m depending on the terrain and nature of sub-soil along the alignment of section.
- 1 thermocouple at about 500m distance from the terminal head.

The spacing may be increased to maximum 5000 metre depending on the terrain and nature of sub soil along the alignment of test section.

Thermocouples shall be attached on the external surface of the pipe after removal of external coating and shall be adequately protected and COMPANY's coating instructions shall be followed.

7.0 **PROCEDURES**

7.1 Equipment and/or parts which need not or must not be subjected to the test pressures, must be disconnected or separated from the pipeline to be tested.

7.2 If the difference of minimum and maximum atmosphere temperature should cause thermal instability on the pipe section directly exposed to atmospheric condition, the scraper traps and above ground pipeline shall be properly protected.

The pipeline test shall exclude long segments of line exposed to atmospheric conditions, viz. Aerial lengths on piers, suspension bridges, etc., which shall be tested separately.

7.3 The test medium shall be soft non-aggressive water furnished by the CONTRACTOR. The water to be used shall be filtered, shall not be contaminated, and free from sand or silt. CONTRACTOR shall submit laboratory test reports of water used for testing. The possible use of sea water shall be subject to its degree of cleanliness, the possibility of obtaining a pre determined salinity neutralization and the use of corrosion inhibitors, this at the sole discretion of COMPANY. CONTRACTOR shall provide COMPANY approved corrosion inhibitors, oxygen scavengers and bactericides to be added to the test water. The CONTRACTOR shall furnish and install all temporary piping which may be necessary to connect from source of water to its pumps and manifolds/ tankage.

7.4 Before filling operation the CONTRACTOR shall clean the pipeline by air driven pigs provided with spring loaded bushes and chisels to remove all mill scale rust/ sand from the inside of pipe section. For this purpose temporary headers for air cleaning shall be attached to the pipeline. The number of pig runs is depending upon the cleaning results and shall be determined by the COMPANY at site.

7.5 "After cleaning the pipeline by using air and acceptance by Company, gauging shall be carried out by using gauging pig. The gauge plate diameter shall be equal to 95% of inside diameter of the heaviest wall pipe in the test section. While computing the ID of heaviest wall pipe, pipe manufacturing tolerance shall not be considered. A 10mm thick aluminium plate shall be used for making gauge plate.

After receipt of gauging pig at the other end, the gauge plate shall be inspected in the presence of Company representative. A deformed, bent or severally nicked plate or damaged pig shall be evidence of gauging pig run failure and the same is not acceptable to company. In such cases the Contractor shall repair and rectify the line and repeat the gauging pig run to the satisfaction and approval of the Company Representative. Any obstruction and/ or faults such as dents, buckles, flat spots, etc. analysed and noted during gauging pig run shall be located and any necessary repair work shall be performed to rectify the same to the satisfaction of the Company. A written approval shall be obtained from Company regarding successful completion of gauging pig run.

After acceptance of gauging operation, air header shall be cut and removed. Pre-tested test headers loaded with three numbers of four cup batching pig shall be welded to test Section. Un-inhibited water equal to 10% of the volume of test section shall be introduced in front of the first pig. The first pig shall be launched by introducing about 1.5 km un-inhibited water.

Then the second pig shall be launched by pumping the inhibited water till the second pig is received at the other end. The thermal stablisation and pressurisation can now the started".

7.6 Thermal Stabilization

After a check has been made to confirm if the pressure has attained at least 1 bar (g) on the highest section, thermal stabilization can be started.

Thermal equilibrium between the pipeline and environment shall be checked through the thermocouples installed on the pipeline.

Temperature readings shall be made at 2 hours-intervals. Thermal stabilization shall be considered to have been achieved when a difference not higher than 1°C is attained between the average values of the last two readings. Thermal stabilization completion shall be approved by COMPANY.

7.7 Pressurisation

Pressurisation shall be performed in the presence of COMPANY at moderate and constant rate not exceeding 2 bars/min. One pressure recording gauge shall be installed in parallel with the dead weight tester. Volume required to reach the test pressure shall be recorded periodically throughout the pressurization as follows:

- each 5 bar increments up to 80% of test pressure as recorded by the dead weight tester;
- each 2 bar increment between 80% to 90% of test pressure as recorded by the dead weight tester;
- each 0.5 bar increment between 90% of test pressure to full test pressure as recorded by the dead weight tester.

The pressurizing shall be cycled according to the following sequence:

a) Pressurize to 50% of test pressure, hold pressure for 1 hour.

b) Drop pressure to static head of test section at test head.

c) Pressurize to 75% of test pressure, hold pressure for 1 hour.

d) Drop pressure to static head of test section at the test head.

e) Pressurize to test pressure.

During the pressurization to each test pressure, two tests shall be carried out for the calculation of air volume in the pipeline under test.

In case, during the hold pressure periods indicated above, a decrease in pressure is observed, the operations shall not be repeated more than twice, after which the line shall not be considered capable of test, until the CONTRACTOR has isolated and eliminated the cause for the lack of water tightness.

7.8 Air Volume Calculation

In order to check the presence of air in the pipeline, two separate consecutive pressure lowering of 0.5 bar shall be carried out.

For calculation of air in the pipeline the second pressure lowering shall be used, and the relevant drained water shall be accurately measured (V_1). This amount measured shall be compared to the theoretical amount (V_p) corresponding to the pressure lowering that has been carried out, by using the procedure outlined in clause 12.1 of this specification.

If no air is present in the length under test:

$$\frac{V_1}{V_p} = 1$$

In order that the above ratio is acceptable, it shall not differ from 1 by more than 6% (i.e. 1.06).

If the air found in the pipeline is within the above established tolerance, then the pressurizing can continue. If the ratio V_1 / V_p exceeds 1.06, the hydrostatic testing cannot go on and additional pig passages shall be performed to remove the air pockets.

The test shall be repeated as per the above procedure until above estimated tolerances are satisfied. The pressurizing can then continue, to reach the value of test pressure.

7.9 Testing

After the section has been pressurized and the air volume test has given acceptable results the test pressure shall be held for a minimum of 24 hours after stabilization. After temperature and pressure has stabilized, the injection pump shall be disconnected and all connections at the test heads shall be checked for leakage. The pressure recorders shall then be started with the charts in a real time orientation for continuous recording throughout the test.

During the testing period the following measurements shall be recorded :

- every one hour pressure measurements form dead weight testers.
- every two hours the ambient temperature and the pipe temperature at the thermocouples.

All data shall be recorded on appropriate forms attached to the hydrostatic test procedure manual. Care shall be taken that the maximum test pressures are not exceeded.

Bleed-off water shall be accurately measured and recorded.

8.0 ACCEPTANCE

8.1 The hydrostatic test shall be considered as passed if pressure has kept a constant value throughout the test duration, except for change due to temperature effects. Such change shall be evaluated as described under clause 12.2 of this specification.

The pressure change value as a function of temperature change shall be algebraically added to the pressure value as read on the meters. The pressure value thus adjusted shall be compared with the initial value and the test shall be considered as acceptable if the difference is less than or equal to 0.3 bar. In case of doubt the testing period shall be extended by 24 hours.

8.2 If test section fails to maintain the specified test pressure after isolation, CONTRACTOR shall determine by search the location of leakage or failure. All leaks and failures within the pipe wall or weld seam shall be repaired by replacement of entire joint or joints in which leakage or failure occurs. In circumferential welds the method of repair shall be determined by the COMPANY. CONTRACTOR shall comply with instructions of the COMPANY whether to replace a section of the line pipe that includes the line leak or whether to repair the circumferential weld. This repair should however meet the requirements of 'Specification for Welding Pipelines and Related Facilities'. Where failure occur in pipeline field bends, bends shall be replaced with same degree of bends. After completion of repairs, the hydrostatic test shall be repeated in full, as per this specification.

8.3 The cost of repairs or replacements, followed by refilling and repressurizing the line, due to poor workmanship, shall be borne by the CONTRACTOR. In the event of leaks or failures resulting form faulty COMPANY furnished materials, CONTRACTOR shall be reimbursed for furnishing all labour, equipment, materials, except those materials furnished by the COMPANY, and transportation necessary to repair and repressurize the section of the pipeline to the pressure at the time of recognition of leak or line failure. CONTRACTOR shall be entitled for compensation as per the provisions of the CONTRACT. All work of reinstalling line pipe, to replace pipe failures shall be done in accordance with the relevant specification included in the CONTRACT.

8.4 CONTRACTOR shall haul and stockpile all damaged and defective pipes to storage locations designated by the COMPANY. All cracks and splice resulting from failures shall be coated with an application of grease to preserve the characteristics of failures from corrosion. Joint of failed pipes shall be marked with paint, with a tag indicating failure details, date and location of failure and pressure at which failure occurred.

9.0 TERMINATION

After the positive results of testing and collection of all data the test shall be terminated upon written approval given by the COMPANY.

9.1 CONTRACTOR shall dewater the tested line as per the following requirement after test acceptance.

The dewatering shall be carried out by using four cup pigs and foam pigs driven by compressed air. The detailed dewatering procedure shall be developed by the CONTRACTOR

in such a way as to provide adequate control of pigs during dewatering. Pigs and equipment required for dewatering the line shall be furnished by CONTRACTOR and shall be approved in advance by the COMPANY. Four cup pigs shall first be passed through the line to displace the water. Foam pigs shall then be passed in order to complete the line dewatering. CONTRACTOR shall use a number of foam pigs, each in different colors/ numbered for this purpose. The line shall be considered dewatered when a negligible amount of water is flushed out by the last foam pig and approval is given by the COMPANY.

9.2 During dewatering, care shall be taken to properly dispose the discharging water in order to avoid pollution, damages to fields under cultivation and/or existing structures and interference with the traffic. Before start of dewatering and disposal of hydrotest water, a procedure for treatment of inhibited water to prevent pollution shall be submitted by contractor to owner/ consultant for review and approval.

9.3 Upon completion of the testing and dewatering operation, any provisional traps for pigs and all other temporary installation relating to the test shall be removed. Subsequently the individual sections of the line already tested shall be joined in accordance with the requirements of relevant specifications issued for the purpose.

10.0 TEST REPORT

A complete report signed by CONTRACTOR and the COMPANY shall be submitted upon completion of the hydrostatic test for each test section.
This report shall contain as a minimum:

- the cleaning, flushing, filling and testing procedures used;
- schematic layout of cleaning, filling and testing facilities;
- instruments calibration certificates;
- a profile of the pipeline that shows the test sites, all instrument and injection connections;
- pipe filling logs and records;
- additive specification, required concentration and additive injection records;
- pig specifications;
- pig inspection records including photographs of the damages;
- records of gauging pig survey and photographs;
- pressurization and stabilization records;
- pressure and temperature recording charts with appropriate information inscribed thereon;

- temperature data along the pipeline;
- dead weight tester logs and recording;
- air volume calculations;
- pressure change due to temperature change calculations;
- environmental data;
- depressurization logs and records;
- dewatering procedure and schematic layout of relevant facilities;
- dewatering logs and records;
- records and photograph of all leaks.

11.0 MEASUREMENTS

11.1 Water Amount Measurement

The water volume added to the section to be tested shall be measured during the filling stage through a positive displacement meter (a turbine meter may also be used). In the calculation, as per clause 12.1 of this specification, use shall be made of the geometrical volume of the section in question.

11.2 Pressure Measurement

Pressure shall be measured with a dead weight tester with an accuracy of 0.01 bar that shall permit readings of at least 0.05 bar.

During the test the pressure shall be recorded by means of a pressure recorder featuring the following specifications:

Accuracy	:	± 0.1% of the full-scale value
Recording	:	continuous on tape or disk, graph width 100mm
Feed	:	20mm/h for tape diagrams, 7.5°/h for disk diagrams
Recording	:	to be such as to record pressure between 50% and 90% of the diagram width.

The pressure recorder shall be checked by means of dead weight tester at the beginning, during and at the end of the hydrostatic test.

A pressure gauge tested with dead weight tester shall be connected in parallel to the dead weight tester at the test head.

11.3 **Temperature Measurements**

Water temperature shall be taken at every 2 hours through the thermocouple that have been installed on the pipe wall along the section under test on the pipe wall.
Further the temperature measurement shall be taken :

- during the filling operation
- during the thermal stabilization stage
- during the hydrostatic test

The thermocouple's sensitivity shall enable temperature readings with an accuracy of ±0.2°C.

b) Water temperature shall also be measured on the pump delivery by means of a recording thermometer (temperature recorder) throughout the filling stage.

The recording thermometer shall have the following features :

Accuracy ± 1% of the scale range

Scale - 10° to + 40° C

Recording: Continuous on tape or disk, diagram within 100mm

Feed : 20mm/h for tape diagrams, 7.5°/h for disk diagrams.

c) Ground temperature shall be taken by measuring pipe temperature at the thermocouple prior to starting the filling operation.

d) Environmental temperature shall be recorded from the beginning of pressurization to the end of the test by means of a recording thermometer featuring the following characteristics:

Accuracy ± 1% of the scale range

Scale - 0° to + 60° C

Recording: Continuous on tape or disk, diagram width 100mm

Feed : 20mm/h for tape diagrams, 7.5°/h for disk diagrams.

12.0 **CALCULATIONS**

12.1 The theoritical water amount that is necessary for filling the section to be tested shall be obtained from the geometrical volume of the section considering the pipe tolerances.

The theoretical water amount that is necessary for pressurizing the section shall be calculated by means of the following formula:

$$Vp = (0.884\ r\ i/t + A) \times 10^{-6} \times V_t \times \Delta P \times K$$

Where:

Vp = computed water amount required to raise by P the pressure in the section to be tested (m^3).

Vt = geometrical volume of the section (m^3)

Δ P = Pressure rise (bar)

r i = nominal inner radius of the pipe (mm)

t = nominal pipe thickness(mm)

A = isothermal compressibility value for water at the pressurization temperature in the P range (bar_{-1}) x 10^6.

(Refer water compressibility factor vs pressure and temperature chart). For temperature above 30°C the values may be extrapolated.

K = a dimensionless coefficient that is equal to a value of 1.02 for longitudinally welded pipe.

12.2 The pressure change due to a water temperature change shall be calculated by the following formula:

$$\Delta P = \frac{B}{0.884\ r\ i/\ t + A}\ \Delta T$$

Where,

ΔP = pressure change resulting from a temperature change (bar)

ΔT algaebrical difference between water temperature at the beginning of the test and water temperature as measured at the end of the test (°C).

B = value of the difference between the thermal expansion of water at the pressure and temperature as measured at the end of the test and that of steel ($°C^{-1}$) x 10^6

(Refer table – A)

A = Isothermal compressibility value of water as estimated at the pressure and temperature values obtained at the end of test (bar^{-1}) x 10^6 (Refer Figure 1)

r i = nominal inner radius of the pipe (mm).

t = nominal thickness of pipe (mm).

13.0 PRECAUTIONS DURING THE TEST

In addition to all that has been expressly described in the procedures for carrying out the tests, the following additional requirements shall be complied with:

13.1 Provision shall be made for the installation of no-admittance signs to unauthorized personnel from the roads to the R.O.W.

13.2 Signs stating "PIPE UNDER TEST-KEEP OFF" with local language translation shall be placed where the pipeline is uncovered, and particularly where the provisional traps and stations are located. Such areas shall be suitably fenced in such a way as to prevent access of unauthorized personnel. No unauthorized personnel shall be closer than 40 m to the pipeline or equipment under test.

13.3 Provisional scraper traps shall be installed in compliance with methods and suitable locations so that their rupture cannot cause any injuries to the personnel or third parties.

13.4 The test station shall be placed in such a location as to prevent it from being affected by a catastrophic failure in the test head.

13.5 Once dewatering is over, the sectionalizing valves and other valve assemblies tested previously, shall be installed at locations shown in the drawings and in accordance with the procedures contained in the relevant specifications. All thermocouple installed in the pipeline shall be removed and damaged corrosion coating shall be repaired using COMPANY approved materials and procedure.

14.0 PRESERVATION OF PIPELINE

When so stated in the CONTRACT, to preserve/conserve the pipeline for a specified duration, CONTRACTOR shall completely fill the pipeline with water, with sufficient quantity of corrosion inhibitors depending upon quality of water and the period of conservation, at a pressure to be agreed upon with the COMPANY at a later stage. CONTRACTOR shall obtain necessary approval from the COMPANY of the procedure and the type and quantity of the inhibitors used before commencement of the works.

TABLE - A

^{0}C Bar	1	2	3	4	5	6	7	8
0.981	-98.62	-79.89	-61.81	-44.34	-27.47	-11.14	+4.66	+19.98
10	-95.55	-76.94	-58.99	-41.65	-24.89	-8.67	+7.02	+22.23
20	-92.15	-73.68	-55.86	-38.64	-22.01	-5.92	+9.65	+24.74
30	-88.74	-70.40	-52.72	-35.63	-19.14	-3.16	+12.29	+27.26
40	-85.32	-67.12	-49.58	-32.62	-16.24	-0.41	+14.93	+29.78
50	-81.90	-63.84	-46.43	-29.60	-13.36	+2.36	+17.57	+32.31
60	-78.47	-60.55	42.27	-26.58	-10.46	+5.15	+22.89	+34.85
70	-75.03	-57.25	-40.10	-23.54	-7.56	+7.92	+22.89	+37.39
80	-71.60	-53.96	-36.94	-20.51	-4.65	+10.70	+25.55	+39.94
90	-68.16	-50.66	-33.77	-17.47	-1.73	+13.50	+28.23	+42.50
100	-64.72	-47.35	-30.60	-14.43	+1.18	+16.29	+30.90	+45.05
110	-61.28	-44.05	-27.43	-11.38	+4.10	+19.08	+33.58	+47.61
120	-57.84	-40.74	-24.26	-8.34	+7.02	+21.88	+36.26	+50.18
130	-54.40	-37.44	-21.08	-5.29	+9.95	+24.68	+38.94	+52.75
140	-50.96	-34.13	-17.90	-2.25	+12.87	+27.49	+41.63	+55.32
150	-47.53	-30.83	-14.73	+0.80	+15.79	+30.29	+44.31	+57.89
160	-44.10	-27.53	-11.56	+3.85	+18.72	+33.10	+47.00	+60.46
170	-40.67	-24.23	-8.40	+6.89	+21.64	+35.90	+49.69	+63.04
180	-37.24	-20.94	-5.23	+9.94	+24.56	+38.70	+52.37	+65.62
190	-33.83	-17.65	-2.06	+12.98	+27.48	+41.51	+55.06	+68.19
200	-30.42	-14.37	+1.09	+16.01	+30.40	+44.30	+57.75	+70.77
210	-27.02	-11.09	+4.25	+19.04	+33.31	+47.10	+60.43	+73.34
220	-23.63	-7.82	+7.40	+22.06	+36.22	+49.90	+63.12	+75.90
230	-20.24	-4.56	+10.54	+25.08	+39.13	+52.69	+65.80	+78.48
240	-16.87	-1.30	+13.67	+28.10	+42.03	+55.48	+68.48	+81.05
250	-13.50	+1.94	+16.79	+31.11	+44.92	+58.26	+71.15	+83.61
260	-10.14	+5.17	+19.90	+34.12	+47.81	+61.04	+73.81	+86.81
270	-6.80	+8.39	+23.00	+37.11	+50.69	+63.80	+76.48	+88.73
280	-3.48	+11.60	+26.11	+40.09	+53.56	+66.57	+79.14	+91.29
290	-0.17	+14.80	+29.19	+43.07	+56.43	+69.33	+81.78	+93.83
300	+3.13	+17.98	+32.27	+46.03	+59.29	+72.06	+84.83	+96.38

DIFFERENCE BETWEEN THE WATER THERMAL EXPANSION FACTOR AND THE STEEL THERMAL EXPANSION FACTOR ($^0C^{-1}$) (10^{-6})

TABLE - A

^{0}C Bar	9	10	11	12	13	14	15
0.981	+34.82	+4922	+63.20	+76.78	+89.99	+102.83	+115.34
10	+36.97	+51.26	+65.15	+78.64	+91.75	+104.51	+116.93
20	+39.36	+53.55	+67.33	+80.71	+93.72	+106.39	+118.71
30	+41.76	+55.84	+69.51	+82.79	+95.70	+108.26	+120.49
40	+44.18	+58.14	+71.70	+84.87	+97.68	+110.14	+122.28
50	+46.60	+60.45	+73.90	+86.96	+99.68	+112.04	+124.07
60	+49.02	+62.76	+76.10	+89.07	+102.67	+113.93	+125.88
70	+51.44	+65.08	+78.32	+91.17	+103.68	+115.84	+127.69
80	+53.88	+67.40	+80.53	+93.29	+105.69	+117.76	+129.50
90	+56.32	+69.73	+82.75	+95.41	+107.70	+119.67	+131.32
100	+58.77	+72.07	+84.98	+97.53	+109.73	+121.59	+133.15
110	+61.21	+74.41	+87.22	+99.66	+111.75	+123.52	+134.98
120	+63.67	+76.74	+89.45	+101.79	+113.79	+125.46	+136.82
130	+66.12	+79.09	+91.69	+103.93	+115.83	+127.39	+138.67
140	+68.58	+81.45	+93.93	+106.07	+117.67	+129.34	+140.51
150	+71.05	+83.80	+96.18	+108.21	+119.90	+131.20	+142.37
160	+73.51	+86.15	+18.43	+110.36	+121.96	+133.74	+144.22
170	+75.97	+88.51	+100.68	+112.51	+124.01	+135.19	+146.08
180	+78.44	+90.87	+102.94	+114.66	+126.06	+137.15	+147.94
190	+80.91	+93.23	+105.19	+116.82	+128.12	+139.11	+149.81
200	+83.37	+95.59	+107.45	+118.97	+130.17	+141.07	+151.68
210	+85.84	+97.95	+109.71	+121.13	+132.24	+143.03	+153.55
220	+88.30	+100.31	+111.97	+123.29	+134.29	+144.99	+155.42
230	+90.67	+102.67	+114.23	+125.45	+136.36	+146.96	+157.30
240	+93.22	+105.03	+116.48	+127.60	+138.42	+148.93	+159.18
250	+95.69	+107.39	+118.74	+129.76	+140.48	+150.90	161.05
260	+98.14	+109.74	+121.00	+131.92	+142.54	+152.87	+162.93
270	+100.60	+112.10	+123.25	+134.08	+144.61	+154.84	+164.81
280	+103.05	+114.44	+125.50	+136.24	+146.67	+156.84	+166.69
290	+105.50	+116.79	+127.75	+138.39	+148.73	+158.78	+168.57
300	+107.94	+119.13	+130.00	+140.54	+150.79	+160.75	+170.45

DIFFERENCE BETWEEN THE THERMAL EXPANSION FACTOR THE STEEL THERMAL EXPANSION FACTOR (^{0}C $^{-1}$) (10^{-6})

TABLE - A

^{0}C Bar	16	17	18	19	20	21	22	23
0.981	+127.52	+139.41	+151.00	+162.31	+173.37	+184.18	+194.75	+205.08
10	+129.02	+140.83	+152.36	+163.58	+174.56	+185.30	+195.79	+206.07
20	+130.71	+142.42	+153.85	+165.00	+175.90	+186.55	+196.96	+207.16
30	+132.40	+144.02	+155.35	+166.42	+177.23	+187.80	+198.14	+208.26
40	+134.10	+145.62	+156.87	+167.85	+178.58	+189.07	+199.33	+209.37
50	+135.80	+147.24	+158.39	+169.85	+179.93	+190.34	+200.52	+210.49
60	+137.51	+148.86	+159.92	+170.73	+181.29	+191.62	+201.72	+211.61
70	+139.22	+150.49	+161.46	+172.18	+182.66	+192.91	+202.93	+212.74
80	+140.95	+152.11	+163.00	+173.64	+184.03	+194.20	+204.14	+213.88
90	+142.67	+153.75	+164.56	+175.10	+185.41	+195.50	+205.36	+215.03
100	+144.42	+155.40	+166.11	+176.58	+186.80	+196.80	+206.59	+216.17
110	146.15	+157.04	+167.66	+178.05	+188.20	+198.12	+207.82	+217.33
120	+147.90	+158.70	+169.24	+179.54	+189.59	+199.44	+209.06	+218.49
130	+149.65	+160.36	+170.81	+181.02	+191.00	+200.75	+210.31	+219.66
140	+151.40	+162.03	+172.39	+182.51	+192.41	+202.09	+211.56	+220.84
150	+153.16	+163.70	+173.98	+184.00	+193.82	+203.42	+212.81	+222.02
160	+154.93	+165.37	+175.56	+185.51	+195.24	+204.76	+214.08	+223.20
170	+156.69	+167.05	+177.15	+187.02	+196.66	+206.10	+215.34	+224.39
180	+158.47	+168.73	+178.75	+188.53	+198.09	+207.45	+216.61	+225.55
190	+160.24	+170.42	+180.35	+190.05	+199.52	+208.80	+217.89	+226.79
200	+162.01	+172.10	+181.95	+191.57	+200.97	+210.16	+219.17	+227.99
210	+163.80	+173.80	+183.55	+193.09	+202.40	+211.53	+220.46	+229.20
220	+165.58	+175.43	+185.16	+194.62	+203.85	+212.89	+221.74	+230.41
230	+167.36	+177.19	+186.78	+196.14	+205.30	+214.26	+223.04	+231.63
240	+169.16	+178.89	+188.39	+197.68	+206.75	+215.63	+224.33	+232.85
250	+170.94	+180.59	+190.01	+199.21	+208.20	+217.00	+225.63	+234.08
260	+172.73	+182.30	+191.63	+200.75	+209.66	+218.40	+226.93	+235.31
270	+174.53	+184.00	+193.25	+202.29	+211.12	+219.77	+228.24	+236.54
280	+176.32	+185.70	+194.88	+203.83	+212.59	+221.16	+229.55	+237.77
290	+178.11	+187.42	+196.50	+205.37	+214.05	+222.54	+230.86	+239.01
300	+179.90	+189.13	+198.13	+206.92	+215.51	+223.93	+232.18	+240.26

DIFFERENCE BETWEEN THE WATER THERMAL EXPANSION FACTOR AND THE STEEL THERMAL EXPANSION FACTOR ($^0C^{-1}$) (10^{-6})

TABLE -A

^{0}C Bar	24	25	26	27	28	29	30
0.981	+215.22	+215.14	+234.88	+244.41	+253.79	+263.00	+272.03
10	+216.13	+225.99	+235.66	+245.13	+254.44	+264.59	+272.57
20	+217.15	+226.94	+236.53	+245.94	+255.18	+264.27	+273.18
30	+218.18	+227.88	+237.41	+246.75	+255.93	+264.95	+273.80
40	+219.21	+228.85	+238.30	+247.58	+256.69	+265.64	+274.42
50	+220.25	+229.82	+239.20	+248.40	+257.45	+266.33	+275.07
60	+221.30	+230.79	+240.11	+249.24	+258.22	+267.04	+275.70
70	+222.35	+231.78	+241.02	+250.08	+258.99	+267.75	+276.35
80	+223.42	+232.77	+241.94	+250.93	+259.78	+248.47	+277.01
90	+224.48	+233.76	+242.87	+251.79	+260.57	+269.19	+277.66
100	+225.56	+234.76	+243.79	+252.66	+261.36	+269.92	+278.33
110	+226.64	+235.78	+244.73	+253.53	+262.17	+270.77	+279.01
120	+227.73	+236.79	+245.68	+254.40	+262.98	+271.41	+279.69
130	+228.82	+237.81	+246.63	+255.28	+263.69	+272.16	+280.38
140	+229.92	+238.84	+247.59	+25618	+264.62	+272.92	+281.08
150	+231.03	+239.87	+248.55	+257.07	+265.44	+273.69	+281.78
160	+232.14	+240.91	+249.52	+257.97	+266.28	+274.46	+282.49
170	+233.26	+241.96	+250.49	+258.88	+267.12	+275.23	+283.20
180	+234.38	+243.01	+251.47	+259.79	+267.97	+276.01	+283.92
190	+235.51	+244.06	+252.46	+260.71	+268.82	+276.80	+284.64
200	+236.64	+245.12	+253.45	+261.63	+269.67	+277.59	+285.37
210	+237.77	+246.18	+254.45	+262.50	+270.54	+278.39	+286.11
220	+238.91	+247.26	+255.45	+263.49	+271.40	+279.19	+286.85
230	+240.06	+248.33	+256.46	+264.43	+272.28	+280.00	+287.59
240	+241.21	+249.41	+257.46	+265.37	+273.16	+280.82	+288.35
250	+242.36	+250.49	+258.48	+266.31	+274.04	+281.63	+289.11
260	+243.52	+251.58	+259.49	+267.27	+274.92	+282.46	+289.86
270	+244.68	+252.66	+260.52	+268.23	+275.82	+283.29	+290.64
280	+245.84	+253.76	+261.54	+269.18	+276.71	+284.12	+291.40
290	+247.01	+254.86	+262.57	+270.15	+277.61	+284.95	+292.18
300	+248.18	+255.96	+263.60	+271.11	+278.51	+285.79	+292.95

DIFFERENCE BETWEEN THE WATER THERMAL EXPANSION FACTOR AND THE STEEL THERMAL EXPANSION FACTOR ($^0C^{-1}$) (10^{-6})

Edition : 1

SPECIFICATION
FOR
QUALITY ASSURANCE SYSTEMS
REQUIREMENTS

SPECIFICATION NO.: MEC/S/05/21/66

(OIL & GAS SBU)
MECON LIMITED
DELHI 110 092

C O N T E N T S

1.0 INTRODUCTION

This specification establishes the Quality Assurance Requirements to be met by the sub-contractors (including turnkey Contractors) and their sub-vendors.

In case of any conflict between this specification and other provisions of the contract/ purchase order, the same shall be brought to the notice of MECON, at the stage of bidding and shall be resolved with MECON, prior to the placement of order.

2.0 DEFINITION

Bidder

For the purpose of this specification, the word “Bidder” means the person(s), firm, company or organisation who is under the process of being contracted by MECON/ Owner for delivery of some products (including service). The word is considered synonymous to supplier, contractor or vendor.

Correction

Action taken to eliminate the detected non-conformity.

Refers to repair, rework or adjustment and relates to the disposition of an existing non-conformity.

Corrective Action

Action taken to eliminate the causes of an existing non-conformity, defect or other undesirable situation in order to prevent recurrence.

Preventive Action

Action taken to eliminate the causes of a potential non-conformity, defect or other undesirable situation in order to prevent its recurrence.

Process

Set of inter-related resources and activities which transform inputs into outputs.

Special Process

Processes requiring pre-qualification of their process capability.

3.0 CONTRACTORS SCOPE OF WORK

3.1 Prior to award of contract

The bidder shall understand scope of work, drawings, specifications and standards etc., attached to the tender/ enquiry document, before he makes an offer.

The bidder shall submit milestone chart showing the time required for each milestone activity and linkages between different milestone activities alongwith overall time period required to complete the entire scope of work.

The bidder shall develop and submit manpower and resource deployment chart.

The bidder shall submit, alongwith the bid, a manual or equivalent document describing/ indicating/ addressing various control/ check points for the purpose of quality assurance and the responsibilities of various functions responsible for quality assurance.

3.2 After the award of contract

The bidder shall submit the schedule for submission of following documents in the kick-off meeting or within two weeks of the placement of order, whichever is earlier.

- Detailed Bar Chart
- Quality plan for all activities, required to be done by the bidder, to accomplish offered scope of work.
- Inspection and test plans, covering various control aspects.
- Job procedures as required by MECON/ Owner.
- Procurement schedule for items to be supplied by contractor covering inspection of the same.

Various documents submitted by the bidder shall be finalised in consultation with MECON. Here it shall be presumed that ones a bidder has made an offer, he has understood the requirements given in this specification and agrees to comply with them in totality unless otherwise categorically so indicated during pre-award stage through agreed deviation/ exception request. All Quality Assurance Plan (QAP) documents shall be reviewed by concerned functional groups of MECON and the bidder shall be required to incorporate all comments within the framework of this specification at this stage of the contract. It is also obligatory on the part of the bidder that obtains approval on every Quality Assurance Plan (QAP) documents, before he starts using a particular document for delivery of contracted scope of work. Participation of MECON/ Owner in review/ approval of quality plan/ QAP documents does not absolve the contractor of his contractual obligations towards specified and intended use of the product (or service) provided/ to be provided by him under the contract.

3.3 **During job execution**

During job execution, the bidder shall fully comply with all quality document submitted and finalised/ agreed against the requirements of this specification. Approval of MECON on all these documents shall be sought before start of work.

Bidder shall produce sufficient quality records on controlled/ agreed forms such that requirements given in this specification are objectively/ demonstrable.

Bidder shall facilitate MECON/ Owner during quality/ technical audits at his works/ sites.

Bidder shall discharge all responsibilities towards enforcement of this specification on all his sub-contractors for any part of the scope which is sub-contracted.

4.0 QUALITY ASSURANCE SYSTEM REQUIREMENTS

4.1 The bidder shall nominate an overall incharge of the contract titled as “Project Manager” for the scope of work of agreed contract. The name of this person shall be duly intimated to MECON including all subsequent changes, if any. MECON shall correspond only with the project manager of the bidder on all matters of the project. The project manager of the bidder shall be responsible for co-ordination and management of activities with bidder’s organisation and all sub-vendors appointed by the bidder.

After award of work, the bidder may review augmentation of manpower and resources deployment chart (submitted earlier), detail it out, if so consented by MECON/ Owner and resubmit the same as “issued for effective implementation of the project”.

4.2 The bidder shall plan the contract scope of work on quality plan format such that no major variation is expected during delivery of contract scope of work. These quality plan shall be made on enclosed format complete in all respect. The quality plan shall be assumed to be detailing bidder’s understanding and planning for the contract/ offered scope of work. The bidder shall plan the type of resources including various work methodology which he agrees to utilize for delivery of contract scope of work.

4.3 The bidder is required to review the contract at all appropriate stages to evaluate his capabilities with respect to timely and quality completion of all activities pertaining to contracted scope of work and shall report for constraints, if any to MECON/ Owner.

4.4 The design activities, if any, performed during delivery of contract scope of work shall be so controlled that the outputs is reliable enough. It is expected that during development of design, the bidder shall take recourse to detailed checking, inter departmental reviews and documented verification methods.

4.5 For all documents which the bidder is likely to utilise for delivery of contract scope of work, a system must exist which assures that latest/ required version(s) of the document(s) is available at all location/ point of use.

4.6 In case the bidder decides to sub-contract any part/ full of the contract scope of work (without prejudice to main Contractual condition), the bidder shall :

- Evaluate the technical and financial capabilities and past performance of the sub-contractor(s) and their products and/ or services before awarding them with the sub-contracted scope of work. Selection of a sub-contractor should meet MECON approval in documented form.

- Requirement of this specification shall be enforced on sub-contracted agency also. The bidder shall choose sub-contractor based on their capability to meet requirements of this specification also.

  Note: It may so happen that, in a given situation, a sub-contractor may not have a system meeting the requirements of this specification. In all such eventualities, bidder may lend his system to sub-contractor for the contract such that sub-contractor effectively meets the requirements of this specification. In all such cases MECON shall be duly informed.

4.7 Bidder shall establish adequate methodology such that the materials supplied by the Owner/ MECON shall be adequately preserved, handled and made use of for the purpose for which they are provided.

4.8 All output delivered against contract scope of work shall be suitably identified in such a manner that either through identification or some other means, sufficient traceability is maintained which permits effective resolution of any problem reported in the outputs.

4.9 Critical activities shall be identified and the bidder is required to have documented methodologies which he is going to utilize for carrying out such activities under the contract scope of work. Wherever it is difficult to fully inspect or verify the output (special process), bidder shall pre-qualify, the performers and methodologies.

4.10 All inspections carried out by the bidder's surveillance/ inspection staff shall be conformity to quality plans and/ or inspection and test plans. All inspection results shall be duly documented on controlled/ agreed forms such that results can be co-related to specific product, that was inspected/ tested.

4.11 All inspection, measuring & test equipments (IMTEs) shall be duly calibrated as per National/ International standards/ codes and only calibrated and certified IMTEs shall be utilized for delivery of contract scope of work.

4.12 All outputs/ products delivered against contract scope of work shall be duly marked such that their inspection status is clearly evident during all stages/ period of the contract.

4.13 All non-conformities (NCs) found by the contractor's inspection/ surveillance staff shall be duly recorded, including their disposal action. The deficiencies observed during stage of the product, shall be recorded and resolved suitably. Effective corrective and preventive action shall be implemented by the bidder for all repetitive NCs, including deficiencies.

4.14 All deficiencies noticed by MECON/ Owner representative(s) shall be recorded on a controlled form (Format No. 00002). Such deficiencies shall be analysed by the bidder and effective and appropriate correction, corrective and preventive actions shall be implemented. Bidder shall intimate MECON/ Owner of all such corrective and preventive action implemented by him.

4.15 Bidder shall establish appropriate methodologies for safe and effective handling, storage, preservation of various materials/ inputs encountered during delivery of contract scope of work.

4.16 Bidder shall prepare sufficient records for various processes carried out by him for delivery of contract scope of work such that requirements of this specification are objectively demonstrable. In case MECON/ Owner finds that enough objective evidence/ recording is not available for any particular process, bidder shall be obliged to make additional records so as to provide sufficient objective evidence. The decision of MECON/ Owner shall be final and binding on such issues.

4.17 The bidder shall arrange internal quality audits at quarterly intervals, to independently assess the conformance by various performers to the requirements of this specification. The findings of such assessment shall be duly recorded and a copy shall be sent to MECON/ Owner for review.

4.18 For all special processes, bidder shall deploy only qualified performers. Wherever MECON/ Owner observes any deficiency, the bidder shall arrange the adequate training to the performer(s) before any further delivery of work.

FORMAT – 00001

Bidder's Quality Plan		Project Name :				PO/ Contract Ref:				
General			Performing Functions			Inspection Functions			Audit Function	
Activity Description	Procedure Number	Code of Conformance	Performer	Checker	Reviewer/ Approver	Sampling Plan	Testing and Inspection Code	Type of (Approval) Surveillance	Audit Scope	Owner's/ MECON Review/ Audit Requirement

Note: 1) The bidder ensures that the filled up format conforms to minimum requirements on Quality Plan/ Quality Assurance, specified by MECON on drawings/ standards/ specifications/ write-up.

2) The bidder confirms that document is issued for information/ approval of Owner/ MECON for the project implementation

OBSERVATION OF QUALITY ASPECTS

FORMAT – 00002

Job No. and Description Issued to : M/s			No. : Date :
Location of Work : Item of Work :			
Details of Observation(Deficiency)	Recommended Course of Action Time Allowed for Correction :		
Issued by : _____ Name of Signature of RCM, MECON Site			
Corrective Action taken report by Contractor/ Vendor : Date : Name and Signature			
Distribution (before resolution) : Project Manager Owner	Chief Business Executive MECON	MECON Inspection New Delhi	Resident Construction Manager, MECON Site
Verification of Resolution by MECON : Date : Name of Signature			
Distribution (before resolution) : Project Manager Owner	Chief Business Executive MECON	MECON Inspection New Delhi	Resident Construction Manager, MECON Site

SPECIFICATION
FOR
DOCUMENTATION FOR PIPELINE CONSTRUCTION

SPECIFICATION NO.: MEC/S/05/21/69

(OIL & GAS SBU)
MECON LIMITED
DELHI 110 092

CONTENTS

1.0 **SCOPE**

1.1 This specification covers the minimum requirements of various records, reports and drawings for all aspects of pipeline construction to be prepared by Contractor and submitted to the Company at intervals as described in this specification and as directed by Company.

1.2 All document required to prepared and submitted by Contractor as per this specification shall be in addition to the various reports, records, methodology statement, calculation, drawings etc. to be submitted by the Contractor for Company's record, review or approval as per the requirements of all other specification included in the Contract between the Company and Contractor.

1.3 This specification shall be read in conjunction with the conditions of all specifications and document included in the Contract between Company and Contractor.

2.0 **RECORDS**

Contractor shall submit daily, weekly, monthly and after completion to the Company, various records and reports for Company's documentation purpose during and immediately after the construction. This shall as minimum include, but not limited to the following :

2.1 **Daily**

- Separate progress reports of all crews
- Daily welding results and repairs
- Actual weather conditions
- Application for deviations, if any
- Accidents
- Damages
- Activities required from Company
- Materials Receipts
- Urgently required materials

2.2 **Weekly**

- Up-to-date list of confirmed site instruction issued by Company
- Materials `taken over'
- Material defects and repairs
- Outstanding activities of Company

- List of installed markers, chainage
- Required approval from Company
- Progress planned
- Reports of manning of all crews, equipment and plant
- Report of equipment and plant
- Report of accidents
- Report of damages
- Report of acquired release, permits
- Priced variations
- Required materials for next month

2.3 **Monthly**

- Progress report for payment, safety report, report of accidents, security report, health and environment report, material balance, approved deviations.

2.4 Further, Contractor shall supply (for approval if required to the Company with document such as but not limited :

- Organogram for construction work.
- Bio-data of key personnel (including foremen).
- (Revised) list of address of personnel in particular of medical staff, safety and security offers.
- (Revised) list of approved coaters.
- (Revised) list of approved sub-contractors.
- Time schedule.
- Acquired permits and/ or approvals from Authorities, if any.
- Minutes of meeting with Company with comments, if any.
- Material certificates, material receipt.
- Guarantee from vendors and sub-contractor.
- Calculations, temporary works, bouyance, blasting.
- Drawings issued by Contractor.
- Vendors drawings.
- As-built of route maps, alignment sheets, details drawings and isometric drawings.
- Procedures such as surveying, stacking, fencing.
- Welding procedure qualification records, radiographic procedure qualification, welder qualification.
- Coating procedure.
- Installation of crossings.
- Hydrostatic testing.
- Blasting.

- Radiographic report alongwith original radiographs
- Pipe and welding book.
- Reports

  - Material tests (coating, welding, painting)
  - Computerised Potential Logging Test
  - Water Samples
  - Cleaning, Pigging Report before Hydrostatic Test
  - Hydrostatic Test
  - Calibration Test
  - Blasting Trials
  - Equipment certificate (dead weight tester, instruments, vessels, equipment)
  - Manuals
  - Major water crossings
  - Waste disposal
  - Disposal of water after hydrostatic test.

2.5 Contractor shall submit to company colour photographs of various construction activities/ operations at regular intervals. Size, number and frequency of the photographs shall be mutually agreed upon at a later stage. Also Contractor shall make video recordings of all operations right from the start of construction till the completion of the work, covering to the extent as instructed by Company and submit to Company. Upon completion of the work, Contractor and submit edited master tape plus six copies of video recording in VHS formats or any format ordered by the Company. The duration of video recording shall be of ½ hour and shall cover all aspects of the job.

3.0 AS-BUILT DRAWINGS AND PIPE BOOK

3.1 General

Contractor shall prepare “as-built” drawings of all by or on behalf of Company issued drawings and of all Contractor work drawings including vendor drawing, such as but not limited to :

For Pipeline Section :

- Route Maps
- Alignment Sheets
- Detail Drawings (road, railway, minor water crossings, major water crossings, valley crossings)

- Isometric drawings of installations
- Special installation

Further Contractor shall prepare a pipe Weld Book.

If required by the Company, Contractor shall update the diskettes for drawings issued for construction of the job.

3.2 **"As-Built" Drawings**

Contractor shall prepare a complete set of "as-built" drawings. From the start of construction, Contractor shall on daily basis process any changes in two sets of drawings. Deleted parts shall be indicated in red, new parts in blue, remarks in green and unchanged parts in yellow. Said drawings shall be kept at site and be available to Company at all times. Contractor shall prepare "as-built" drawings based on these data. On completion of the work, one revised film transparency of all drawing made "as-built" by Contractor containing the "as-built" information shall be handed over to Company as well as one complete set of CD ROM/ floppy diskettes as specified by Company.

Contractor shall prepare and submit a specimen of the layout of the drawings for Company's approval.

The required measurement for "as-built" drawing shall be executed by Contractor by experienced, qualified surveyors.

The surveyors shall daily take care of all measurement required such as but not limited to:

- Horizontal location of pipeline with regard to deviations and Permanent Grid Pillars.
- Vertical Level with regard to Mean Sea Level of pipeline and grade.
- Location and type of bends, fittings etc. and grades, points of intersection.
- Change of wall thickness, materials.
- Location and details of valves, insulating flanges, fencing.
- Location and details of crossing pipes, vents.
- Location and type of coating.
- Location and type of weighting, anchoring.
- Location and type of markers.
- Location of further appurtenance (Pig-Signallers)
- Location of ROU and of pipeline with respect to ROU.
- Type of soil.

- Type of rock
- Type of blasting and ripping.
- Sand padding.
- Type of road pavement.
- Details of bank protection, number of insulators, seals.

Contractor shall also prepare isometric drawings of all installation (facilitates) etc. for which the data as mentioned in or required for the Pipe and Welding Book can be identified and these drawings can also be used for material accounting.

3.3 **Nameplates of Equipment**

All permanent equipment supplied and installed by Contractor shall be provided with plates by Contractor. All texts shall be submitted to Company for approval before plates may be manufactured.

3.4 **Pipe Book**

Every page of the pipe and Welding Book shall mention:

- Data relevant to the project and section there of.
- Sequential number.
- Length brought forward (for pipes and other materials).
- Length to bring forward (for pipes and other materials).

Alignment sheet number and atleast the location thereon of two welds on every page of the pipe Book.

Further,

- Diameter of pipeline
- Length of each pipe
- Wall thickness
- Pipe number
- Heat number, certificate number
- Cut and re-numbered pipe ends
- Coating type
- Date of stringing
- Date of welding
- Weld number
- Welder number
- Direction of working

- Type of welding, electrodes, diameter of electrode etc.
- Heat treatment
- Equipment used for radiography
- Limits of water crossings
- Test pressure and date of test.

In order to achieve this, Contractor shall identify all pipe elements. Sample format of Pipe Book shall be submitted for Company approval.

3.5 **As-Built Documents**

Contractor shall prepare all documents in the prescribed format as indicated below. In addition to the hard copies, softcopies of final documents shall also be submitted in electronic media i.e. CD / DVD format.

Software used for the preparation of these documents shall be as follows:

Type document		Software
a)	Reports/ Documents	MS Office
b)	Drawings	Auto CAD

For the purpose of preparation of as-built drawings, Contractor shall update the "Issued for construction" drawings issued by the Company. It shall be the Contractor's responsibility to covert the drawings furnished by the Company in hard copy into CAD drawings including scanning, digitising and converting the drawings into a suitable format compatible with the AutoCAD and above. As-built drawings shall be prepared only on AutoCAD drawings.

SPECIFICATION
FOR
HEALTH, SAFETY
AND
ENVIRONMENT (HSE)
MANAGEMENT

SPECIFICATION NO.: MEC/S/05/21/65

(OIL & GAS SBU)
MECON LIMITED
DELHI 110 092

C O N T E N T S

1.0 **SCOPE**

This specification establishes the Healthy, Safety and Environment (HSE) management requirement to be compiled with by the Contractors during construction.

This specification is not intended to replace the necessary professional judgement needed to design & implement an effective HSE system for construction activities and the contractor is expected to exceed requirements given in this specification.

Requirement stipulated in this specification shall supplement the requirement of HSE management given in relevant Act (S)/ legislations. General Condition of Contract (GCC) Special Condition of Contract (SCC) and Job Specifications. Where different documents stipulate different requirements, the most stringent shall be adopted.

2.0 **REFERENCES**

This document should be read in conjunction with following:

- General Conditions of Contract (GCC)
- Special Conditions of Contract (SCC)
- Building and other construction workers (regulation of employment and condition of service) Act, 1996
- Job Specifications
- Relevant IS Codes (refer Annexure-A)
- Reporting Formats (refer Annexure-B)
- Statutory requirements

3.0 **REQUIREMENT OF HEALTH, SAFETY & ENVIRONMENT (HSE) MANAGEMENT SYSTEM TO BE COMPLETED BY BIDDERS.**

3.1 **Management Responsibility**

3.1.1 The Contract should have a document HSE policy to cover commitment of the organization to ensure health, safety and environment aspects in their line of operations

3.1.2 The HSE management system of the Contractor shall cover HSE requirement including but not limited to what specified under clause 1.0 & 2.0 mentioned above

3.1.3 Contractor shall be fully responsible for planning and implementing HSE requirement to the satisfaction of the company. Contractor as a minimum requirement shall designate/deploy the following to co-ordinate the above:

No. Of workers deployed		
Up to 250	-	Designate one safety supervisor who will guide the workers from time to time, as well as impart training basic guidelines at least weekly once.

Above 250 & upto 500	-	Deploy one qualified and experienced safety Engineer/ Officer who will guide the workers from time to time as well as impart basic guideline & training at least weekly once. He / She shall possess a recognized Degree in any branch of engineering or technology or architecture and had a post qualification construction experience of minimum two years or possess a recognized Diploma in any branch of engineering or technology or Graduate in Science stream and had a post qualification construction experience of minimum five years.
Above 500 (for every 500 or less)	-	One additional safety engineer/Officer whose function will be as mentioned above

Contractor shall indemnify and hold harmless OWNER/ MECON & their representative's from any and all liabilities arising out of non fulfillment of HSE requirements.

Above is the minimum requirement and the Contractor shall ensure physical presence of a safety personnel at each place where Hot work permit is required. No work shall be started at site until above safety personnel are physically present at site. The contractor shall submit a safety organogram clearly indicating the lines of responsibility and reporting system. He shall furnish Bio-Data/Resume/Curriculum Vitae of the safety personnel he intends to mobilize, at least 1 month before the intended mobilization, for MECON/Owner's approval.

3.1.4 The Contractor shall ensure that the Health, Safety and Environment (HSE) requirements are clearly understood & faithfully implemented at all levels, at each and every site/ work place.

3.1.5 The Contractor shall promote and develop consciousness for Health, Safety and Environment among all personnel working for the Contractor. Regular awareness programs and fabrication shop/work site meeting shall be arranged on HSE activities to cover hazards involved in various operations during construction.

3.1.6 Arrange suitable first aid measures such as First Aid Box, trained personnel to give First Aid, Stand by Ambulance or Vehicle and install fire protection measures such as: adequate number of steel buckets with sand and water and adequate fire extinguishers to the satisfaction of OWNER/ MECON. In case the number of workers exceeds 500, the Contractor shall position an ambulance /vehicle on full time basis very close to the worksite.

3.1.7 The Contractor shall evolve a comprehensive planned and documented system for implementation and monitoring of the HSE requirements. This shall submitted to

OWNER & MECON for approval well in advance, prior to start of work. The monitoring for implementation shall be done by regular inspection and compliance to the observations thereof. The Contractor shall get similar HSE requirements implemented at his sub-contractor (s) work site/ Office. However, compliance of HSE requirement shall be the sole responsibility of the Contractor. Any review/ approval by OWNER/ MECON shall not absolve the Contractor of his responsibility/ liability in relation to all HSE requirements.

3.1.8 Non-Conformance on HSE by the Contractor (including his Sub-contractors) as brought out during review/ audit by MECON/ OWNER representative shall be resolved forthwith by Contractor. Compliance report shall be possibility submitted to MECON/ OWNER at the earliest.

3.1.9 The Contractor shall ensure participation of his Resident Engineer/Site-in-Charge in the Safety Committee/HSE Committee meetings arranged by OWNER/ MECON. The compliance of any observation shall be arranged urgently. Contractor shall assist OWNER/MECON to achieve the targets set by them on HSE during the project implementation.

The contractor shall ensure that his staff members & workers (permanent as well casual) shall not be in a state of intoxication during working hours and shall abide by any law relating to consumption & possession of intoxicating drinks or drugs in force. Awareness about local laws on this issue shall form part of the Induction Training.

The contractor shall ensure that all personnel working for him comply with No-smoking requirements of the owner as notified from time to time. Cigarettes, lighters, auto ignition tools or appliances shall not be allowed inside the plant complex. Smoking shall be permitted only inside smoking booths expressly designated & authorized by the Owner/MECON.

3.1.10 The Contractor shall adhere consistently to all provisions of HSE requirements. In case of non-compliance or continuous failure in implementation of any of HSE provisions; OWNER/ MECON may impose stoppage of work without any Cost & Time implication to Owner and/or impose a suitable penalty for non-compliance with a notice of suitable period, upto a cumulative limit of 1.0% (one percent) of Contract value with a ceiling of Rs. 10 lakhs.

0.2% (Zero decimal two percent) of the contract value for LSTK, EPC, EPCC or Package contracts with an overall ceiling of Rs. 1,00,00,000/- (Rupees one crore).

S. No.	Violation or HSE norms	Penalty Amount
1.	For not using personal protective equipment (Helmet, Shoes, Goggles, Gloves, Full body harness, Face shield, Boiler suit, etc.)	Rs. 250/- per day / item / person
2.	Working without Work Permit / Clearance	Rs.5,000/- per occasion

S. No.	Violation or HSE norms	Penalty Amount
3.	Unsafe electrical practices (not installing ELCB, using poor joints of cables, using naked wire without top plug into socket, laying wire / cables on the roads, electrical jobs by incompetent person, etc.)	Rs.3,000/- per item per day.
4.	Working at height without full body harness, using non-standard / rejected scaffolding and not arranging fall protection arrangement as required like Safety Nets.	Rs.1,000/ per case per day.
5.	Unsafe handling of compressed gas cylinders (No trolley, jubilee clips double gauge regulator, improper storage / handling).	Rs. 100/- per item per day
6.	Use of domestic LPG for cutting purpose.	Rs.1,000/- per occasion
7.	No fencing / barricading of excavated areas.	Rs.1,000/- per occasion
8.	Not providing shoring / strutting / proper slope and not keeping the excavated earth at least 1.5 M away from excavated area.	Rs.5,000/- per occasion
9.	Non display of caution boards, list of hospitals, emergency services available at work locations.	Rs.500/- per occasion
10.	Traffic rules violations like over speeding of vehicles, rash driving, wrong parking, not using seat belts, vehicles not fitted with reverse warning alarms.	Rs.1,000/- per occasion
11.	Absence of Contractor's top most executive at site in the safety meetings whenever called by MECON / Owner	Rs.1,000/- per occasion
12.	Failure to maintain safety records by Contractor Safety personnel.	Rs.1,000/- per month.
13.	Failure to conduct daily safety site inspection, HSE meeting and HSE audit at predefined frequencies.	Rs.1,000/- per occasion
14.	Failure to submit the monthly HSE report by 5th of subsequent month to Engineer-in-Charge.	Rs. 1,000/- per occasion and Rs. 100/- per day for further delay.
15.	Poor House Keeping	Rs.1,000/- per occasion
16.	Failure to report & follow up accident (including Near Miss) reporting system.	Rs. 10,000/- per occasion

S. No.	Violation or HSE norms	Penalty Amount
17.	Degradation of environment (not confining toxic spills oil / lubricants onto ground)	Rs.1,000/- per occasion
18.	Not medically examining the workers before allowing them to work at height, not providing ear muffs while allowing them to work in noise polluted areas, made them to work in air polluted areas without respiratory protective devices, etc.	Rs.1,000/- per occasion
19.	Violation of any other safety condition as per job HSE plan, work permit and HSE conditions of contract (using crowbar on cable trenches, improper welding booth, not keeping fire extinguisher ready at hot work site, unsafe rigging practices, non-availability of First-Aid box, etc.)	Rs.1,000/- per occasion
20.	Any violation not covered above.	To be decided by MECON / Owner

This penalty shall be in addition to all other penalties specified else where in the contract. The decision of imposing stoppage of work, its extent & monitory penalty shall rest with MECON/OWNER & binding on the Contractor.

3.1.11 All fatal accidents and other personnel accidents shall be investigated by a team of Contractor's senior personnel for root cause and recommend corrective and preventive actions. Findings shall documented and suitable actions taken to avoid recurrences shall be communicated to OWNER / MECON. OWNER / MECON shall have the liberty to independently investigate such occurrences and Contractor shall extend all necessary help and co-operation in this regard. MECON / Owner shall have to right to share the content of this report with the outside world.

3.2 **House Keeping**

3.2.1 Contractor shall ensure that a high degree of house keeping is maintained and shall ensure the followings:

a. All surplus earth and debris are removed/disposed off from the working site to identified location (s).

b. Unused/Surplus Cables Steel items and steel scrap lying scattered at different places within the working areas are removed to identified location (s).

c. All wooden scrap, empty wooden cable drums and other combustible packing materials shall be removed from work place to identified location(s).

d. Roads shall be kept clear and materials like pipes, steel, sand, boulders, concrete chips and bricks, etc. shall not be allowed in the roads to obstructs free movement of men & machineries.

e. Fabricated steel structurals, pipes & piping materials shall be stacked properly for erection.

f. Water logging on rods shall not be allowed.

g. No parking of trucks/ trolleys, cranes and trailors etc. shall be allowed on of roads, which may obstruct the traffic movements.

h. Utmost care shall be taken to ensure over all cleanliness and proper up keep of the working areas.

i. Trucks carrying sand, earth and pulverized materials etc. shall be covered while moving within the plant areas.

j. The contractor shall ensure that the atmosphere in plant area and on roads is free from particulate matter like dust, sand, etc. by keeping the top surface wet for ease in breathing.

k. At least two exits for any unit area shall be assured at all times.

3.3 **Healthy, Safety and Environment**

a) The Contractor shall provide safe means of access to any working place including provision of suitable and sufficient scaffolding at various stages during all operations of the work for the safety of his workmen, and OWNER/ MECON. Contractor shall ensure deployment of appropriate equipment and appliances for adequate safety and healthy of the workmen and protection of surrounding areas.

Contractor shall ensure identification of all Occupational Health, Safety & Environmental hazards in the type of work he is going to undertake and enlist mitigation measures. Contractor shall carry out Job Safety Analysis (JSA) specifically for high risk jobs like working at height & in confined space, deep excavations, radiography jobs, electrical installations, blasting operations, demolishing / dismantling activities, welding / gas cutting jobs and submit the findings to MECON / Owner. The necessary HSE measures devised shall be in place prior to start of an activity by the contractor.

b) The Contractor shall ensure that all their staff workers including their sub-Contractor (s) shall wear Safety Helmet and Safety shoes. Contractor shall also ensure use of safety belt, protective goggles, gloves etc. by the personnel as per jobs requirements. All these gadgets shall conform to relevant IS specification equivalent.

The Contractor shall ensure that all their staff, workers and visitors including their sub-contractor(s) have been issued (records to be kept) & wear appropriate PPEs like nape strap type safety helmets preferably with head & sweat band with ¾" cotton chin strap (made of industrial HDPE), safety shoes with steel toe cap and antiskid sole, full body harness (C∈ marked and conforming to EN361), protective goggles, gloves, ear muffs, respiratory protective devices, etc. All these gadgets shall conform to applicable IS Specifications / C∈ or other applicable international standards.

Owner may issue a comprehensive color scheme for helmets to be used by various agencies. The Contractor shall follow the scheme issued by the owner. All Safety / Fire personnel shall preferably wear red colour helmet so that workmen can approach them for guidance during emergencies.

For shot blasting, the usage of protective face shield and helmets, gauntlet and protective clothing is mandatory.

For offshore jobs/contracts, contractor shall provide PPEs (new) to MECON & Owner's personnel, at his (contractor's) cost. All personnel shall wear life jacket at all time.

An indicative list of HSE standards/codes is given under Appendix-A.

The contractor shall issue height permit for working at height after verifying and certifying the checkpoints as specified in the attached permit (Format No. HSE-6). He shall also undertake to ensure compliance to the conditions of the permit during the currency of the permit including adherence to personal protective equipments.

The permit shall be issued initially for one week or expected duration of an activity and extended further for the balance duration. This permit shall be applicable in areas where specific clearance from Owner's operation Deptt. / Safety Deptt. is not required. MECON field Engineers / Safety Officers / Area Coordinators may verify and counter sign this permit (as an evidence of verification) during the execution of the job.

In case work is undertaken without taking sufficient precautions as given in the permit, MECON Engineers may cancel the permit and stop the work till satisfactory compliance is arranged. Contractors are expected to maintain a register for issuance of permit and extensions thereof including preserving the used permits for verification during audits etc.

Contractor shall arrange (at his cost) and ensure use of Fall Arrester Systems by his workers. Fall arresters are to be used while climbing / descending tall structures. These arresters should lock automatically against the anchorage line, restricting free fall of the user. The device is to be provided with a double security opening system to ensure safe attachment or release of the user at

any point of rope. In order to avoid shock, the system should be capable of keeping the person in vertical position in case of a fall.

Contractor shall ensure that Full body harnesses conforming EN361 and having authorized CC marking is used by all personnel while working at height. The lanyards and life lines should have enough tensile strength to take the load of the worker in case of a fall. One end of the lanyard shall be firmly tied with the harnesses and the other end with life line. The harness should be capable of keeping the workman vertical in case of a fall, enabling him to rescue himself.

Contractor shall provide Roof Top Walk Ladders for carrying out activities on sloping roofs in order to reduce the chances of slippages and falls.

c) Contractor shall ensure that a proper Safety Net System shall be used at appropriate locations. The safety net shall be located not more than 30 feet (9.0 metres) below the working surface at site to arrest or to reduce the consequences of possible fall of persons working at different heights.

d) Contractor shall ensure that flash back arrestors conforming to BS:6158 or equivalent are installed on all gas cylinders as well as at the torch end of the gas hose, while in use. All cylinders shall be mounted on trolleys and provided with a closing key. The burner and the hose placed downstream of pressure reducer shall be equipped with Flash Back Arrester / Non Return Valve device. The hoses for acetylene and oxygen cylinders must be of different colours. Their connections to cylinders and burners shall be made with a safety collar. At end of work, the cylinders in use shall be closed and hoses depressurized. All welding machines shall have effective earthing. In order to help maintain good housekeeping, and to reduce fire hazard, live electrode bits shall be contained safely and shall not be thrown directly on the ground.

e) The Contractor shall assign to his workmen, tasks commensurate with their qualification, experience and state of health for driving of vehicles, handling and erections of materials and equipment's. All lifting equipments shall be tested certified for its capacity before use. Adequate and suitable lighting at every work place and approach there to shall be provided by the contractor before starting the actual work/ operation at night.

Contractor shall ensure installation of Safe Load Indicator (SLI) on all cranes (while in use) to minimize overloading risk. SLI shall have capability to continuously monitor and display the load on the hook, and automatically compare it with the rated crane capacity at the operating condition of the crane. The system shall also provide visual and audible warnings at set capacity levels to alert the operator in case of violations.

The contractor shall be responsible for safe operations of different equipments mobilized and used by him at the workplace like transport

vehicles, engines, cranes, mobile ladders, scaffoldings, work tools, etc.

f) Hazardous and/or toxic material such as solvent coating or thinners shall be stored in appropriate containers.

g) All hazardous materials shall be labeled with the name of the materials, the hazards associated with its use and necessary precautions to be taken.

The work place shall be checked prior to start of activities to identify the location, type and condition of any asbestos materials which could be disturbed during the work. In case asbestos material is detected, usage of appropriate PPEs by all personnel shall be ensured and the matter shall be reported immediately to MECON / Owner.

h) Contractor shall ensure that during the performance of the work all hazards to the health of personnel have been identified assessed and eliminated.

i) Chemical spills shall be contained & cleaned up immediately to prevent further contamination.

j) All personnel exposed to physical agents such as ionizing or non-ionizing radiation ultraviolet rays or similar other physical agents shall be provided with adequate shielding or protection commensurate with type of exposure involved. For ionizing radiation, requirements of Bhabha Atomic Research Centre (BARC)/ Atomic Energy Regulatory Board (AERB) shall be followed.

k) Where contract or exposure of hazardous materials could exceed limits or could otherwise have harmful affects, appropriate personal protective equipment's such as gloves, goggles, aprons, chemical resistant clothing and respirator shall be used.

l) Contractor shall ensure the following facilities at work sites:

I) A Crèche where 10 or more female workers are having children below the age of 6 years.

II) Reasonable Canteen facilities are made available at appropriate location depending upon site conditions.

m) Suitable facilities for toilet, drinking water, proper lighting shall be provided at site and labor camps, commensurate with applicable Laws/Legislation.

n) Contractor shall ensure storage and utilization methodology of material that are not detrimental to the environment. Wherever required Contractor shall ensure that only the environment friendly material are selected.

Emphasize on recycling of waste materials such as metals, plastics, glass, paper, oil & solvents. The waste that can not be minimized, reused or

recovered shall be stored and disposed of safely. In no way, toxic spills shall be allowed to percolate into the ground. The contractor shall not use the empty areas for dumping the wastes.

o) All person deployed at site shall be knowledgeable of and comply with the environmental laws, rules & regulation relating to the hazardous materials substance and wastes. Contractor shall not dump, release or otherwise discharge or dispose off any such materials without the authorization of OWNER/ MECON.

Suitable scaffoldings shall be provided to workmen for all works that cannot be safely done from the ground or from solid construction except such short period work that can be safely done using ladders. When a ladder is used, an extra workman shall be engaged for holding the ladder.

The contractor shall ensure that the scaffolds used during construction activities shall be strong enough to take the designed load. Owner / MECON reserves the right to ask the contractor to submit certification and or design calculations from his Engineering regarding load carrying capacity of the scaffoldings.

All scaffolds shall be inspected by a Scaffolding Inspector of the contractor. He shall paste a GREEN tag on each scaffold found safe and a RED tag on each scaffold found unsafe. Scaffolds with GREEN tag only shall be permitted to be used and RED ones shall immediately be removed from the site.

All electrical installations / connections shall be carried out as per the provisions of latest revision of following codes/standards, in addition to the requirements of Statutory Authorities and IE / applicable international rules & regulations:

- OISO SID 173 : Fire prevention & protection system for electrical installations
- SP 30 (BIS) : National Electric Code

All electrical installations shall be approved by the concerned statutory authorities.

- The contractor shall meet the following requirements:

i) Ensure that electrical systems and equipment including tools & tackles used during construction phase are properly selected, installed, used and maintained as per provisions of the latest revision of the Indian Electrical / applicable international regulations.

ii) Shall deploy qualified & licensed electricians for proper & safe installation and for regular inspection of construction power

distribution system / points including their earthing. A copy of the license shall be submitted to MECON / Owner for records. Availability of at least one competent licensed electrician shall be ensured at site round the clock to attend to the normal / emergency jobs.

iii) All switchboards / welding machines shall be kept in well-ventilated & covered shed. The shed shall be elevated to avoid water logging. No flammable materials shall be used for constructing the shed. Also flammable materials shall not be stored in and around electrical equipment / switchboard. Adequate clearances and operational space shall be provided around the equipment.

iv) Fire extinguishers and insulating mats shall be provided in all power distribution centers.

v) Temporary electrical equipment shall not be employed in hazardous area without obtaining safety permit.

vi) Proper house keeping shall be done around the electrical installations.

vii) All temporary installations shall be tested before energising, to ensure proper earthing, bonding, suitability of protection system, adequacy of feeders/cables etc.

viii) All welders shall use hand gloves irrespective of holder voltage.

ix) Multilingual (Hindi, English and local language) caution boards, shock treatment charts and instruction plate containing location of isolation point for incoming supply, name & telephone No. of contact person in emergency shall be provided in substations and near all distribution boards / local panels.

x) Operation of earth leakage device shall be checked regularly by temporarily connecting series test lamp (2 bulbs of equal rating connected in series) between phase and earth.

xi) Regular inspection of all installations (at least once in a month)

- The following features shall also be ensured for all electrical installations during construction phase by the contractor:

i) Each installation shall have a main switch with a protective device, installed in an enclosure adjacent to the metering point. The operating height of the main switch shall not exceed 1.5 M. The main switch shall be connected to the point of supply by means of armoured cable.

ii) The outgoing feeders shall be double or triple pole switches with fuses / MCBs. Loads in a three phase circuit shall be balanced as far as

possible and load on neutral should not exceed 20% of load in the phase.

iii) The installation shall be adequately protected against overload, short circuit and earth leakage by the use of suitable protective devices. Fuses wherever used shall be HRC type. Use of rewirable fuses shall be strictly prohibited. The earth leakage device shall have an operating current not exceeding 30 mA.

iv) All connections to the hand tools / welding receptacles shall be taken through proper switches, sockets and plugs.

v) All single phase sockets shall be minimum 3 pin type only. All unused sockets shall be provided with socket caps.

vi) Only 3 core (P+N+E) overall sheathed flexible cables with minimum conductor size of 1.5 mm^2 copper shall be used for all single phase hand tools.

vii) Only metallic distribution boxes with double earthing shall be used at site. No wooden boxes shall be used.

viii) All power cables shall be terminated with compression type cable glands. Tinned copper lugs shall be used for multistrand wires / cables.

ix) Cables shall be free from any insulation damage.

x) Minimum depth of cable trench shall be 750 mm for MV & control cables and 900 mm for HV cables. These cables shall be laid over a sand layer and covered with sand, brick & soil for ensuring mechanical protection. Cables shall not be laid in waterlogged area as far as practicable. Cable route markers shall be provided at every 25 M of buried trench route. When laid above ground, cables shall be properly cleated or supported on rigid poles of atleast 2 M high. Minimum head clearance of 6 meters shall be provided at road crossings.

xi) Under ground road crossings for cables shall be avoided to the extent feasible. In any case no under ground power cable shall be allowed to cross the roads without pipe sleeve.

xii) All cable joints shall be done with proper jointing kit. No taped / temporary joints shall be used.

xiii) An independent earthing facility should preferably be established within the temporary installation premises. All appliances and

equipment shall be adequately earthed. In case of armoured cables, the armour shall be bonded to the earthing system.

xiv) All cables and wire rope used for earth connections shall be terminated through tinned copper lugs.

xv) In case of local earthing, earth electrodes shall be buried near the supply point and earth continuity wire shall be connected to local earth plate for further distribution to various appliances. All insulated wires for earth connection shall have insulation of green colour.

xvi) Separate core shall be provided for neutral. Earth / Structures shall not be used as a neutral in any case.

xvii) ON/OFF position of all switches shall be clearly designated / painted for easy isolation in emergency.

The contractor shall identify all operations that can adversely affect the health of its workers and issue & implement mitigation measures.

For surface cleaning operations, sand blasting shall not be permitted even if not explicitly stated elsewhere in the contract.

To eliminate radiation hazard, Tungsten electrodes used for Gas Tungsten Arc Welding shall not contain Thorium.

Appropriate respiratory protective devices shall be used to protect workmen from inhalation of air borne contaminants like silica, asbestos, gases, fumes, etc.

Workmen shall be made aware of correct methods for lifting, carrying, pushing & pulling of heavy loads. Wherever possible, manual handling shall be replaced by mechanical lifting equipments.

For jobs like drilling / demolishing / dismantling where noise pollution exceeds the specified limit of 85 decibels, ear muffs shall be provided to the workers.

To avoid upper limb disorders and backaches, Display Screen Equipments' workplace stations shall be carefully designed & used with proper sitting postures. Power driven hand-held tools shall be maintained in good working condition to minimize their vibrating effects and personnel using these tools shall be taught how to operate them safely & how to maintain good circulation in hands.

The contractor shall arrange health check up for all the workers at the time of induction. Health check may have to be repeated if the nature of duty assigned to him is changed necessitating health check or doubt arises about his wellness. MECON / Owner reserve the right to ask the contractor to submit test reports.

Weather Protection

Contractor shall take appropriate measures to protect workers from severe storms, solar radiations, poisonous gases, dust, etc. by ensuring proper usage of PPEs like Sun glasses, Sun screen lotions, respirators, dust masks, etc. and rearranging / planning the construction activities to suit the weather conditions.

Communication

All persons deployed at the work site shall have access to effective means of communication so that any untoward incident can be reported immediately and assistance sought by them.

All health & safety information shall be communicated in a simple & clear language easily understood by the local workforce.

Unsuitable Land Conditions

Contractor shall take appropriate measures and necessary work permits / clearances if work is to be done in or around marshy areas, river crossings, mountains, monuments, etc.

Under Water Inspection

Contractor shall ensure that boats and other means used for transportation, surveying & investigation works shall be certified seaworthy by a recognized classification society. It shall be equipped with all life saving devices like life jackets, adequate fire protection arrangements and shall posses communication facilities like cellular phones, wireless, walkie-talkie. All divers used for seabed surveys, underwater inspections shall have required authorized license, suitable life saving kit. Number of hours of work by divers shall be limited as per regulations. MECON / Owner shall have the right to inspect the boat and scrutinize documents in this regard.

TOOL BOX MEETING (TBM)

Contractor shall conduct daily TBM with workers prior to start of work and shall maintain proper record of the meeting. A suggested format is given below. The TBM is to be conducted by the immediate supervisor of the workers.

TOOLBOX MEETING RECORDING SHEET

Date & Time		
Subject		
Presenter		
Hazards involved		
Precautions to be taken		
Worker's Name	Signature	Section
Remarks, if any		

The topics during TBM shall include

- Hazards related to work assigned on that day and precautions to be taken.
- Any forthcoming HSE hazards / events / instruction / orders, etc.

The above record can be kept in local language, which workers can read. These records shall be made available to MECON / Owner whenever demanded.

TRAINING

Contractor shall ensure that all his personnel possess appropriate training to carry out the assigned job safely. The training should be imparted in a language understood by them and should specifically be trained about

- Potential hazards to which they may be exposed at their workplace
- Measures available for prevention and elimination of these hazards

The topics during training shall cover, at the minimum;

- Education about hazards and precautions required
- Emergency and evacuation plan
- HSE requirements
- Fire fighting and First-Aid
- Use of PPEs
- Local laws on intoxicating drinks, drugs, smoking in force

Records of the training shall be kept and submitted to MECON / Owner whenever demanded.

For offshore and jetty jobs, contractor shall ensure that all personnel deployed have undergone a structured sea survival training including use of lifeboats, basket landing, use of radio communication etc. from an agency acceptable to Owner / MECON.

INSPECTION

The contractor shall carryout daily HSE inspection and record observations at a central location. These inspection records shall be freely accessible to Owner / MECON representatives. The contractor shall also assist Owner / MECON representatives during the HSE inspections conducted by them.

ADDITIONAL SAFETY REQUIREMENTS FOR WORKING INSIDE A RUNNING PLANT

As a minimum, the contractor shall ensure adherence to following safety requirements while working in or in the close vicinity of an operating plant :

a) Contractor shall obtain permits for Hot work, Cold work, Excavation and Confined Space from Owner in the prescribed format.

b) The contractor shall monitor, record and compile list of his workers entering the operational plant/unit each day and ensure & record their return after completing the job.

c) Contractor's workers and staff members shall use designated entrances and proceed by designated routes to work areas only assigned to them. The workers shall not be allowed to enter units' area, tanks area, pump rooms, etc. without work authorization permit.

d) Work activities shall be planned in such a way so as to minimize the disruption of other activities being carried out in an operational plant / unit and activities of other contractors.

e) The contractor shall submit a list of all chemicals / toxic substances that are intended to be used at site and shall take prior approval of the Owner.

f) Specific training on working in a hydrocarbon plant shall be imparted to the work force and mock drills shall be carried out for Rescue operations / First-Aid measures.

g) Proper barricading / cordoning of the operational units / plants shall be done before starting the construction activities. No unauthorized person shall be allowed to trespass. The height and overall design of the barricading structure shall be finalized in consultation with the Owner and shall be got approved from the Owner.

h) Care shall be taken to prevent hitting underground facilities such as electrical cables, hydrocarbon piping during execution of work.

i) Barricading with water curtain shall be arranged in specific/critical areas where hydrocarbon vapors are likely to be present such as near horton spheres or tanks. Positioning of fire tenders (from owner) shall also be ensured during execution of critical activities.

j) Emergency evacuation plan shall be worked out and all workmen shall be apprised about evacuation routes. Mock drill operations may also be conducted.

k) Flammable gas test shall be conducted prior to any hot work using appropriate measuring instruments. Sewers, drains, vents or any other gas escaping points shall be covered with flame retardant tarpaulin.

l) Respiratory devices shall be kept handy while working in confined zones where there is a danger of inhalation of poisonous gases. Constant monitoring of presence of Gas / Hydrocarbon shall be done.

m) Clearance shall be obtained from all parties before starting hot tapping, patchwork on live lines and work on corroded tank roof.

n) Positive isolation of line/equipment by blinding for welding/cutting/grinding shall be done. Closing of valve will not be considered sufficient for isolation.

o) Welding spatters shall be contained properly and in no case shall be allowed to fall on the ground containing oil. Similar care shall be taken during cutting operations.

p) The vehicles, cranes, engines, etc. shall be fitted with spark arresters on the exhaust pipe and got it approved from Safety Department of the Owner.

q) Plant air should not be used to clean any part of the body or clothing or use to blow off dirt on the floor.

r) Gas detectors should be installed in gas leakage prone areas as per requirement of Owner's plant operation personnel.

s) An experienced full time safety personnel shall be exclusively deployed to monitor safety aspects in running plants.

HSE PROMOTION

The contractor shall encourage his workforce to promote HSE efforts at workplace by way of organizing workshops / seminars / training programmes, celebrating HSE awareness weeks & National Safety Day, conducting quizzes & essay competitions, distributing pamphlets, posters & material on HSE, providing incentives for maintaining good HSE practices and granting bonus for completing the job without any lost time accident.

4.0 DETAILS OF HSE MANAGEMENT SYSTEM BY CONTRACTOR

4.1 On Award of Contract

The Contractor shall prior to start of work submit his Health. Safety and Environment Manual of procedure and HSE Plans for approval by OWNER/MECON. The Contractor shall participate in the pre-start meeting with OWNER/MECON to finalize HSE plans including the following.

- Job procedure to be followed by Contractor for activities covering Handling of equipment's, Scaffolding, Electric Installation, describing the risks involved, actions to be taken and methodology for monitoring each.

- Organizations structure alongwith responsibility and authority records/ reports etc. on HSE activities.

4.2 During job execution

4.2.1 Implement approved Health, Safety and Environment management procedure including but not limited to as brought our under para 3.0. Contractor shall also ensure to:

- Arrange workmen compensation insurance, registration under ESI Act, third party liability insurance etc. as applicable.

- Arrange all HSE permits before start of activities (as applicable) like her work, confined space, work at heights, storage of Chemicals/explosives materials and its use and implement all precautions mentioned therein

- Submit timely the completed check list on HSE activities, Monthly HSE report, accident report, investigation report, etc. as per OWNER/MECON requirements. Compliance of instructions on HSE shall be done by Contractor and informed urgently to OWNER/MECON.

- Ensure that resident Engineers/Site-In-Charge of the Contractor shall amend all the Safety Committee/HSE meeting arranged by OWNER/ MECON only in case of his absence from site, a seconds senior most person shall be nominated by him in advance and communicated to OWNER/MECON.

- Display at site office and work locations caution boards, list of hospitals for emergency services available.

- Provided posters, banners, for safe working to promote safety consciousness

- Carryout audits/inspection at sub Contractor work as per approved HSE documents & submit the reports for OWNER/MECON review.

- Assist in HSE audits by OWNER/ MECON and submit compliance report.
- Generate & submit HSE records/ reports as per HSE Plan.
- Appraise OWNER/MECON on HSE activities at site.

5.0 RECORDS

At the minimum, the contractor shall maintain/ submit HSE records in the following reporting formats:

1.	Monthly HSE Checklist cum compliance report	HSE-1
2.	Accident / Incident Report	HSE-2
3.	Supplementary Accident / Incident Investigation report	HSE-3
4.	Near Miss Incident Report	HSE-4
5.	Monthly HSE Report	HSE-5
6.	Permit for working at height	HSE-6
7.	Permit for working in confined space	HSE-7
8.	Permit for radiation work	HSE-8
9.	Permit for demolishing / dismantling	HSE-9

ANNEXURE-A

A. I.S. CODES ON HSE

SP:53	Safety code for the use, Care and protection of hand operated tools.
IS: 818	Code of practice for safety and health requirements in electric and gas welding and cutting operations
IS: 1179	Eye and Face precautions during welding, equipment etc.
IS: 1860	Safety requirements for use, care and protection of abrasive grinding wheels.
IS: 1989(Part-I & II)	Leather safety boots and shoes
IS: 2925	Industrial Safety Helmets
IS: 3016	Code of practice for fire safety precautions in welding and cutting operations.
IS: 3043	Code of practice for earthing.
IS: 3764	Code of safety for excavation work
IS: 3786	Methods for computation of frequency and severity rates for industrial injuries and classification of industrial accidents.
IS: 3996	Safety Code of scaffolds and ladders.
IS: 4082	Recommendation on stacking and storage of construction materials and components at site.
IS: 4770	Rubber gloves for electrical purposes
IS: 5121	Safety code for piling and other deep foundations
IS: 5216 (Part-I)	Recommendations on Safety procedures and practices in electrical works
IS: 5557	Industrial and Safety rubber lined boots.
IS: 5983	Eye protectors
IS:6519	Selection, care and repair of Safety footwear
IS: 6994 (Part-I)	Industrial Safety Gloves (Leather & Cotton Gloves)
IS: 7293	Safety Code for working with construction Machinery

IS: 8519	Guide for selection of industrial safety equipment for body protection
IS: 9167	Ear protectors
IS: 11006	Flash back arrestor (Flame arrestor)
IS:11016	General and safety requirements for machine tools and their operation
IS: 11057	Specification for Industrial safety nets
IS: 11226	Leather safety footwear having direct moulded rubber sole
IS: 11972	Code of practice for safety precaution to be taken when entering a sewerage system
IS: 13367	Code of practice-safe use of cranes
IS: 13416	Recommendations for preventive measures against hazards at working place

B. INTERNATIONAL STANDARDS ON HSE

Safety Glasses	:	ANSI Z 87.1, ANSI ZZ 87.1, AS 1337, BS 2092, BS 1542, BS 679, DIN 4646 / 58211
Safety Shoes	:	ANSI Z 41.1, AS 2210, EN 345
Hand Gloves	:	BS 1651
Ear Muffs	:	BS 6344, ANSI S 31.9
Hard Hat	:	ANSI Z 89.1 / 89.2, AS 1808, BS 5240, DIN 4840
Goggles	:	ANSI Z 87.1
Face Shield	:	ANSI Z 89.1
Breathing Apparatus	:	BS 4667, NIOSH
Welding & Cutting	:	ANSI Z 49.1
Safe handling of compressed Gases in cylinders	:	P-1 (Compressed Gas Association 1235 Jefferson Davis Highway, Arlington VA 22202 – USA)

ANNEXURE-B

DETAILS OF FIRST AID BOX

SL. NO	DESCRIPTION	*QUANTITY*
1.	Small size Roller Bandages, 1 inch wide (Finger Dressing small)	6 Pcs.
2.	Medium size Roller Bandages, 2 inch wide (Hand and Foot Dressing)	6 Pcs.
3.	Large size Roller Bandages, 4 inch wide (Body Dressing Large)	6 Pcs.
4.	Large size Burn Dressing (Burn Dressing Large)	4 Pkts.
5.	Cotton wool (20 gms packing)	4 Pkts.
6.	Antiseptic Solution Dettol (100 ml.) or Savlon	1 Bottle
7.	Mercurochrome Solution (100 ml.) 2% in water	1 Bottle
8.	Ammonia Solution (20 ml.)	1 Bottle
9.	A Pair of Scrissors	1 Piece
10.	Adhesive Plaster (1.25 cm x 5 m)	1Spool
11.	Eye pads in Separate Sealed Packet	4 Pcs.
12.	Tourniqut	1 No.
13.	Safety Pins	1 Dozen
14.	Tinc. Iodine / Betadin (100 ml.)	1 Bottles
15.	Ointment for burns (Burnol 20 gms.)	1 Bottole
16.	Polythene Wash cup for washing eyes	1 No.
17.	Potassium Permanganate (20 gms.)	1 Pkt.
18.	Tinc. Benzoine (100 ml.)	1 Bottole
19.	Triangular Bandages	2 Nos.
20.	Band Aid Dressing	5 Pcs.
21.	Iodex / Moov (25 gms.)	1 Bottole
22.	Tongue Depressor	1 No.
23.	Boric Acid Powder (20 gms.)	2 Pkt.
24.	Sodium Bicarbonate (20 gms.)	1 Pkt.
25.	Dressing Powder (Nebasulf) (10 gms.)	1 Bottole
26.	Medicinal Glass	1 No.
27.	Duster	1 No.
28.	Booklet (English & Local Language)	1 No. each
29.	Soap	1 No.
30.	Toothache Solution	1 No.
31.	Eye Ointment	1 Bottle
32.	Vicks (22 gms.)	1 Bottle
33.	Forceps	1 No.
34.	Cotton Buds (5 nos.)	1 Pkt.
35.	Note Book	1 No.
36.	Splints	4 Nos.
37.	Lock	1 Piece
38.	Life Saving/Emergency/Over-the Counter Drugs	As decided at site
	Box size : 14” x 12” x 4”	

Note : The medicines prescribed above are only indicative. Equivalent medicines can also be used. A prescription, in this regard, shall be required from a qualified Physician.

ANNEXURE – C

TYPE OF FIRES VIS-À-VIS FIRE EXTINGUISHERS

Fire	Fire Extinguishers				
	Water	**Foam**	**CO_2**	**Dry Powder**	**Multi Purpose (ABC)**
Originated from paper, clothes, wood	√	√	Can control minor surface fires	Can control minor surface fires	√
Inflammable liquids like alcohol, diesel, petrol, edible oils, bitumen	x	√	√	√	√
Originated from gases like LPG, CNG, H_2	x	x	√	√	√
Electrical Fires	x	x	√	√	√

Legend : √ Can be used
x Not to be used

Note : Fire extinguishing equipment must be checked atleast once a year and after every use by an authorized person. The equipment must have an inspection label on which the next inspection date is giver:. Type of extinguisher shall clearly be marked on it.

ANNEXURE – D

Indicative List of Statutory Acts & Rules Relating to HSE

- The Indian Explosives Act and Rules
- The Motor Vehicle Act and Central Motor Vehicle Rules
- The Factories Act and concerned Factory Rules
- The Petroleum Act and Petroleum Rules
- The Workmen Compensation Act
- The Gas Cylinder Rules and the Static & Mobile Pressure Vessels Rules.
- The Indian Electricity Act and Rules
- The Indian Boiler Act and Regulations
- The Water (Prevention & Control & Pollution) Act
- The Water (Prevention & Control of Pollution) Cess Act
- The Mines & Minerals (Regulation & Development) Act
- The Air (Prevention & Control of Pollution) Act
- The Atomic Energy Act
- The Radiation Protection Rules
- The Indian Fisheries Act
- The Indian Forest Act
- The Wild Life (Protection) Act
- The Environment (Protection) Act and Rules
- The Hazardous Wastes (Management & Handling) Rules
- The Manufacturing, Storage & import of Hazardous Chemicals Rules
- The Public Liability Act
- The Building and Other Construction Workers (Regulation of Employment and Condition of service) Act
- Other statutory acts Like EPF, ESIS, Minimum Wage Act.

ANNEXURE – E

CONSTRUCTION HAZARDS, THEIR EFFECTS & PREVENTIVE MEASURES

ACTIVITY	*TYPE OF HAZARD*	EFFECT OF HAZARD	PREVENTIVE MEASURES
(A) EXCAVATION Pit Excavation up to 3.0m	➢ Falling into pit	➢ Personal injury	➢ Provide guard rails/barricade with warning signal. ➢ Provide at least two entries/exits. ➢ Provide escape ladders.
	➢ Earth Collapse	➢ Suffocation / Breathlessness ➢ Buried	➢ Provide suitable size of shoring and strutting, if required. ➢ Keep soil heaps away from the edge equivalent to 1.5m or depth of pit whichever is more. ➢ Don't allow vehicles to operate too close to excavated areas. Maintain at least 2m distance from edge of cut. ➢ Maintain sufficient angle of repose. Provide slope not less than 1:1 and suitable bench of 0.5m width at every 1.5m depth of excavation in all soils except hard rock. ➢ Battering/benching the sides.
	➢ Contact with buried electric cables ➢ Gas/ Oil Pipelines	➢ Electrocution ➢ Explosion	➢ Obtain permission from competent authorities, prior to excavation, if required. ➢ Locate the position of buried utilities by referring to plant drawings. ➢ Start digging manually to locate the exact position of buried utilities and thereafter use

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
			mechanical means.
Pit Excavation beyond 3.0m	➢ Same as above plus ➢ Flooding due to excessive rain/ underground water	➢ Can cause drowning situation	➢ Prevent ingress of water ➢ Provide ring buoys ➢ Identify and provide suitable size dewatering pump or well point system
	➢ Digging in the vicinity of existing Building/ Structure	➢ Building/ Structure may collapse ➢ Loss of health & wealth	➢ Obtain prior approval of excavation method from local authorities ➢ Use under-pining method ➢ Construct retaining wall side by side
	➢ Movement of vehicles / equipments close to the edge of cut.	➢ May cause cave-in or slides ➢ Persons may get buried	➢ Barricade the excavated area with proper lighting arrangements ➢ Maintain at least 2m distance from edge of cut and use stop block to prevent over-run. ➢ Strengthen shoring and strutting
Narrow deep excavations for pipelines, etc.	➢ Same as above plus ➢ Frequent cave-in or slides	➢ May cause severe injuries or prove fatal	➢ Battering/benching of sides ➢ Provide escape ladders
	➢ Flooding due to Hydrostatic testing	➢ May arise drowning situation	➢ Same as above plus ➢ Bail out accumulated water ➢ Maintain adequate ventilation
Rock excavation by blasting	➢ Improper handling of explosives	➢ May prove fatal	➢ Ensure proper storage, handling & carrying of explosives by trained personnel. ➢ Comply with the applicable explosive acts & rules.
	➢ Uncontrolled explosion	➢ May cause severe injuries or prove fatal	➢ Allow only authorized persons to perform blasting operations. ➢ Smoking and open

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
			flames are to be strictly prohibited.
	➢ Scattering of stone pieces in atmosphere	➢ Can hurt people	➢ Use PPE like goggles, face mask, helmets etc.
Rock excavating by blasting (Contd)	➢ Entrapping of persons/ animals.	➢ May cause severe injuries or prove fatal	➢ Barricade the area with red flags and blow siren before blasting.
	➢ Misfire	➢ May explode suddenly	➢ Do not return to site for at least 20 minutes or unless announced safe by designated person.
Piling Work	➢ Failure of pile-driving equipment	➢ Can hurt people	➢ Inspect Piling rigs and pulley blocks before the beginning of each shift.
	➢ Noise pollution	➢ Can cause deafness ➢ and psychological imbalance	➢ Use personal protective equipments like ear plugs, muffs, etc.
	➢ Extruding rods / casing	➢ Can hurt people	➢ Barricade the area an install sign boards ➢ Provide first-aid
	➢ Working in the vicinity of 'Live-Electricity'	➢ Can cause electrocution / asphyxiation	➢ Keep sufficient distance from Live-Electricity as per IS code. ➢ Shut off the supply, if possible ➢ Provide artificial/rescue breathing to he injured.
(B) CONCRETING	➢ Air pollution by cement	➢ May affect Respiratory System	➢ Wear respirators or cover mouth and nose with wet cloth.
	➢ Handling of ingredients	➢ Hand s may get injured	➢ Use gloves and other PPE.
	➢ Protruding reinforcement rods.	➢ Feet may get injured	➢ Use Safety shoes. ➢ Provide platform above reinforcement for movement of workers.
	➢ Earthing of electrical mixers,	➢ Can cause electrocution / asphyxiation	➢ Ensure earthing of equipments and proper functioning of

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
	vibrators, etc. not done		electrical circuit before commencement of work.
	➢ Falling of materials from height	➢ Persons may get injured	➢ Use hard hats ➢ Remove surplus material immediately from work place ➢ Ensure lighting arrangements during night hours.
	➢ Continuous pouring by same gang	➢ Cause tiredness of workers and may lead to accident.	➢ Insist on shift pattern ➢ Provide adequate rest to workers between subsequent pours.
	➢ Revolving or concrete mixer/ vibrators	➢ Parts of body or clothes may get entrapped.	➢ Allow only mixers with hopper ➢ Provide safety cages around moving motors ➢ Ensure proper mechanical locking of vibrator
Super-structure	➢ Same as above plus ➢ Deflection in props or shuttering material	➢ Shuttering / props may collapse and prove fatal	➢ Avoid excessive stacking on shuttering material ➢ Check the design and strength of shuttering material before commencement of work ➢ Rectify immediately the deflection noted during concreting
	➢ Passage to work place	➢ Improperly tied and designed props / planks may collapse	➢ Ensure the stability and strength of passage before commencement of work ➢ Do not overload and under the passage.
(C) REINFORCEMENT	➢ Curtailment and binding of rods	➢ Persons may get injured	➢ Use PPE like gloves, shoes, helmets, etc. ➢ Avoid usage of shift tools
	➢ Carrying of rods for short distance/ at	➢ Workers may injure their hands and shoulders	➢ Provide suitable pads on shoulders and use safety

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
	heights		gloves. ➢ Tie up rods in easily liftable bundles ➢ Ensure proper staging.
	➢ Checking of clear distance/ cover with hands	➢ Rods may cut or injure the finger	➢ Use measuring devices tape, measuring rods, etc.
	➢ Hitting projected rods and standing on cantilever rods	➢ Persons may get injured and fall down	➢ Use safety shoes and avoid standing unnecessarily on cantilever rods ➢ Avoid wearing loose clothes
	➢ Falling of material from height	➢ May prove fatal	➢ Use helmets ➢ Provide safety nets
	➢ Transportation of rods by trucks / trailers	➢ Protruded rods may hit the persons	➢ Use red flags/lights at the ends ➢ Do not protrude the rods in front of or by the side of driver's cabin. ➢ Do not extend the rods 1/3rd of deck length or 1.5 m which is less
(D) WELDING AND GAS CUTTING	➢ Welding radiates invisible ultraviolet and infrared says	➢ Radiation can damage eyes and skin.	➢ Use specified shielding devices and other PPE of correct specifications ➢ Avoid throated tungsten electrodes for GTAW.
	➢ Improper placement of oxygen and acetylene cylinders	➢ Explosion may occur	➢ Move out any leaking cylinder ➢ Keep cylinder in vertical position ➢ Use trolley for transportation of cylinders and chain them ➢ Use flash back arrestors
	➢ Leakage / cuts in hoses	➢ May cause fire	➢ Purge regulators immediately and then turn off ➢ Never use grease or

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
			oil on oxygen line connections and copper fittings on acetylene lines ➢ Inspect regularly gas carrying hoses ➢ Always use red hose for acetylene & other fuel gases and black for oxygen.
	➢ Opening-up of cylinder	➢ Cylinder may burst	➢ Always stand back from the regulator while opening the cylinder ➢ Turn valve slowly to avoid bursting ➢ Cover the lug terminals to prevent short circuiting.
	➢ Welding of tanks, container or pipes storing flammable liquids	➢ Explosion may occur	➢ Empty & purge them before welding ➢ Never attach the ground cable to tanks, container or pipe storing flammable liquids ➢ Never use LPG for gas cutting
(E) RADIOGRAPHY	➢ Ionizing Radiation	➢ Radiations may react with the skin and can cause cancer, skin irritation, dermatitis, etc.	➢ Ensure safety regulations as per BARC/AERB before commencement of job. ➢ Cordon off the area and install Radiation warning symbols ➢ Restrict the entry of unauthorized persons ➢ Wear appropriate PPE and film badges issued by BARC/AERB
	➢ Transportation and Storage of Radiography source	➢ Same as above	➢ Never touch or handle radiography source with hands ➢ Store radiography source inside a pit in an exclusive isolated

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
			storage room with lock and key arrangement. The pit should be approved by BARC/AERB ➢ Radiography source should never be carried either in passenger bus or in a passenger compartment of trains. ➢ BARC/AERB have to be informed before source movement. ➢ Permission from Director General of Civil Aviation is required for booking radio isotopes with airlines.
	➢ Loss of Radio isotope	➢ Same as above	➢ Try to locate with the help of Survey Meter. ➢ Inform BARC/AERB(*) (*) Atomic Energy Regulatory Board (AERB), Bhabha Atomic Research Centre (BARC) Anushaktinagar, Mumbai – 400 094
(F) ELECTRICAL INSTALLATION AND USAGE	➢ Short circuiting	➢ Can cause Electrocution or Fire	➢ Use rubberized hand gloves and other PPE ➢ Don't lay wires under carpets, mats or door ways. ➢ Allow only licensed electricians to perform on electrical facilities ➢ Use one socket for one appliance ➢ Ensure usage of only fully insulated wires or cables ➢ Don't place bare wire ends in a socket

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
			➢ Ensure earthing of machineries and equipments ➢ Do not use damaged cords and avoid temporary connections ➢ Use spark-proof/flame proof type field distribution boxes. ➢ Do not allow open/bare connections ➢ Provide all connections through ELCB ➢ Protect electrical cables / equipment's from water and naked flames ➢ Check all connections before energizing.
	➢ Overloading of Electrical System	➢ Bursting of system can occur which leads to fire	➢ Display voltage and current ratings prominently with 'Danger' signs. ➢ Ensure approved cable size, voltage grade and type. ➢ Switch off the electrical utilities when not in use. ➢ Do not allow unauthorized connections. ➢ Ensure proper grid wise distribution of Power.
	➢ Improper laying of overhead and underground transmission lines / cables	➢ Can cause electrocution and prove fatal	➢ Do not lay unarmored cable directly on ground, wall, roof of trees ➢ Maintain at least 3m distance from HT cables ➢ All temporary cables should be laid at least 750 mm below ground on 100 mm

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
			fine sand overlying by brick soling ➢ Provide proper sleeves at crossings/ intersections ➢ Provide cable route markers indicating the type and depth of cables at intervals not exceeding 30m and at the diversions / termination.
(G) FIRE PREVENTION AND PROTECTION	➢ Small fires can become big ones and may spread to the surrounding areas	➢ Cause burn injuries and may prove fatal.	➢ In case a fire breaks out, press fire alarm system and shout “Fire, Fire” ➢ Keep buckets full of sand & water/fire extinguishing equipment near hazardous locations ➢ Confine smoking to ‘Smoking Zones’ only ➢ Train people for using specific type of fire equipments under different classes of fire ➢ Keep fire doors/ shutters, passages and exit doors unobstructed ➢ Maintain good house keeping and first-aid boxes (for detail refer Annex-2) ➢ Don’t obstruct assess to Fire extinguishers ➢ Do not use elevators for evacuation during fire ➢ Maintain lightening arrestors for elevated structures ➢ Stop all electrical motors with internal combustion. ➢ Move the vehicles from dangerous

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
			locations. ➢ Remove the load hanging from the crane booms. ➢ Remain out of the danger areas.
	➢ Improper selection of Fire Extinguisher	➢ It may not extinguish the fire	➢ Ensure usage of correct fire extinguisher meant for the specified fire (for details refer Appendix-C) ➢ Do not attempt to extinguish Oil and electric fires with water. Use foam cylinders/CO_2/sand or earth.
	➢ Improper storage of highly inflammable substances	➢ Same as above	➢ Maintain safe distance of flammable substances from source of ignition ➢ Restrict the distribution of flammable materials to only min. necessary amount ➢ Construct specifically designed fuel storage facilities ➢ Keep chemicals in cool and dry place away from hat. Ensure adequate ventilation ➢ Before welding operation, remove or shield the flammable material properly ➢ Store flammable materials in stable racks, correctly labeled preferably with catchments trays. ➢ Wipe off the spills immediately

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
	➢ Short circuiting of electrical system	➢ Same as above ➢ Can cause Electrocution	➢ Don't lay wires under carpets, mats or door ways ➢ Use one socket for one appliance ➢ Use only fully insulated wires or cables ➢ Do not allow open/bare connections ➢ Provide all connections through ELCB ➢ Ensure earthing of machineries and equipments
(H) VEHICULAR MOVEMENT	➢ Crossing the Speed Limits (Rash driving)	➢ Personal injury	➢ Obey speed limits and traffic rules strictly ➢ Always expect the unexpected and be a defensive drive ➢ Use sat belts/helmets ➢ Blow horn at intersections and during overtaking operations. ➢ Maintain the vehicle in good condition ➢ Do not overtake on curves, bridges and slopes
	➢ Adverse weather condition	➢ Same as above	➢ Read the road ahead and ride to the left ➢ Keep the wind screen and lights clean ➢ Do not turn at speed ➢ Recognize the hazard, understand the defense and act correctly in time.
	➢ Consuming alcohol before and during he	➢ Same as above	➢ Alcohol and driving do not mix well. Either choose

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
	driving operation		alcohol or driving. ➢ If you have a choice between hitting a fixed object or an oncoming vehicle, hit the fixed object ➢ Quit the steering at once and become a passenger. Otherwise take sufficient rest and then drive. ➢ Do not force the driver to drive fast and round the clock ➢ Do not day dram while driving
	➢ Falling objects / Mechanical failure	➢ May prove fatal	➢ Ensure effective braking system, adequate visibility for the drives, reverse warning alarm. ➢ Proper maintenance of the vehicle as per manufacturer instructions
(I) PROOF TESTING (HYDROSTATIC/ PNEUMATIC TESTING	➢ Bursting of piping ➢ Collapse of tanks ➢ Tanks flying off	➢ May cause injury and prove fatal	➢ Prepare test procedure & obtain CONSULTANT/ Owner's approval ➢ Provide separate gauge for pressurizing pump and piping/equipment ➢ Check the calibration status of all pressure gauges, dead weight testers and temperature recorders ➢ Take dial readings at suitable defined intervals and ensure most of them fall between 40-60% of the gauge scale range ➢ Provide safety relief valve (set at

ACTIVITY	*TYPE OF HAZARD*	EFFECT OF HAZARD	PREVENTIVE MEASURES
			pressure slightly higher than test pressure) while testing with air/nitrogen ➢ Ensure necessary precautions, stepwise increase in pressure, tightening of bolts/ nuts, grouting, etc. before and during testing ➢ Keep the vents open before opening any valve while draining out of water used for hydro testing of tanks ➢ Pneumatic testing involves the hazard of released energy shored in compressed gas. Specific care must therefore be taken to minimize the chance of brittle failure during a pneumatic leak test. Test temperature is important in this regard and must be considered when the designer chooses the material of construction ➢ A pressure relief device shall be provided, having a set pressure not higher than the test pressure plus the lesser of 345 KPa (50 psi) or 10% of he test pressure. The gas used as test fluid, if not air, shall be nonflammable and nontoxic.
(J) WORKING AT HEIGHTS	➢ Person can fall down	➢ May sustain severe injuries or	➢ Provide guard rails/barricade at the

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
		prove fatal	work place ➢ Use PPE like safety belts, full body harness, life line, helmets, safety shoes, etc. ➢ Obtain a permit before starting the work at height above 3 meters ➢ Fall arrest systems like safety nets, etc. must be installed ➢ Provide adequate working space (min. 0.6 m) ➢ Tie/weld working platform with fixed support ➢ Use roof top walk ladder while working on a slopping roofs ➢ Avoid movement on beams
		➢ May hit the scrap / material stacked at the ground or in between	➢ Keep the work place neat and clean ➢ Remove the scrap immediately
	➢ Material can fall down	➢ May hit the workers working at lower levels and prove fatal.	➢ Same as above plus ➢ Do not throw or drop material or equipment from height ➢ All tools to be carried in a toolkit bags or on working uniform ➢ Remove scrap from the planks ➢ Ensure wearing of helmet by the workers at low level
(K) CONFINED SPACES	➢ Suffocation / drowning	➢ Unconsciousness, death	➢ Use respiratory devices, if required ➢ Avoid over crowding inside a confined space ➢ Provide Exhaust Fans for ventilation ➢ Do not wear loose clothes, neck ties,

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
			etc. ➢ Fulfill conditions of the permit. ➢ Check for presence of hydrocarbons, O_2 level ➢ Obtain work permit before entering a confined space ➢ Ensure that the connected piping of the equipment which is to be opened is pressure free, fluid has been drained, vents are open and piping is positively isolated by a blind flange
	➢ Presence of foul smell and toxic substances	➢ Inhalation can pose threat to life.	➢ Same as above plus ➢ Check for hydrocarbon and Aromatic compounds before entering a confined space ➢ Depute one person outside the confined space for continuous monitoring and for extending help in case of an emergency
	➢ Ignition / flame can cause fire	➢ Person may sustain burn injuries or explosion may occur	➢ Keep fire extinguishers at a hand distance ➢ Remove surplus material and scrap immediately ➢ Do not smoke inside a confined space ➢ Do not allow gas cylinders inside a confined space ➢ Use low voltage (24V) lamps for lighting ➢ Use tools with air motors or electric tools with max.

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
			voltage of 24V ➢ Remove all equipments at the end of the day
(L) HANDLING AND LIFTING EQUPMENTS	➢ Failure of load lifting and moving equipments	➢ Can cause accident and prove fatal	➢ Avoid standing under the lifted load and within the operating radius of cranes ➢ Check periodically oil, brakes, gears, horns and tyre pressure of all moving machinery ➢ Check quality, size and condition of all chain pulley blocks, slings, U-clamps, D-shackles, wire ropes, etc. ➢ Allow crane to move only on hard, firm and leveled ground ➢ Allow lifting slings as short as possible and check gunny packings at the friction points ➢ Do not allow crane to tilt its boom while moving ➢ Install Safe Load Indicator ➢ Ensure certification by applicable authority.
	➢ Overloading of lifting equipments	➢ Can cause electrocution and fire	➢ Safe lifting capacity of derricks and winches written on them shall be got verified. ➢ The max safe working load shall be marked on all lifting equipments ➢ Check the weight of columns and other heavy items painted on them and accordingly decide about the crane

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
			capacity, boom and angle of erection ➢ Allow only trained operators and riggers during crane operation
	➢ Overhead electrical wires	➢ Can cause electrocution and fire	➢ Do not allow boom or other parts of crane to come within 3 m reach of overhead HT cables ➢ Hook and load being lifted shall preferably remain in full visibility of crane operator.
(M) SCAFFOLDING, FORMWORK AND LADDERS	➢ Person can fall down	➢ Person may sustain severe injuries and prove fatal	➢ Provide guard rails for working at height ➢ Face ladder while climbing and use both hands ➢ Ladders shall extend about 1m above landing for easy access and tying up purpose ➢ Do not place ladders against movable objects and maintain base at ¼ unit of the working length of the ladder ➢ Suspended scaffolds shall not be less than 500 mm wide and tied properly with ropes ➢ No loose planks shall be allowed ➢ Use PPE, like helmets, safety shoes, etc.
	➢ Failure of scaffolding material	➢ Same as above	➢ Inspect visually all scaffolding materials for stability and anchoring with permanent structures. ➢ Design scaffolding

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
			for max. load carrying capacity ➢ Scaffolding planks shall not be less than 50x250 mm full thickness lumber or equivalent. These shall be cleared or secured and must extend over the end supports by at least 150mm and not more that 300 mm ➢ Don't overload the scaffolds ➢ Do not splice short ladders to make a longer one. Vertical ladders shall not exceed 6m.
	➢ Material can fall down	➢ Persons working at lower level gets injured.	➢ Remove excess material and scrap immediately ➢ Carry the tools in a tool-kit bag only ➢ Provide safety nets
(N) STRUCTURAL WORKS	➢ Personal negligence and danger of fall	➢ Can cause injury or casualty	➢ Do not take rest inside rooms built for welding machines or electrical distribution system ➢ Avoid walking on beams at height ➢ Wear helmet with chin strap and safety belts when working at height ➢ Use hand gloves and goggles during grinding operations ➢ Cover or mark the sharp and projected edges ➢ Do not stand within the operating radius of cranes
	➢ Lifting / slipping of	➢ Same as above	➢ Do not stand under the lifted load

ACTIVITY	*TYPE OF HAZARD*	EFFECT OF HAZARD	PREVENTIVE MEASURES
	material		➢ Stack properly all the materials. Avoid slippage during handling ➢ Control longer pieces lifted up by cranes from both ends ➢ Remove loose materials from height ➢ Ensure tightening of all nuts and bolts
(O) PIPELINE WORKS	➢ Erection / lowering failure	➢ Can cause injury	➢ Do not stand under the lifted Load ➢ Do not allow any person to come within the radii of the side boom handling pipes ➢ Check the load carrying capacity of the lifting tools and tackles ➢ Use safe Load Indicators ➢ Use appropriate PPEs
	➢ Other	➢ Same as above	➢ Wear gum boots in marshy areas ➢ Allow only one person to perform signaling operations while lowering of pipes ➢ Provide night caps on pipes ➢ Provide end covers on pipes for stoppage of pigs while testing/cleaning operations.

FORMAT NO. : HSE-1, REV. 0

HSE CHECKLIST CUM COMPLIANCE REPORT (1/6)

Project: _____ Contractor :_____
Date: _____ Owner :_____
Inspection By:_____ Report No. :_____
Frequency : Fortnightly Job No :_____

Note: write 'NA' wherever the item is not applicable

SL. NO.	ITEM	YES	NO	REMARKS	ACTION
1	**HOUSEKEEPING**				
a)	Waste containers provided and used				
b)	Sanitary facilities adequate and clean				
c)	Passageways and Walkways clear				
d)	General neatness of working areas				
e)	Others				
2	**PERSONNEL PROTECTIVE EQUIPMENT**				
a)	Goggles; Shields				
b)	Face protection				
c)	Hearing protection				
d)	Safety shoes				
e)	Hand protection				
f)	Respiratory Masks etc.				
g)	Safety Belts				
h)	Safety Helmet/Hard Hat				
I)	Others				
3	**EXCAVATIONS/OPENINGS**				
a)	Openings properly covered or barricaded				
b)	Excavations shored				
c)	Excavations barricaded				
d)	Overnight lighting provided				
e)	Others				
4	**WELDING & GAS CUTTING**				
a)	Gas cylinders chained upright				
b)	Cables and hoses not obstructing				
c)	Screens or shields used				
d)	Flammable materials protected				
e)	Fire extinguisher(s) accessible				
f)	Others				
5	**SCAFFOLDING**				
a)	Fully decked platforms				
b)	Guard and intermediate rails in place				

SL. NO.	ITEM	YES	NO	REMARKS	ACTION
c)	Toe boards in place				
d)	Adequate shoring				
e)	Adequate access				
f)	Others				
6	**LADDERS**				
a)	Extension side rails 1m above				
b)	Top of landing				
c)	Properly secured				
d)	Angle + 70 from horizontal				
e)	Others				
7	**HOISTS, CRANES AND DERRICKS**				
a)	Condition of cables and sheaves OK				
b)	Condition of slings, chains, hooks and eyes OK				
c)	Inspection and maintenance logs maintained				
d)	Outriggers used				
e)	Signs/barricades provided				
f)	Signals observed and understood				
g)	Qualified operators				
h)	Others				
8	**MACHINERY, TOOLS AND EQUIPMENT**				
a)	Proper instruction				
b)	Safety devices				
c)	Proper cords				
d)	Inspection and maintenance				
e)	Others				
9	**VEHICLE AND TRAFFIC**				
a)	Rules and regulations observed				
b)	Inspection and maintenance				
c)	Licensed drivers				
d)	Others				
10	**TEMPORARY FACILITIES**				
a)	Emergency instructions posted				
b)	Fire extinguishers provided				
c)	Fire-aid equipment available				
d)	Secured against storm damage				
e)	General neatness				
f)	In accordance with electrical requirements				
g)	Others				
11	**FIRE PREVENTION**				
a)	Personnel instructed				
b)	Fire extinguishers checked				
c)	No smoking in Prohibited Areas				
d)	Hydrants Clear				

SL. NO.	ITEM	YES	NO	REMARKS	ACTION
e)	Others				
12	**ELECTRICAL**				
a)	Use of 3-core armoured cables				
b)	Usage of 'All insulated' or 'double insulated' electrical tools				
c)	All electrical connection are routed through ELCB				
d)	Natural Earthing at the source of power (main DB)				
e)	Continuity and tightness of earth conductor				
f)	Covering of junction boxes, panels and other energized wiring places				
g)	Ground fault circuit interrupters provided				
h)	Prevention of tripping hazards				
i)	Others				
13	**HANDLING AND STORAGE OF MATERIALS**				
a)	Properly stored or stacked				
b)	Passageways clear				
c)	Others				
14	**FLAMMABLE GASES AND LIQUIDS**				
a)	Containers clearly identified				
b)	Proper storage				
c)	Fire extinguishers nearby				
d)	Others				
15	**WORKING AT HEIGHT**				
a)	Erection plan and work permit obtained				
b)	Safety nets				
c)	Full body harness and lanyards; chute lines				
d)	Health Check record available for workers going up?				
e)	Others				
16	**CONFINED SPACE**				
a)	Work permit obtained				
b)	Test for toxic gas and sufficient availability of oxygen conducted				
c)	At least one person outside the confined space for monitoring deputed				
d)	Availability of sufficient means of entry, exit and ventilation				
e)	Fire extinguishers and first-aid facility ensured				
f)	Lighting provision made by using 24V lamps				
g)	Proper usage of PPEs ensured				
17	**RADIOGRAPHY**				
a)	Proper storage and handling of source as per BARC / AREB guidelines				
b)	Working permit obtained				
c)	Cordoning of the area done				

SL. NO.	ITEM	YES	NO	REMARKS	ACTION
d)	Use of appropriate PPE's ensured				
e)	Proper training to workers/supervisors imparted				
f)	Minimum occupancy of workplace ensured				
18	**HEALTH CHECKS**				
a)	Workers medically examined and found to fit for working : i) At heights ii) In confined space.				
b)	Availability of First-aid facilities				
c)	Proper sanitation at site, office and labour camps				
d)	Arrangement of medical facilities				
e)	Measures for dealing with illness				
f)	Availability of Portable drinking water for workmen & staff				
g)	Provision of crèches for children				
h)	Stand by vehicle available for evacuation of injured.				
19	**ENVIRONMENT**				
a)	Chemical and other effluents properly disposed				
b)	Cleaning liquid of pipes disposed off properly				
c)	Seawater used for hydro-testing disposed off as per agreed procedure				
d)	Lubricant Waste/Engine oils properly disposed				
e)	Waste from Canteen, offices, sanitation etc. disposed properly				
f)	Disposal of surplus earth, stripping materials, oily rags and combustible materials done properly				
g)	Green belt protection				

_____

Signature of Resident Engineer with Seal

FORMAT NO. : HSE-2, REV. 0

ACCIDENT / INCIDENT REPORT

(To be submitted by Contractor after every Accident / Incident within 24 hours)

Report No:_____
Date: _____

Name of Site:-_____
CONTRACTOR_____

Type of Accident / Incident : ☐ Fatal ☐ Other Lost Time ☐ Non Loss Time ☐ First-Aid case

NAME OF THE INJURED……
AGE ……
FATHER'S NAME……..
SUB-CONTRACTOR M/S……..
DATE & TIME OF ACCIDENT……
LOCATION ……

BRIEF DESCRIPTION OF ACCIDENT

CAUSE OF ACCIDENT

NATURE OF INJURY/DAMAGE

MEDICAL AID PROVIDED/ACTIONS TAKEN

INTIMATION TO LOCAL AUTHORITIES (IF APPLICABLE)

DATE: SIGNATURE OF CONTRACTOR WITH SEAL

To : OWNER…….. 1 COPY
: RCM/SITE-IN-CHARGE, MECON 3 COPIES

→ Divisional Head (Constn.) through RCM
→ Project Manager MECON, through RCM

FORMAT NO. : HSE-3, REV. 0

SUPPLEMENTARY ACCIDENT / INCIDENT INVESTIGATION REPORT

Supplementary to Report No: _____(Copy enclosed)

Project:_____ Site:_____
Name of Work :_____ Date:_____
Contractor:_____ Work Order / LOI No. :_____

NAME OF THE INJURED …….
AGE : ……...
SUB-CONTRACTOR M/S……...
DATE & TIME OF ACCIDENT / INCIDENT ……
LOCATION……

BRIEF DESCRIPTION & CAUSE OF A ACCIDENT/ INCIDENT

NATURAL OF INJURY/DAMAGE

COMMENTS FROM MEDICAL PRACTITIONER WHO ATTENDED THE VICTIM/INJURED

SUGGESTED IMPROVEMENT IN THE WORKING CONDITION IF ANY

LOSS OF MANHOURS AND IMPACT ON SITE WORKS

ANY OTHER COMMENT BY SAFETY OFFICER.

DATE: SIGNATURE OF CONTRACTOR WITH SEAL

To : OWNER…….. 1 COPY
: RCM/SITE-IN-CHARGE, MECON 3 COPIES

→ Divisional Head (Constn.) through RCM
→ Project Manager MECON, through RCM

FORMAT NO. : HSE-4, REV. 0

NEAR MISS INCIDENT – SUGGESTED PROFORMA

Report No: _____

Name of Site :_____ Date :_____

Name of Work :_____ Contractor :_____

INCIDENT REPORTED BY :

DATE & TIME OF INCIDENT :

LOCATION :

BRIEF DESCRIPTION OF INCIDENT

PROBABLE CAUSE OF INCIDENT

SUGGESTED CORRECTIVE ACTION

STEPS TAKEN TO AVOID RECURRENCE YES ☐ NO ☐

DATE: SIGNATURE OF CONTRACTOR WITH SEAL

To : OWNER…….. 1 COPY
: RCM/SITE-IN-CHARGE, MECON 3 COPIES

→ Divisional Head (Constn.) through RCM
→ Project Manager MECON, through RCM

FORMAT NO. : HSE-5, REV. 0

MONTHLY HEALTH, SAFETY & ENVIRONMENT (HSE) REPORT
(To be submitted by each Contractor)

Actual work start Date:_____ For the Month of:_____
Project:_____ Report No:_____
Name of the Contractor:_____ Status as on:_____
Name of Work:_____ Name of Safety officer:_____

ITEM			UPTO PREVIOUS MONTH	THIS MONTH	CUMU-LATIVE
a)	Average number of Staff & Workmen (average daily headcount, not man days)				
b)	Manhours Worked				
c)	Number of HSE meeting organized at site				
d)	Number of HSE awareness programmes conducted at site				
e)	Number of Lost Time Accidents (LTA)	Fatal			
		Other LTA			
f)	Number of Loss time Injuries (LTI)	Fatalities			
		Other LTI			
g)	Number of Loss Time Accidents				
h)	Number of First Aid Cases				
i)	Number of Near Miss Incidents				
j)	Man-days lost due to accidents				
k)	LTA Free Manhours i.e. Number of LTA free manhours from the Lst LTA				
l)	Compensation cases raised with Insurance				
m)	Compensation case resolved and paid to workmen				
n)	Whether workmen compensation policy taken		Y/N		
o)	Whether workmen compensation policy valid		Y/N		
p)	Whether workmen registered under ESI Act		Y/N		
Remark					

DATE:

Safety Officer /Resident Engineer
(Signature and Name)

To : OWNER
: RCM/, MECON (2 COPIES)

FORMAT NO. : HSE-6, REV. 0

PERMIT FOR WORKING AT HEIGHT (ABOVE 2 METER)

Project Site : …… Sr. No.: ……
Name of the work: …… Date: ……
Name of Contractor : …….. Nature of Work : ……
Total No.of Workers: …….. Exact location of work : ……
Duration of work: from ..…… to ……

The following items have been checked and compliance shall be ensured during the currency of the permit:

Sl.	ITEM	DONE	NOT REQD.
1.	Equipment/Work Area inspected	☐	☐
2.	Considered hazard from other routine/non-routine operations and concerned person alerted	☐	☐
3.	ELCB provided	☐	☐
4.	Proper lighting provided	☐	☐
5.	Area cordoned off.	☐	☐
6.	Precautions against public traffic taken	☐	☐
7.	Sound Scaffolding provided	☐	☐
8.	Adequate protected Platform provided	☐	☐
9.	Acces and Exit to the area (Ladder properly fixed)	☐	☐
10.	Floor Openings covered	☐	☐
11.	Safety Net provided	☐	☐
12.	Heath check of personnel	☐	☐

A. Following personal protective equipment are provided (mark) and used as relevant Safety helmet/Gloves/Goggles/Shoes/Face Shield/Life Line/Safety Belt/Safety Harness.

B. This permit shall be available at the work site at all times.

C. Permit shall be issued for maximum one week only (Monday to Sunday).

D. This permit shall be applicable in non-operational areas.

E. After completion of the work, used permits shall be preserved for record purposes.

F. Additional precautions, if any …….

Permission is granted to work (See overleaf) = Yes/No

Name of Contractor's Supervisor (Initiator)

Name of Contractor's Safety Officer (Issuing Authority)

GRANT OF PERMIT AND EXTENSIONS

Sl. No.	Validity Period From …… To ……	Work time From …..Hrs. To …….Hrs.	Initiator (Supervisor of Contractor)	Issuing Authority (Safety Officer) of Contractor	Verification by CONSULTANT with date

Additional safety instructions, if any.

FORMAT NO. : HSE-7, REV. 0

CONFINED SPACE ENTRY PERMIT

Project Site : …… Sr. No.: ……
Name of the work: …… Date: ……
Name of Contractor : …….. Nature of Work : ……
Exact location of work : ……

Safety Requirements : POSITIVE ISOLATION OF THE VESSEL IS MANDATORY

(A) Has the equipment been ?

Y	NR		Y	NR		Y	NR	
☐	☐	isolated from power / steam / air	☐	☐	water flushed &/or steamed	☐	☐	radiation sources removed
☐	☐	isolated from liquid or gases	☐	☐	Manways open & ventilated	☐	☐	Proper lighting provided
☐	☐	depressurized &/or drained	☐	☐	cont. inset gas flow arranged	☐	☐	
☐	☐	blanked / blinded / disconnected	☐	☐	adequately cooled	☐	☐	

(B) Expected Residual Hazards

Y	NR		Y	NR		Y	NR	
☐	☐	lack of O_2	☐	☐	combustible gas / liquid	☐	☐	H_2S / toxic gases
☐	☐	corrosive chemicals	☐	☐	pyrophoric iron / scales	☐	☐	electricity / static
☐	☐	Heat / stream / frost	☐	☐	high humidity	☐	☐	ionizing radiation
☐	☐		☐	☐		☐	☐	

(C) Protective Measures

Y	NR		Y	NR		Y	NR	
☐	☐	gloves	☐	☐	ear plug / muff	☐	☐	goggles / face shield
☐	☐	protective clothing	☐	☐	dust / gas / air line mask	☐	☐	personal gas alarm
☐	☐	Grounded air educater / blower / AC	☐	☐	attendant with SCBA / air mask	☐	☐	rescue equipment / team
☐	☐	Fire fighting arrangements	☐	☐	safety harness & lifeline	☐	☐	communication equipment
☐	☐		☐	☐		☐	☐	

Authorization / Renewal (It is safe to enter the confirmed space)

Date	No. of Persons Allowed	Name of Persons allowed	Signature		Time		Signature
			Contractor's Supervisor	Contractor's Safety Officer	From	To	Workman

Permit Closure :

(A) Entry □ was closed □ stopped □ will continue on

(B) □ Site left in a safe condition
□ Housekeeping done

(C) Multi lock □ removed □ key transferred
□ Ensured all men have come out □ Manways barricaded

Remarks, if any :

FORMAT NO. : HSE-8, REV. 0

RADIATION WORK PERMIT

Project : Sr. No.:

Name of the work : Date:

Name of Contractor : Job No. :

Location of work :

Source Strength :

Cordoned distance (m) :

Name of Radiographing agency : Approved by Owner / MECON ☐

The following items have been checked & compliance shall be ensured during currency of the permit :

S. No.	Item Description	Done
1.	Safety regulations as per BARC/AERB ensured while source in use/ in transit & during storage.	☐
2.	Area cordoned off.	☐
3.	Lighting arrangements for working during nights ensured.	☐
4.	Warning signs / flash lights installed.	☐
5.	Cold work permit taken (if applicable)	☐
6.	PPEs like film badges, dosimeters used.	☐

Additional precautions, if any _____

(Radiography Agency's BARC / AREB authorized Supervisor) (Contractor's Safety Officer)

Permission is granted.

Permit is valid from _____ AM/PM _____ Date to _____ AM/PM _____ Date

(Signature of permit issuing authority)

Name : Designation : Date :

Permit renewal :

Permit extended upto		Additional precautions required, if any.	Sign of issuing authority with date
Date	Time		

Work completed / stopped / area cleared at _____ Hrs. of Date _____

(Sign of permit issuing authority)
Name :

FORMAT NO. : HSE-9, REV. 0

RADIATION WORK PERMIT

Project : Sr. No.:

Name of the work : Date:

Name of Contractor : Job No. :

Name of Contractor :

Line No. / Equipment No. /Structure to be dismantled :

Location details of dismantling / demolition with sketch : (Clearly indicate the area)

The following items have been checked & compliance shall be ensured during currency of the permit :

S. No.	Item Description	Done	Not Applicable
1.	Services like power, gas supply, water, etc. disconnected.	☐	☐
2.	Dismantling / Demolishing method reviewed & approved.	☐	☐
3.	Usage of appropriate PPEs ensured.	☐	☐
4.	Precautions taken for neighboring structures	☐	☐
5.	First-Aid arrangements made	☐	☐
6.	Fire fighting arrangements ensured	☐	☐
7.	Precautions taken for blasting	☐	☐

(Contractor's Supervisor) (Contractor's Safety Officer)

Permission is granted.

(Permit issuing authority)
Name :
Date :

Completion Report :

Dismantling / Demolishing is completed on _____ Date at _____ Hrs.

Materials / debris transported to identified location ☐

Tagging completed (as applicable) ☐

Services like power, gas supply, water, etc. restored ☐

(Permit issuing authority)

TECHNICAL SPECIFICATION

FOR

PRE-COMMISSIONING AND COMMISSIONING

OF

KAKINADA-SRIKAKULAM PIPELINE PROJECT

(PHASE-I)

TS NO.: MEC/23QC/05/28/M/000/1093

(OIL & GAS SBU)
MECON LIMITED
DELHI 110 092

C O N T E N T S

PREPARED BY:	CHECKED BY:	APPROVED BY:
(Puneet)	(Abhishek Agrawal)	(Sunil Kumar)

1.0 INTRODUCTION

This specification covers the minimum technical requirements for:

i) Pre-commissioning activities consists of:

- Carrying out pre-commissioning checks of the underground pipeline system including above ground piping at dispatch station and at receipt stations, Sectionalizing Valve (SV) stations and tap-off / hook-up piping.
- Dewatering of the pipeline.
- Flushing and dry air blowing of underground & above ground piping at dispatch and receipt stations, SV stations and hook–up point.
- Swabbing of pipeline.
- Preparation of detailed commissioning procedures

ii) Commissioning activities consisting of Drying, Inertisation, Gas-in/ Commissioning, stabilization and 72 hours run of all the pipe lines and facilities mentioned in (i).

Bidder, along with his bid documents, is required to submit the following:

- Execution plan and method statement for pre-commissioning and commissioning activities.
- Past experience of pre-commissioning and commissioning activities carried out for a similar pipeline system / network.
- Plan to engage an agency / subcontractor for these activities (if envisaged).
- Organization charts of bidder's proposed pre-commissioning and commissioning team indicating the positions with the required qualifications and experience.
- Biodatas of Key personnel comprising the commissioning team along with their contact nos. In case the member of commissioning team as mentioned in the offer is not available at the actual time of commissioning then the contractor shall ensure a replacement with equivalent qualification & experience. The format of biodata is enclosed as **Annexure-I**.
- Clause wise list of deviations, if any, from this technical specification. In the absence of this, it shall be considered that the bidder has no deviation.
- Questionnaire as given in **Annexure-II**.

2.0 RESPONSIBILITY OF CONTRACTOR

The contractor shall be responsible for all the pre-commissioning and commissioning activities that need to be carried out for the pipeline system.

2.1 Pre-commissioning

In order to execute and perform pre-commissioning activities, the contractor shall be responsible for (but not limited to):

- Carrying out pre-commissioning checks of the underground pipeline system including above ground piping at dispatch station and at receipt stations, Sectionalizing Valve (SV) stations and tap-off / hook-up piping.
- Dewatering of the pipeline.
- Flushing and dry air blowing of underground & above ground piping at dispatch and receipt stations, SV stations and hook–up point.
- Swabbing of pipeline.
- Low pressure leak check (with air) for the aboveground section of the pipelines.
- Supply and supervision of manpower for pre-commissioning.
- Supply and operation of machinery & equipment for pre-commissioning.
- Supply and use of materials and consumables as required for the pre-commissioning activities.
- Design and supply all temporary line connections, pig launcher/receiver, valves, instruments, manpower etc. as required during various operations.
- Preparation of detailed pre-commissioning procedures, activity schedules, bar charts, schemes etc. This shall include preparation of detailed procedures for dewatering, flushing, swabbing and low pressure leak check and shall address the sequence and methodology describing all operations, data on materials, equipment, instruments, consumables, communication systems, necessary calculations, detailed time schedule and organization chart.
- All necessary work to perform the job successfully including all modifications that would be required.

The contractor shall demonstrate to the COMPANY (for COMPANY's approval) the successful completion of all of the above-mentioned activities.

In the event of any detail, which is not fully addressed, contractor should warrant that work shall be performed in accordance with the relevant codes, Company's specifications and the best recognized Engineering guidelines and practices being followed in the on-shore pipeline industry.

2.2 Drying, Inertisation, Gas-in / Commissioning, stabilization and 72 hours run

In order to execute and perform commissioning related activities, the contractor shall be responsible for (but not limited to):

- Drying of the underground pipeline and above ground piping system at dispatch and receipt stations, above ground piping system at SV stations and hook-up / tap-off points to a water dew point of –8°C at atmospheric pressure, and maintain this dew point in the pipeline, till inertisation and gas-in activities commence.
- Commissioning checks including Safety review prior to start of commissioning activities to achieve 'Ready for commissioning' status for underground pipeline and above ground piping system at dispatch and receipt stations, above ground piping system at SV stations and hook-up / tap-off points.
- Inertisation of the pipeline system including above ground piping system at dispatch and receipt stations, above ground piping system at SV stations and hook-up / tap-off points.
- Gas-in activities including pressurization, carrying out high pressure leak checks and establishment of flows in the pipeline system including above ground piping at dispatch and receipt stations, SV stations, IP station and hook-up points.
- Stabilization and 72 hours run of the pipeline system.
- Supply and supervision of manpower for commissioning.
- Supply and operation of machinery & equipment for commissioning.
- Supply and use of materials and consumables as required for the commissioning activities.
- Design and supply all temporary line connections, pig launcher/receiver, valves, instruments, manpower etc. as required during various operations.
- Preparation of detailed commissioning procedures, activity schedules, bar charts, schemes etc. This shall include preparation of detailed procedures for drying, inertisation, gas-in / commissioning operations, high pressure leak check operations, pressurization, establishing flows and 72 hours run of the pipeline system, and shall address the sequence and methodology describing all operations, data on materials, equipment, instruments, consumables, communication systems, necessary calculations, detailed time schedule and organization chart.
- Ensuring all communication facilities are in place and in proper working condition prior to start of commissioning activities of the pipeline system.
- All necessary work to perform the job successfully including all modifications that would be required.

The contractor shall demonstrate to the COMPANY (for COMPANY's approval) the successful completion of all of the above-mentioned activities.

In the event of any detail, which is not fully addressed, contractor should warrant that work shall be performed in accordance with the relevant codes, Company's specifications and the best recognized Engineering guidelines and practices being followed in the on-shore pipeline industry.

2.3 Mechanical Completion

Mechanical Completion of system shall mean completion of underground / aboveground pipeline system and station work including pre-commissioning along with ECP of U/G pipeline and make the system ready to start commissioning activities.

3.0 SCOPE OF WORK

The work to be performed by the Contractor as part of the pre-commissioning activities for the facilities outlined in paragraphs (i) of Section-1.0 above and commissioning related activities for the facilities outlined in paragraphs (ii) of Section-1.0 above shall consist of the following:

3.1 Pre-commissioning activities

3.1.1 Pre-commissioning checks

Pre-commissioning checks shall be carried out for the pipeline system to ascertain that the pipeline system has been mechanically completed in all respects. These checks shall cover the pipelines including distribution network system, dispatch and receipt stations, I.P. stations, sectionalizing valve stations and the hook up points. The pre-commissioning checks shall include the following:

A) System Checks

The entire facilities shall be checked against the latest P&ID's, Engineering and Vendor drawings / documents and other design specifications. Any shortcomings observed shall be listed down in the form of punch lists and duly attended.

B) Checking of Field Instruments

All the field instruments like actuated valves, control valves, shutdown valves, transmitters, solenoid valves, shut down switches, alarms etc. shall be checked physically and also for their intended application by simulating the operating condition. It will also include checking of Different meters, gauges, action of actuated valves, control valves, shutdown valves etc.

C) Survey of the Pipelines

This shall be per formed to confirm that proper fittings/supports, cathodic protection system, route markets, warning signs, fencing around SV stations, crash barriers etc. have been installed along the pipeline.

D) Checking of Communication System

This is to check that there is proper communication with adequate back up power to ensure uninterrupted communication.

E) Checking of Electrical Distribution System

This is to ensure safety and also to ensure an uninterrupted power supply during startup and normal pipeline operation.

F) Checking of Instruments, Controls & Interlocks

This is to check that instrument controls and interlocks are functional as per the normal operating conditions.

G) Checking of Utilities

This is to check that utilities like power, nitrogen, UPS system, instrument air, etc. are available prior to start-up.

H) Any other checks as may be considered necessary.

3.1.2 Dewatering

3.1.2.1 General

Dewatering of a pi peline section shall be don e subsequent to the hydro-test of the respective pipeline section. During the dewatering operation, the major quantity of hydro-test water shall be r emoved from the pipelines and di stribution network. It is the responsibility of the contractor to develop suitable dewatering procedure and submit the same for Company's approval.

The disposal of the water shall be per formed such that no har m is done t o the environment and the Dewatering procedure should indicate this disposal methodology.

3.1.2.2 Operational requirements

The dewatering operation for the pipelines shall consist of a number of dewatering pig runs and dry air shall be used as propellant for pig trains.

Cup pigs shall be used and will be suitable for traversing the entire length of the pipelines / pipe segments being dewatered. Contractor shall ensure that all the pigs are designed to prevent damage to the pipeline's internal coating (if any).

The contractor shall propose the minimum speed and the backpressure of the pigs in order that continuous operation will be performed without the pig getting stuck. Contractor shall submit all the calculations regarding this procedure and a contingency plan for implementation in case the pigs get stuck.

Contractor shall provide a suitable compressor for oil-free air with sufficient capacity and pressure.

Upon arrival of the pigs at the receiving end, the Contractor in the presence of Company's representative shall remove the pigs without delay.

3.1.2.3 Flushing of aboveground piping

Flushing of above ground piping at dispatch and receipt stations, SV stations and hook-up / tap-off points shall be done with water to remove debris from within the piping and then with dry air to remove the residual amount of water from the aboveground piping.

3.1.2.4 Acceptance criteria

Before proceeding to the next stage of operations, Contractor shall ensure that bulk of the water has been removed from the pipeline system. Contractor shall specify when the dewatering phase (for the underground pipeline) and flushing and dry air blowing (for above ground piping) is finished and shall obtain approval of the company before proceeding to the next phase.

3.1.3 Swabbing

3.1.3.1 General

The swabbing operation, which shall be done subsequent to the dewatering operation, is meant to reduce the remaining water in the pipeline to acceptable condition and to ensure removal of free water left inside the pipeline prior to final drying, Inertisation and commissioning of the Pipeline system. This is done by driving number of foam pigs propelled by oil free compressed dry air, which can pick up free water in the pipeline. Hence for swabbing, air compressors of required capacity, after-coolers and dryers should be deployed by the contractor.

Contractor may suggest alternate methodology for Swabbing operation. The swabbing activity is precursor for drying of the pipeline and is basically to reduce duration of drying.

The contractor shall submit the detailed procedure and the duration of the swabbing operation and obtain approval of the company before starting the operation.

3.1.3.2 Acceptance criteria

The Contractor shall ensure that swabbing operation is considered to be completed when it is considered that there is no free water left in the pipeline. This shall be subject to Company's approval.

3.1.4 Safety review prior to start of commissioning activities

A pre-startup safety review of the pipeline system including the underground pipeline and the above ground piping at dispatch and receipt stations, SV stations and hook-up / tap-of points shall be carried out by the Contractor before permitting entry of natural gas into the new pipeline facility. Company / Company's representative shall also participate in the pre-startup safety review.

3.2 Commissioning related activities

3.2.1 Drying

Before charging the line with gas, the contractor may propose to dry the pipeline either by super drying or vacuum drying or any other suitable technique as approved by Engineer-in-charge (EIC). Following specifications shall govern the drying procedures and shall be submitted for approval of the EIC.

3.2.1.1 Vacuum Drying

a) General

The contractor shall dry the underground pipeline and the above ground piping at dispatch and receipt stations, SV stations and hook-up / tap-off points with vacuum drying technique prior to charging natural gas.

Water vapour shall be evacuated from the pipeline by vacuum units alone or in combination with dry air or dry nitrogen vacuum purging as specified in the scope of work. The final dew point temp. of the dry pipeline shall be -8 °C, which is equivalent to a pressure of 3 mbar (absolute), unless otherwise specified in the scope of work.

Vacuum drying should consist of the following stages:

- pre-drying checks;
- one or more leak tests;
- pump-down;
- evaporation/evacuation, including vacuum purging(if applicable);
- soak test/acceptance test;

The size of the vacuum units should be sufficient to reduce the pressure in the pipeline to the vaporisation pressure during pump-down within typically 12 h to 36 h of commencement of the pump-down operation, depending on the length and diameter of

the pipeline. Vacuum units having excessive capacity would draw down the pressure too rapidly, which could cause localised ice formation.

The Contractor shall prepare a theoretical pressure/ time graph each of the drying phases and submit it along with detailed work procedure for approval of MECON/APGDC.

b) **Pre-drying checks**

Before commencement of vacuum drying the Contractor shall verify that:

- The pipeline has been isolated from other pipelines and piping by closing valves at the battery limit. As a precaution against possible "air-in" leaks through the battery limit valves, all valves immediately adjacent to the battery limit valves shall also be closed wherever possible;
- All pressure safety valves, actuator tappings etc. shall be isolated by closing the respective valves;
- All vent drain, utility connections, tapping valves shall be closed and ends shall be blind flanged;
- The blow down piping (if any) shall also be isolated by closing the respective valves;
- The bypass piping across the mainline valves at SV stations shall be isolated by closing all the by-pass valves;
- valves are designed for vacuum drying and have been placed in to the half open position;
- valve body bleeder parts are vacuum tight;
- Temporary connections, pig trap valves and pig trap end closure seals are able to withstand the prevailing vacuum pressure. If this is not the case, Contractor shall provide adequate seals for the vacuum drying operation and replace these seals by the permanent seals once the vacuum drying operation has been completed.

c) Leak tests

I. Low pressure leak check of aboveground station piping

The above ground station piping including all instrument impulse tubing shall be pressurised with air to a minimum pressure of 6 kg/cm^2. All flanged threaded and tubing joints shall be checked for leaks by soap solution.

II. Leak test of pipeline

The piping connecting the vacuum unit with the pipeline, including pig trap(s) and vacuum unit(s), shall be isolated from the pipeline and the pressure in the isolated piping lowered to slightly above the theoretical evaporation pressure.

The vacuum unit shall be switched off and the isolated piping checked for leaks by soap solution. Leaks shall be cured by flange tightening etc.

The pipeline shall then be opened to the vacuum unit(s) and the pressure in the entire system reduced to a pressure of 50 mbar (abs) to 100 mbar (abs) for the final leak test. The pressure shall be maintained at this level and all other piping, such as at the pig trap system at the other end of the pipeline if vacuum drying is carried out from one end only, shall be checked for leaks. Leaks shall be cured as stated above.

After all leaks have been cured, where possible, the vacuum unit shall be turned off and isolated from the pipeline and the pressure in the pipeline and the associated pipework monitored for at least 1 hr. Pressure increases shall be recorded and plotted on a pressure/time chart. From the measured pressure increase, the total leak rate shall calculated. Curing of leaks shall be continued until the calculated total leak rate is less than 10 % of evacuation capacity of the vacuum units at the initial leak test pressure. The final in-leak rate shall be recorded for use when analysing the final soak test results

d) **Pump-down/ pull down**

The pressure in the pipeline shall then be reduced at a steady rate to a vacuum level of 40-50 torr (53- 67 mbar). Alternatively the contractor may reduce the pressure in the pipeline further to a level where the ambient temperature of the pipeline will cause the free water to boil and then eventually to evaporate. The approximate pressure value is calculated in advance but it is easily recognized at site by a fall in the rate of pressure reduction, which is noted from the plot of pressure against time.

A significantly shorter pump down time than that theoretically predicted could indicate freezing and shall be evaluated immediately. The pressure shall be kept at this level, and pig traps and piping inspected for vacuum tightness and any leaks cured.

e) **Evaporation/ evacuation**

As the pressure in the pipeline approaches the saturated vapour pressure at the pipeline's ambient temperature, the rate of vapour evolution will increase, resulting in a reduction in the rate of pressure decrease. During this phase, the pressure will remain at more or less constant level until all the free water has been converted into water vapour. The vaporisation pressure shall be maintained and water vapour evacuated by pumping until all residual water has evaporated. Once all the free water has evaporated from the pipeline, the rate of pressure decrease will increase.

Ice formation in the pipeline and associated fittings shall be avoided by control of the evacuation rate through the vacuum units. A vaporisation pressure plateau at a level markedly lower than expected or erratic pressure fluctuations during plateau are indications of ice formation.

Vaporisation and evacuation by pumping shall continue until the vapour pressure has reached the level that is equivalent to the dew point specified for the dry pipeline
This pressure shall be maintained for at least 3 hrs to confirm that a stable balanced vacuum pressure is established throughout the pipeline. Evacuation shall then be

stopped and a soak test carried out.

Vacuum purging with dry air or nitrogen at pressures in the range of 4 mbar (abs) to 10 mbar (abs) may be applied in addition to evacuation by pumping to reduce the time needed for conventional evaporation and water vapour evacuation. The rates and pressures are dependent on the performance curves of the vacuum equipment, as the aim is to increase the pressure in the pipeline to an efficient volume transfer level. If applied, purging and evacuation shall continue until the dew point at the vacuum unit is constantly below the dew point for a dry pipeline as specified in the scope of work while replacing at least twice the contents of the pipeline. Purging shall then be stopped, and the pressure reduced to 3 mbar (abs) and maintained at this level for at least 3 hrs to achieve stable conditions in the pipeline. A soak test shall then be performed.

f) **Soak test/acceptance test**

Soak test is carried out to ensure that all free water has been evaporated. All the equipment other than that required for pressure monitoring shall be temporarily isolated from pipeline for a period of at least 12 hrs and pressure is monitored at an interval of 1 hr.

Pressure monitoring shall be carried out by means of pressure gauges and recorders with range 0 mbar to 10 mbar, a reading division of 0.1 mbar and an accuracy of ± 1 % of the measured value.

Initially the pressure will rise as the higher pressure in the centre of the pipeline (or at the opposite end if a single vacuum plant is in operation) balances with that nearest to the vacuum plant. After this initial stabilisation, which should occur well below the evaporation plateau. The test shall be acceptable if the pressure remains more or less constant (+/-5% variation is acceptable) at 3 mbar. If this is not the case, the observed pressure increases must be due to further flashing-off of moisture vapour, indicating that additional drying is required.

3.2.2.2 Super drying

a) **General**

The pipeline shall be dried using super dry air or nitrogen. The contractor shall submit work procedure for super drying in line with the scope of work to Engineer-in-charge for approval prior to start of any activity.

The super drying operation shall follow within 48 hrs of swabbing. In case super drying of the pipeline does not start within 48 hrs of completion of swabbing, then the swabbing shall be repeated again.

The drying medium to be used shall be as specified in the scope of work or as per the directions of Engineer-in-charge. Dry air or nitrogen drying shall be executed consecutively in the following phases:

- pigging;
- purging for drying; and
- Purging for acceptance testing.

The basis of this technique is to run a series of light weight foam pigs through the pipeline with super dry air or dry nitrogen. The pigs initially absorb large quantities of water and ensure that water in the pipeline is continually spread out in a thin film, thus facilitating evaporation into the dry air system. Where permanent pig- launcher and receivers are not available temporary traps must be connected to the line and the drying unit may then be connected to the pig launcher by flexible hoses of appropriate rating.

The sizing of the drying equipment and calculations of the time required for drying shall be based on a film thickness of the residual water of not less than 0.1 mm for internally uncoated pipes and not less than 0.05 mm for internally coated pipes. Air introduced into the pipeline during dry air drying shall have a dew point of at least 15 °C below the final dew point (-8°C) of the pipeline.

Nitrogen used during drying shall have a minimum dew point of -50 °C at atmospheric pressure.

b) **Pigging**

The pipeline shall be pigged with high sealing disc pigs driven by dry air or nitrogen in combination with water absorbing foam pigs having a large water absorption capacity (approximately 80 % of their body mass), high abrasion resistance and a density between 30 to 50 kg/m^3 as follows:

- the travelling speed of the foam pigs should not exceed 1.2 m/s;
- a back-pressure of at least 0.5 bar shall be maintained at the receiving end; and
- pigs in a pig train should be separated by at least 300 meters

Pigging shall continue until the dew point of the drying medium at the receiving end remains below the dew point specified in the scope of work and does not fluctuate by more than 3°C whilst replacing the content of the line by a pig.

c) **Purging For Drying**

After pigging, the pipeline should be purged with the drying medium with a minimum velocity of 3 m/s in the pipeline at the discharge end. Purging shall continue until the dew point at the discharge end remains below the specified dew point whilst replacing twice the content of the pipeline at purging pressure.

d) **Purging For Acceptance Testing**

The difficulty in defining the acceptance criterion is that the dew point sampling at each end of the pipeline does not necessarily represent the actual dew point condition prevailing within the whole pipeline. This is because the dry air (or nitrogen) entering the pipeline performs extensive drying at the start of the pipeline and then becomes saturated. As the pressure falls off towards the end of the pipeline, the air

(or nitrogen) is again able to absorb moisture. Thus the situation can arise where the beginning and the end of a pipeline are dry but the middle may still be wet, or at a higher dew point than the ends. It can be checked that the acceptance criterion has been met by means of the following procedure.

Upon completion of purging, the pipeline shall be blocked-in for a period of at least 12 hrs and at a pressure of 0.5 bar above the ambient pressure at all points along the pipeline. After this period the pipeline content shall be replaced at the lowest possible pressure and the dew point continuously measured at the discharge end.

Drying is complete when the dew point during acceptance purging remains below the final dew point (-8°C) specified for the pipeline whilst replacing the line content. Purging for drying shall recommence and the acceptance test shall be repeated until this requirement has been met.

Upon completion of the drying, the pipeline shall be blocked in at a pressure of 0.5 bar above the ambient pressure at any point along the pipeline.

e) Preservation after Drying

The Contractor shall increase the pressure in the pipeline with either dry air or dry nitrogen.
The requirements for preservation are as follows:
- the final pipeline pressure to be achieved at the end of the filling operation shall be 0.5 bar above the ambient pressure at any point along the pipeline, plus a margin allowing for the maximum possible ambient temperature fluctuation during the post pre-commissioning period;
- The dew point, pressure and temperature of the medium introduced into the pipeline shall be measured and recorded constantly at the inlet of the pipeline throughout the filling operation;
- Warning signs, in English and the local or working languages, such as "PIPELINE FILLED WITH NITROGEN" or "PIPELINE FILLED WITH DRY AIR" shall be provided and placed at block valve stations and pig trap systems.

3.2.2 Low Pressure leak check for aboveground piping

3.2.2.1 General

The aboveground piping sections of the pipeline system shall be checked for leaks at flange points of piping and equipment, instrument impulse tubing points etc. This shall be done by pressurizing the system piping / equipment with dry compressed air (for this purpose, oil free air compressors shall be used) and testing the system by means of soap solution for leaks.

The contractor shall submit the detailed procedure and the duration of the leak check

operations and obtain approval of the company before starting the operation.

3.2.2.2 Acceptance criteria

The leak check operation shall be considered to be completed when the piping system / equipment is free of leaks when tested at a pressure of 6.0 Kg/cm^{2}g. This shall be subject to Company's approval.

3.2.3 Ready for Commissioning

After completion of drying activities and safety review prior to startup, Contractor shall notify the Company that the systems associated with the pipeline system including the underground pipeline and the above ground piping at dispatch and receipt stations, SV stations and hook-up / tap-of points are ready for gas-in/commissioning. 'Ready for commissioning status' shall be jointly reviewed by Company and Contractor and final clearance for start-up shall be given by the Company. After such joint assessment, if all the criteria are met, it will then be declared that the pipeline system has reached a stage of 'Ready for Commissioning'.

3.2.4 Inertisation

3.2.4.1 General

Contractor shall carry out inertisation of the entire pipeline system including the underground pipeline and the above ground piping at dispatch and receipt stations, SV stations and hook-up / tap-off points).

3.2.4.2 Operational requirements

During the Inertisation operation, the air left in the pipelines shall be replaced by nitrogen before admitting the natural gas into the pipeline for safe commissioning. The pipeline shall be inertized under vacuum condition after drying is achieved. For this, introduce nitrogen from one end of the pipeline maintaining vacuum from other end of the pipeline. After inertisation, gas charging shall be done into the pipeline.
For above ground piping at dispatch and receipt stations, SV stations and hook-up / tap-of points, the piping shall be purged with nitrogen till the residual oxygen content in the piping is below 1% (vol/vol).

Nitrogen required for Inertisation purpose of the pipeline and aboveground piping shall be supplied by the contractor and should be of purity level 99.9% or above. Nitrogen gas at ambient temperatures (AND NOT LIQUID NITROGEN) and in completely vaporized and gaseous state shall be used as the inertising medium. In case the source of gaseous nitrogen is from liquid nitrogen tankers, then all precautions (including verification of the lowest tolerable temperature of all components in the system under commissioning) should be ensured.

The contractor shall submit the detailed procedure (in line with the above suggested method or any other acceptable one) and the duration of the inertisation operation and obtain approval of the company before starting the operation. Inertisation shall be followed immediately by charging of pipeline by natural gas.

3.2.4.3 Acceptance Criteria

Inertisation of the pipelines may be accepted to be complete when the required quantity of nitrogen has been introduced into the pipeline. The contractor has to ensure this condition for safe commissioning of the pipeline. For above ground piping at dispatch and receipt stations, SV stations and hook-up / tap-of points, the inertisation may be accepted to be complete when the residual oxygen content in the piping is below 1% (vol/vol).

3.2.5 Gas-in/Commissioning and Stabilization

3.2.5.1 General

Contractor shall carry out gas-in and commissioning activities of the entire pipeline system including the underground pipeline and the above ground piping at dispatch and receipt stations, SV stations and hook-up / tap-of points.

3.2.5.2 Operational requirements

During introduction of natural gas into the pipeline, natural gas shall be the motive fluid for driving the last pig of the nitrogen slug train. The pig train speed shall be maintained at 3 to 4 Km/hr. Maintenance of proper backpressure shall control pig train speed. Venting shall be controlled at the pig-receiving end to achieve the desired dynamics. In this fashion, slowly the desired portion of the pipeline shall be commissioned. Alternatively contractor may propose procedure for introduction of gas in pipeline under vacuum condition after inertisation with Nitrogen.

Subsequently, the pipeline system shall be slowly pressurized up to its operating conditions and high pressure leak checks of the pipeline system at flange points, instrument points etc. shall be carried out with soap solution at regular intervals during the course of pressurization of the pipeline system. Once the pipeline system is pressurized at its operating conditions, normal gas flows shall be established in the pipeline system.

The contractor shall submit the detailed procedure (in line with the above suggested method or any other acceptable one) and the duration of the commissioning operation and obtain approval of the company before starting the operation.

Commissioning shall also include establishing the process control parameters first at turn down & then at design value stipulated in the process package along with supplementary instructions, if any, from Company / Company's Representative.

3.2.5.3 Acceptance Criteria

The system shall be considered to be commissioned successfully when the pipeline system including the underground pipeline and the above ground piping at dispatch and receipt stations, SV stations and hook-up / tap-of points is charged with natural gas, is free of leaks and run successfully at stable operating conditions with instrumentation / control systems process utilities and support systems taken on line for a minimum period of 72 hours.

The commissioning of pipeline system shall include commissioning of branch lines and associated facilities including auxiliary facilities and aboveground piping.

4.0 DOCUMENTATION

Contractor shall submit for approval of the Company, the complete description, detailed procedures and time schedule for all of the following activities:

- Pre-commissioning checks
- Dewatering
- Flushing
- Swabbing
- Drying
- Low pressure leak check of aboveground piping system with dry compressed air
- Inertisation
- Gas in and commissioning activities (including pressurization of pipeline system, high pressure leak check, establishment of flows and 72 hours run).

All these documents should be prepared covering all aspects of HSE, quality assurance and quality control plans.

Contractor shall ensure that his documents are related to “as-built” conditions of the pipeline and structure involved.

Documents shall also contain all safety plans, procedures, to be followed while carrying out the activities.

Upon successful completion of the work, contractor shall prepare a final report of the work which shall include necessary charts, diagrams, graphs, calculations, recordings, daily logs, measurements, details of the operation, etc. Report shall also include all certificates of calibration of instruments required, together with records of calibration performed at site prior to the start of any operation and the approved pre-commissioning and commissioning formats and check sheets.

5.0 SPARES AND CONSUMABLES

Contractor shall identify and arrange for supply of manpower, spares, tools, tackles and consumables as required for pre-commissioning and commissioning activities.

6.0 SAFETY

Contractor shall follow the safety practices during execution of pre-commissioning and Commissioning works as detailed in the scope of work. He shall also maintain and follow all safety practices equivalent or better than those being practiced by the industry during pre-commissioning and commissioning activities.

ANNEXURE - I

FORMAT FOR BIODATA OF KEY PERSONNEL FOR COMMISSIONING

1. PRPOSED POSITION IN ORGANISATION CHART:
2. NAME:
3. QUALIFICATION:
4. TOTAL YEARS OF EXPERIENCE IN PLANT OPERATION / COMMISSIONING:
5. DETAILS OF COMMISSIONING EXPERIENCE:

SL NO.	PROJECT DESCRIPTION	PLANT CAPACITY	LICENSOR	OWNER	YEAR OF COMMISS.	DURATION OF STAY AT SITE

ANNEXURE - II

QUESTIONNAIRE

CLAUSE NO.	DESCRIPTION OF CLAUSE	AGREED	NOT AGREED	REMARKS
1.0	SCOPE	[ ]	[ ]	
2.0	DEFINITIONS	[ ]	[ ]	
3.0	MANUFACTURER REPRESENTATIVE	[ ]	[ ]	
4.0	DOCUMENT FOR PRECOMMISSIONING AND COMMISSIONING	[ ]	[ ]	
5.0	OTHER REQUIREMENTS	[ ]	[ ]	
6.0	REVIEW/CHECKLISTING/INSPECTION/CO-ORDINATION	[ ]	[ ]	
7.0	COMMISSIONING	[ ]	[ ]	
8.0	CONSUMABLES	[ ]	[ ]	
9.0	SPECIAL REQUIREMENTS	[ ]	[ ]	
10.0	SAFETY	[ ]	[ ]	

NOTE:

1) PLEASE TICK THE RELEVANT BOX.
2) MENTION THE REASON & THE SUB-CLAUSE NOT AGREED IN THE REMARKS COLUMN.

ANNEXURE-III

FORMAT TO BE USED DURING PRE-COMMISSIONING AND COMMISSIONING

(TOTAL 5 FORMATS)

F O R M A T - I

INTIMATION REGARDING SYSTEM COMPLETION

PROJECT:_____ CUSTOMER:_____ UNIT:_____

Following system/sub-system has been mechanically completed in all respects with exceptions noted below. The system/sub-system can be taken up for checking and preparation of checklist.

SYSTEM NO.

SYSTEM DESCRIPTION:

EXCEPTIONS:

SIGNATURE DATE

CONTRACTOR'S CONSTRUCTION:

CO-ORDINATOR

The system is ready/ not ready for Check listing

OWNER/ PMC:

F O R M A T - II

CHECKLIST

PROJECT:_____CUSTOMER:_____UINT:_____

SYSTEM/SUB-SYSTEM_____

CHECKLIST TYPE **PRELIMINARY/FINAL**

SL.NO.	**CHECKLIST ITEMS**	**REMARKS**

SIGNATURE DATE

PMC :

OWNER:

F O R M A T - III

READY FOR PRE-COMMISSIONING CERTIFICATE

PROJECT:_____CUSTOMER:_____ UNIT:_____

SYSTEM/SUB-SYSTEM_____

This is to certify that the following Plant/system/sub- system as detailed below is completely installed and all the Checklist points are carried out except for minor details as given in the attached list.

DESCRIPTION ON PLANT/SECTION/SUB-SECTION_____

SIGNATURE DATE

CONTRACTOR'S CONSTRUCTION
CO-ORDINATOR:

CONTRACTOR'S COMMISSIONING
CO-ORDINATOR

The system is ready/ not ready for pre-commissioning

PMC :
OWNER:

F O R M A T - IV

READY FOR COMMISSIONING CERTIFICATE

PROJECT:_____CUSTOMER:_____ UNIT:_____

SYSTEM/SUB-SYSTEM_____

This is to certify that all the necessary pre-commissioning activities for the system/sub-system as detailed below have been completed and the system/sub-system is ready for commissioning except for the minor details as given below which will not effect the commissioning trial runs.

DESCRIPTION OF SYSTEM/SUB-SYSTEM_____

SIGNATURE DATE

CONTRACTOR'S COMMISSIONING:

CO-ORDINATOR SIGNATURE DATE

PMC: OWNER:

F O R M A T - V

COMPLETION OF COMMISSIONING CERTIFICATE

PROJECT:_____CUSTOMER:_____ UNIT:_____

SYSTEM/SUB-SYSTEM_____

This is to certify that the system/sub-system as detailed below has been successfully commissioned and is under operational control of Client's Production department. The minor items, which will not effect the normal operation of the system/sub-system, are given in the attached list.

DESCRIPTION OF SYSTEM/SUB-SYSTEM_____

SIGNATURE DATE

CONTRACTOR'S COMMISSIONING:
CO-ORDINATOR SIGNATURE DATE

PMC: OWNER:

SPECIFICATION
FOR
REPAIR OF PIPELINE CORROSION COATING

SPECIFICATION NO.: MEC/S/05/21/08

(OIL & GAS SBU)
MECON LIMITED
DELHI 110 092

CONTENTS

1.0 **SCOPE** :

This specification covers the minimum requirement of material and equipment, installation procedure and inspection of repair of damaged polyethylene coatings on steel pipes.

1.1 The repair shall be carried out using repair patch made of radiation crosslinked Polyolefin backing, coated on the inside with semi-crystalline thermoplastic Adhesive and filler mastic

1.2 The repair patch shall have thermal indicators to ensure correct heat is being applied during application.

2.0 MATERIAL AND EQUIPMENT

2.1 CONTRACTOR shall supply all ,equipment and manpower required for a skillful and adequate application in the field in accordance with the specification.

2.2 The repair material shall be :

- Repair patch shall be cross linked polyolefin with semi-crystalline thermoplastic adhesive (PERP 80 patch make of Covalence Raychem or equivalent).
- Filler mastic : PERPFILLER of make Covalence Raychem or equivalent.
- PERP melt stick of make Covalence Raychem or equivalent.
- Certified by DIN to meet the requirement of EN12068 stress class CHT 80.

2.3 The material shall not be older than their period of validity at the time of Application by CONTRACTOR. Deteriorated/decomposed materials shall not be used.

2.4 Material shall be stored in sheltered storages in the manufacturer's original packing and away from direct sunlight and in accordance with manufacturer's recommendations.

3.0 **APPLICATION PROCEDURE**

The application procedure to be followed for Holiday type of damage shall be in accordance with manufacturer's instructions and minimum requirements specified below whichever is more stringent.

Preparation : Remove coating from damaged area with knife, scraper or power brush. Scrap off the damaged area and adjacent coating to remove oil, grease, ruse dirt and moisture.

Preheating : Preheat the exposed bare metal surface to about 80°C and adjacent pipe coating to about 60°C with a torch moved back and forth over the surface.

Application of the Filler : Plastic filler shall be applied to all exposed metal surface. The mastic is heated and smoothed down with a paint scraper to cover all bare metal in a manner such that all entrapped air is removed.

Application of repair tape : Cut a patch from the tape in a manner such that it extends 50 mm beyond the damaged area, position it over the damaged area, heat until the temperature sensitive paint on the outside of the patch changes colour. It shall be smoothed down to confirm with the contour of lap, and shall be freed of any air bubbles or wrinkles.

For cosmetic type of defects such as minor gauging tearing, scratches which do not indicate holiday during holiday inspection, following procedure shall be adopted :

The defect area shall be roughened to remove loose polyethylene coating, oil grease, dirt etc.

This shall be followed by application of repair patch as described above.

4.0 INSPECTION, TEST

A visual inspection shall be carried out for the following :

- Mastic extrusion on ends of the patch shall be examined.
- There shall be no sign of punctures or pin holes or bend failure. The external appearance of the patch shall be smooth, free from dimples, air entrapment or void formation.
- The entire repair patch shall have changed colour uniformly.

5.0 HOLIDAY INSPECTION

- The holiday detector used shall be checked and calibrated easily with an accurate D.C. Voltmeter. The detector electrode shall be in direct contact with the surface of coating to be inspected.

- The entire surface of the repaired section shall be inspected by means of a full circle holiday detector approved by company set to a DC Voltage of at least 25 KV. Inspection of repaired patch shall be conducted only after it has cooled below 50°C.

- No repaired point shall be covered or lowered in the trench until it has been approved by the COMPANY.

- Procedure qualification shall be carried out for repair patch. The value for peel strength to pipe surface and to factory coating carried out as per EN 12068 shall be 0.5 N/mm minimum at 60°C.

6.0 DOCUMENTATION

6.1 Prior to procurement of coating repair materials, Contractor shall furnish four copies of, but not limited to, the following for qualification of the Manufacturer and material :

i) Complete descriptive technical catalogs describing the materials offered alongwith samples of repair coating materials, its properties and installation instruction as applicable specifically to the project.

ii) Test certificate and results of previously conducted tests from independent inspection agency.

iii) Reference list of previous supplies of the similar material indicating the project details such as diameter, quantity, service conditions, year of supply, project name, contact person and feed back on performance.

Once the Company's approval has been given, any change in material or Manufacturer shall be notified to Company, whose approval in writing of all changes shall be obtained before the materials are manufactured.

6.2 Prior to shipment of materials from the Manufacturer's works. Contractor shall furnish six copies of the following :

i) Test Certificates for each batch of materials.
ii) Specific installation instruction with pictorial illustrations.
iii) Specific storage and handling instructions.

6.3 All documents shall be in English Language only.