

		PROJECT	Standby SRU & Additional Tanks IOCL Paradip Refinery		
		CLIENT	INDIAN OIL CORPORATION LIMITED		
CONSTRUCTION OF TANKAGE RELATED PIPING-QCP PLANS		Project No. 080557C001	Document No. 080557C-000-PP-820	Rev. No. 0	Page 1 of 12

## PIPING -FLUSHING, TESTING & REINSTATEMENT- PROCEDURE

0	16/10/2019	ISSUED FOR INFORMATION	NVK	PKP	LA	JMC
REV.	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED	AUTHORIZED



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## 1. INTRODUCTION

**INDIAN OIL CORPORATION LIMITED (IOCL)** has awarded Fax of Acceptance (FOA) dated 29<sup>th</sup> August 2019 to M/s. Technip India Limited (TPIL) for Consultancy services (PMC/EPCM services) for overall project management, FEED Review / FEED, Detailed Engineering, Procurement & expediting services, Tendering & award, Construction Management & Supervision, Assistance in start-up, Commissioning & performance test runs for installation of a Standby SRU of 525 TPD capacity and execution of Additional tanks for Paradip Refinery, Odisha, India.

## 2. DEFINITIONS & ABBREVIATIONS

Abbreviation	Definition /Expanded form
IOCL/ CLIENT	Indian Oil Corporation Limited
PMC/ CONSULTANT	Technip India Limited
LICENSOR	Party selected by IOCL for process technology ownership for any UNIT
CONTRACTOR	Party whose services are obtained for performing the works specified as part of LSTK / packages.
EPCM	Engineering, Procurement & Construction Management Services.
LSTK	Lump Sum Turn Key portion of the work to be executed by CONTRACTOR
FEED	Front End Engineering Design
AUTHORISED REPRESENTATIVE	IOCL's/ CONSULTANT's representative authorized to act for and on behalf of them.
VENDOR	Any third party supplying the equipment/materials for setting up the Plant
PROJECT	Indicates Standby SRU and Additional tanks Project, Paradip Refinery
UNIT	Indicates any particular portion of the project to be built which can be Process related or Utilities/Offsites related
SRU	Sulphur Recovery Unit

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### 3. **SCOPE**

This specification covers the minimum requirements for flushing, pressure testing, draining, drying and reinstatement of piping systems.

### 4. **REFERENCE DOCUMENTS**

Contractor shall meet all requirements of federal, state and local laws and regulations, which maybe specified by Owner / TPIL.

#### 4.1 **CODES**

ASME B31.1	Power Piping
ASME B31.3	Process Piping
IBR	Indian Boiler Regulations.

#### 4.2 **STANDARDS**

The version valid on the date of contract award shall be used.

ASME B16.34 Valves Flanged, Threaded and Welding Ends.



#### 4.3 SPECIFICATIONS/DRAWINGS, ETC.

### 5. **PRESSURE TESTING SCOPE**

- 5.1 Piping systems subject to pressure testing shall be indicated on test diagrams & line list which shall be prepared by CONTRACTOR using the P&ID's as the basis.
- 5.2 Prior to testing, CONTRACTOR shall provide documentation (test packages) in which the test system limits, type of testing and the test pressure are defined.
- 5.3 Test systems shall be divided into:
  - 5.3.1 **Systems, which require pneumatic testing.**

Pneumatic testing always needs approval from OWNER / TPIL and shall be limited to:

    - a. High-pressure Nitrogen lines.
    - b. Flare lines and overhead vapor lines not designed for full of water testing.
    - c. Lines in cryogenic service (cold packs) where freezing of water in cavities may damage piping or valves (e.g. ball valves).
    - d. Lines where introduction of water damages piping systems or product to be conveyed after start-up (oxygen lines, EO lines etc.).

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### 5.3.2 Systems, which require service testing.

Service test always needs approval from OWNER / TPIL

Service testing shall be limited to piping systems as defined in ASME B31.1 / B31.3. Instrument air, plant air and nitrogen lines shall be service tested to avoid presence of water in the lines.

### 5.3.3 Systems, which require "full of liquid testing".

"Full of liquid testing" shall be limited to pressure-less sewer systems and all other systems under atmospheric pressure (vent lines etc.).

### 5.3.4 Systems, which require hydrotesting

All systems except those mentioned under 5.3.1, 5.3.2 and 5.3.3, require hydro-testing

### 5.4 All testing for piping subject to authority approval as identified in "test packages" shall be in accordance with authority rules and additional requirements of this specification.

In case requirements of this specification are in contradiction with authority requirements, authority requirements are governing.

### 5.5 Piping not subject to authority approval shall be tested in accordance with this specification and ASME B31.1/B31.3 (depending on selected design code) as a minimum.

### 5.6 Test pressures listed in test packages shall be determined in accordance with one of the applicable codes, as mentioned above

## 6. GENERAL REQUIREMENTS

### 6.1 Prior to testing CONTRACTOR must have inspected the piping system for completeness and conformity to piping drawings and specifications.

### 6.2 Test packages for piping systems are to be released by Owner / TPIL prior to start of pressure testing and flushing.

### 6.3 All welds shall be free of painting, coating or insulation to enable visual inspection of all welds.



### 6.4 Welds of piping spools, which have been pressure tested in the piping prefabrication shop and have been painted afterwards, may remain painted during field pressure testing after erection.

### 6.5 For stainless steel piping, the duration of the hydrotesting, flushing and draining/drying sequence shall be kept as short as possible, to reduce the possibility of chloride attack.

### 6.6 Testing against a closed valve is not permitted, unless specifically approved by Owner / TPIL and under the condition that the test pressure is not higher than the maximum allowable pressure at ambient temperature of subject valve as indicated in ASME B16.34.

The pressure test certificate of subject valves must be included in the test package.

### 6.7 Test systems without equipment or closed valves may be combined when specifically approved by TPIL

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## 7. SAFETY AND ENVIRONMENTAL CONTROL

- 7.1 Before starting any pressure test or flushing operation, adequate measures for safety and environmental control shall be established. All code requirements, local regulations and recommendations from OWRN and TPIL shall be complied with.

### 7.2 SAFETY



- 7.2.1 Test pressure shall not be applied until the piping system and its contents are at approximately the same temperature.
- 7.2.2 Pressure testing shall be executed under supervision of an experienced piping supervisor to prevent accidents
- 7.2.3 The testing area shall be marked with signs indicating risk boundaries.
- 7.2.4 It is recommended to limit access to test area to authorized personnel only.
- 7.2.5 All piping systems shall be provided with a protective device to relieve excess pressure due to thermal expansion of the test fluid.
- 7.2.6 Actions, which may cause damage to pipe under pressure, are prohibited.
- 7.2.7 Test pressure shall be increased gradually in steps as shown below providing sufficient time between each step to check for leaks or unacceptable deformation and to allow the piping to equalize strains during testing.

Acceptable steps are:

- Increase to half the intended test pressure with a maximum of twenty-five (25) bars.
  - Increase with one (1) quarter of the intended test pressure with a maximum of twenty- five (25) bars.
  - Repeat step "b" until the intended test pressure has been reached.
- 7.2.8 Test pressure shall be released immediately if piping shows changes in form or size, which are not normal.
- 7.2.9 After completion of the pressure test, the pressure shall be released so as not to endanger personnel or damage equipment.
- 7.2.10 Care shall be taken that as little water as possible is spilled over the paving to prevent muddy and/or wet roads, or damage to equipment, instrumentation or insulation. A hose shall be used to drain water to a gutter or sewer system to avoid any damage to equipment and personnel or contact with electrical systems.
- 7.2.11 Pneumatic Testing
- As pneumatic testing presents special risks, utmost care shall be taken during pressurization and inspection of the systems to prevent any danger to personnel or equipment.
- 7.2.12 Following additional safety measures shall be taken:
- Access to test area shall be limited to test personnel only.
  - Compressor and pressure gauge for checking the test pressure shall be in a sheltered area.
  - Contractor shall prepare a procedure detailing steps to be taken for pneumatic testing.

### 7.3 ENVIRONMENTAL CONTROL

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- 7.3.1 The use of chemical additives, i.e. wetting agents, biocides, inhibitors, etc., shall only be allowed when an environmentally acceptable disposal has been agreed with OWNER / TPIL and local authorities.
- 7.3.2 A wastewater disposal plan, which will specify the handling of the water used for flushing and pressure testing, shall be prepared and agreed upon between OWNER & TPIL
- 7.3.3 Disposal of flush and test water via the plant sewer system shall only be allowed after written approval from OWNER / TPIL at specified flow rates.
- 7.3.4 Subcontractor shall estimate the expected quantities, flow rate and composition of the wastewater.

## 8. TEST EQUIPMENT

- 8.1 Equipment used for testing shall be approved by Owner / TPIL and authority inspectors prior to use.
- 8.2 Contractor shall supply hydrostatic testing equipment, including filters, fill pump, pressurizing pump, test gauges, relief devices, storage tanks, and test and flushing medium.
- 8.3 For pneumatic testing, an air compressor suitable to supply dry, clean air at the pneumatic test pressure shall be supplied by contractor.
- 8.4 The test pressure shall be checked by means of gauges having a range from zero up to a minimum of 1.5 and a maximum of 4 times the required maximum test pressure.
- 8.5 All test pressure gauges shall be calibrated within a tolerance of 1% accuracy prior to testing. Calibration certificates shall be available at the work site and all gauges shall be properly identified to enable traceability to the calibration certificates.
- 8.6 Calibration of gauges shall be repeated every 6 months or whenever requested by the inspection team (representatives from the authorities, OWNER & TPIL).
- 8.7 Temperature measuring equipment to measure metal temperature and content temperature shall have a tolerance of + 0.5°C.
- 8.8 CONTRACTOR shall prove by means of calculations that supplied test blanks are suitable for the intended test pressure. Contractor shall supply test blanks test gaskets & water. Design and dimensions shall be in accordance with piping standards.



## 9. TEST MEDIUM

- 9.1 The test medium for hydrostatic testing shall be clean water (maximum chloride content 20-25 ppm) without foreign matter such as sand, rust or other particles.

A filter shall be provided in the water fill lines.

Prior to use the water shall be analysed and the results shall be reported to TPIL. Testing of the water quality shall be repeated once every week.

- 9.2 Where the test packages indicate that a pneumatic test must be performed, air shall be used for pressure testing.

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9.3 Service tests shall be performed with the intended service medium.

## 10. TEST PROCEDURE

### 10.1 PREPARATIONS FOR PRESSURE TESTING

- 10.1.1 Blind flanges, blanks, caps or plugs with adequate pressure rating shall be installed to isolate piping systems and equipment as indicated on the test diagrams.
- 10.1.2 All temporarily installed items (blanks, gaskets, spools, strainers, etc.), shall be adequately marked using paint or tags for easy traceability.
- 10.1.3 Items not to be subjected to the pressure test shall be removed. Items to be removed or blanked off prior to testing/flushing shall include, but shall not be limited to:
  - Equipment not included in the test system.
  - Relief valves and rupture discs.
  - Orifice plates, flow nozzles or other similar restrictions.
  - Venturi type flow meters (flanged).
  - Internals of equipment (trays, demisters, level instrument floats, float cages, etc.), if included in the test system.
  - Flanged control valves (for welded-in type control valve internals shall be removed).
  - Flanged check valves unless internals are removed (for butt-weld check valves internals shall be removed).
  - All in-line instruments (unless otherwise approved by TPIL) .
  - Any items not designed to withstand the test pressure (e.g. pressure gauges).
  - Internals of strainers and filters.
- 10.1.4 Instrument piping shall be tested together with the piping system up to the piping block valve nearest to the instrument.
- 10.1.5 When a union is provided downstream of an instrument block valve, it shall be broken to prevent dirt or foreign matter from being introduced into the instrument.
- 10.1.6 If the test pressure on both sides of flanged control valves is equal and when block valves and bypass are installed, the block and bypass valves shall be left open with the control valve removed and with blinds or a spool piece installed.
- 10.1.7 If test pressures up and downstream of a control valve are not equal, the spool piece between the control valve and the downstream block valve shall be tested in combination with the upstream part.
- 10.1.8 Piping supported by counterweight or spring without "down travel stop" shall be temporarily supported prior to filling of the line with water.
- 10.1.9 A spring with "down travel stop" shall have the "stop" (wedges or block) inserted prior to filling of the line with water.



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10.1.10 Piping designed for vapor or gas shall (when necessary) be provided with additional temporary supports, as indicated on isometrics, to support the additional weight of the test liquid.

10.1.11 All open valves in the test system, which have a back seat (gate and globe valves) shall be fully opened until the stem seat contacts the back seat and then the hand wheel shall be turned twice in the direction of closing to assure that gland packing is subjected to full line test pressure.

10.1.12 Open ends of atmospheric lines to be "full of liquid" tested shall be left open during testing.

10.1.13 For pneumatic testing or service testing with air or nitrogen, screwed and flanged joints shall be prepared for soap testing by taping with masking tape and punching a 3 mm diameter hole through the tape.

When electronic leak testing will be applied, taping with masking tape will not be required.

## 10.2 PRESSURE TESTING

10.2.1 After acceptance of the preparations for pressure testing by TPIL, the piping system will be released for pressure testing.

10.2.2 All systems shall be properly vented (at the high points) while filling.

10.2.3 Test pressure shall be applied by means of a suitable test pump or other pressure source. This pump shall be positively isolated from the system except when being used to pressurize the system (the hose should be disconnected after filling).

10.2.4 At least two (2) pressure gauges per test system shall be installed: one (1) at the test pump discharge and one (1) at or near the highest point of the test system. The pressure recorded at the pump is governing (lowest point). Other gauges shall indicate same pressure with a correction for static head. For large systems, more pressure gauges shall be installed at suitable locations, in coordination with TPIL.

10.2.5 An authorized person shall constantly attend the test pump during the test. Before the pump is left unattended, it shall be positively disconnected from the system, while the pressure gauge remains connected to the test system.

10.2.6 The test pressure shall be as indicated in the Line List as prepared by CONTRACTOR

10.2.7 Retesting of a system (when required) shall be performed at the same pressure as originally specified for the test.

10.2.8 The outside surface of the test system shall be dry and free from grease and dirt before and during testing. Testing during rain periods can't be performed.



10.2.9 The test pressure shall be maintained for at least half an hour prior to start of inspection and long enough to enable a visible inspection of the complete test system by the inspection team.

10.2.10 Atmospheric lines to be "full of liquid" tested shall be filled with water for at least 24 hours before visible inspection of the complete test system by the inspection team.

Water level in the test system shall be checked and marked at the start of the test and rechecked after twenty-four (24) hours during visible inspection of the system.

10.2.11 In case hydrotesting through equipment is required, LSTK/EPC Contractor shall provide special instructions & approved by Owner / TPIL (e.g. maximum differential pressures on shell and tube side of heat exchangers) where applicable.

## 10.3 ADDITIONAL REQUIREMENTS FOR SERVICE TESTS

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10.3.1 A service test shall be performed with the line in service i.e. with the service medium and at service pressure.

10.3.2 Visual inspection, and/or (in case of air or nitrogen lines) soap leakage tests shall be carried out.

#### 10.4 **ADDITIONAL REQUIREMENTS FOR PNEUMATIC TESTING**

10.4.1 For systems being pneumatically tested, a preliminary check of the test system shall be made at a pressure not exceeding 1.7 barg (25 psig).

10.4.2 A visual inspection, and soap leakage tests shall be carried out.

10.4.3 Care shall be taken to avoid a temperature drop which could cause failure of metal and thermoplastics due to embrittlement. The metal temperature during testing shall not be below the minimum allowable temperature indicated in the "test package".

#### 10.5 **FLUSHING**

Requirements described in this paragraph are for construction flushing only. Whenever flushing, cold commissioning and hot commissioning are part of the scope of the CONTRACTOR a separate specification shall be developed to describe flushing methods and cleanliness requirements for the piping systems involved.

10.5.1 After acceptance of testing reports by TPIL, the piping system will be released for flushing.

10.5.2 Flushing will be carried out to remove all trash and construction debris from the piping systems.

10.5.3 Flushing through equipment is not allowed unless specifically approved by TPIL

10.5.4 During flushing of pump suction/discharge lines, the elbow close to the pump shall be turned away and the pump inlet shall be adequately covered to prevent contamination of pumps. This applies also for equipment nozzles, which shall be blinded off during the flushing operation.

10.5.5 Commissioning team representatives from TPIL shall witness each flushing operation.

10.5.6 Flushing shall be performed against open pipe ends. Flushing via small openings like vents, drains, etc., is regarded as insufficient.

10.5.7 Stainless-steel lines shall be flushed with DM water or clean condensate to prevent chloride stress corrosion cracking.

10.5.8 After completion of the flushing operation, equipment which is welded in-line and included in the test system, shall be inspected internally for cleanliness.

10.5.9 For a better flushing effect, it is recommended to use special water/air flushing tools.



10.5.10 Trash and construction debris in air or nitrogen systems, which will not be hydrotested, shall be removed from the piping systems by air blowing.

#### 10.6 **DRAINING AND DRYING**

10.6.1 Immediately after flushing, all lines and systems shall be completely drained.

10.6.2 After draining, all test systems not subject to chemical cleaning shall be dried with air.

Contractor shall provide a suitable air compressor with drier.

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The system shall be pressurized with air up to the system operating pressure with a maximum of 6 barg and expanded abruptly to atmospheric pressure.

10.6.3 After dry out, the systems shall be presented to TPIL for acceptance

## 10.7 REINSTATEMENT

10.7.1 After completion of testing, chemical cleaning (where applicable) and drying, all systems shall be reinstated as per drawings and specifications.

This also includes but shall not be limited to:

- Removal of all temporary materials such as spades, blinds, gaskets, pipe spools, temporary supports, etc.
- Replacement of all damaged gaskets and all test gaskets.
- Positioning of spectacle blinds to the correct position.
- Reinstallation of all items removed for hydrotesting.
- Reinstallation of unions downstream of instrument block valves.
- Inspection of the completed system for correct flow direction of instruments, check and control valves, etc.

10.7.2 During the activities described above, measures shall be taken to avoid dirt, debris, etc., entering the piping system. Each pipe spool shall be inspected for cleanliness prior to reinstallation.

OWNER, TPIL and CONTRACTOR shall witness this inspection.

10.7.3 After inspection and acceptance by Owner / TPIL, the system shall be released for further activities, e.g. steam tracing, painting, insulation, etc.



10.7.4 The "stop" of pipe support springs with "down travel stop" placed prior to flushing, shall be removed during pre-commissioning or commissioning stage.

## 11. INSPECTION AND REPORTING

Contractor shall prepare a final report, giving positive documented evidence that subject systems are pressure tested in accordance with the requirements.

Documentation shall be maintained in accordance with the code and/or authority requirements for piping systems. The report will have to include as a minimum:

- All information required by the applicable code and/or authority requirements.
- Reference to documents and specifications.
- Applicable:
- Hydrotest diagrams.
- P&ID's.
- Isometrics, duly marked up with all weld joints.

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- Internal cleaning reports
- Line History Sheets & NDT reports.
- Agreed punch lists.
- Authority approvals.
- All required certificates.
- A continuous log of operation, if applicable.
- Test results and duration.
- Pressure.
- Temperature (metal and content).
- Duration.
- Ambient temperature.
- Signature of local authority (when applicable), OWNER, TPIL and CONTRACTOR.