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		CLIENT	INDIAN OIL CORPORATION LIMITED		
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JOB SPECIFICATION FOR HYDROJETTING OF PIPING AND EQUIPMENT.

0	05/12/2019	ISSUED FOR IMPLEMENTATION	KMK	TNVS	TNVS	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 29th 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. General

The purpose of hydro-jetting is to remove from piping and equipment loose and foreign materials such as rust, mill scale, metal pieces, welding slags, sand, earth, bolts, tools, etc. which may otherwise plug pipes, control valves and orifices and cause serious damage to moving parts of equipment.

4. Scope

The scope of this procedure is to establish the guidelines for Hydro-jetting of Piping and Equipment. Nonstandard mill scale that has become part of the metal surface during the manufacturing or any heat treatment process will not be removed by hydro-jetting. Chemically cleaned and passivated piping and equipment shall not be subjected to Hydro jetting.

5. Overview Of Hydro jetting

Hydro-jetting is a time effective and environmentally friendly methodology to clean pipe and equipment internal surface. Hydro-jetting can remove rust, mill scale, sand, weld slugs, and different deposits from the lines and equipment using only high-pressure water without any additives.

Hydro-jetting cleaning operation shall be undertaken by proved experienced and competent company only.

Hydro-jetting is capable to

- Remove mill scale from piping 6" to 120" diameter;
- Clean piping with multiple directional changes utilizing a single access point;
- Clean horizontal, vertical, U-bend and submerged piping;
- Climb vertically from ground level without above support;
- Remove heavy scale pieces of construction debris.

The quality and efficiency of the cleaning achieved through hydro-jetting is well proved: hydro-jetting can be considered as alternative to a chemical cleaning process, especially on large bore piping (e.g.: compressor suctions, steam network distribution).



Hydro-jetting is normally carried out in three stages:

- Hydro-jetting: to remove rust, scale and loose debris;
- Flushing: to remove all debris from the first stage;
- Passivation (optional): to leave a protective film to avoid surface corrosion and recontamination of the piping.

Depending on the system condition and piping configuration it may be possible to combine flushing and passivation stages.

In addition, water recycle system equipped with filtering unit can be used to recover majority of water, thus decreasing water consumption/need.

It is important to highlight that a minimum 4" opening is required for entry of the jetting nozzle; any limitation in the size of the entry point will also limit the size of the debris which can be removed.

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The cleaning process is designed to draw all removed debris back to the entry point; hence it is always preferable to have an entry point as large as possible.

The number of the required entry points will be dictated by the configuration of the circuit to be cleaned: required entry points will be defined together with specialized contractor during dedicated method statement preparation.

To provide the required entry points, the following options are available:

- Removal of valves, spools or instruments;
- Swinging or longitudinal separation of pipes and flanges;
- Drip legs or drain points.

5.1 Water Quality

Depending on circumstances, hydro-jetting/flushing may be performed with:

- Filtered raw water;
- Fire water;
- Cooling water;
- Drinking water;
- Demineralized water.

when austenitic stainless steel is to be cleaned, special care should be taken regarding the quality of water used for hydro jetting /flushing. As a rule, water containing more than 50 ppm. chlorine should not be used and the chloride content in the water must be determined and recorded.



5.2 Drying

After flushing and passivation completion, pipe circuits shall be dried. Refer to specific procedures issued for drying of piping and equipment.

5.3 Preliminary Activities

Before starting hydro-jetting, a number of preliminary activities should be undertaken. These include the following:

- Identify the area for hydro-jetting equipment entry and set-up;
- Locate high pressure water pump as close as possible to pipe access points to minimize amount of high pressure water hose;
- Be sure no hoses are crossing the road;
- Check safety relief valve on high pressure water pump;
- Check pressure water hoses to be used during hydro-jetting;
- Disconnect pumps, turbine, compressor intake and discharge lines and cover casing nozzles;
- Remove orifice plates;
- Remove any in-line strainers;
- Remove control valves and check valves. If this is not possible cleaning from either sides of the valves will be required;
- Full port opening valves can remain in situ;
- Isolate or disconnect and protect instrument connections;
- Protect equipment to prevent water damage to electric devices or instruments;
- Barricade the working area;



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- Put warning sign “Danger” wherever appropriate;
- Ensure full coordination between Construction Contractor and CONTRACTOR representatives to meet all technical and safety requirements, prior to starting hydro-jetting;
- Check that adequate draining facilities are in place to avoid flooding of working areas;
- Prepare a specific procedure detailing stepwise all the activities to be performed.
- Prepare the Job Hazard Analysis for hydro-jetting execution.

5.4 Hydro-Jetting Preparation

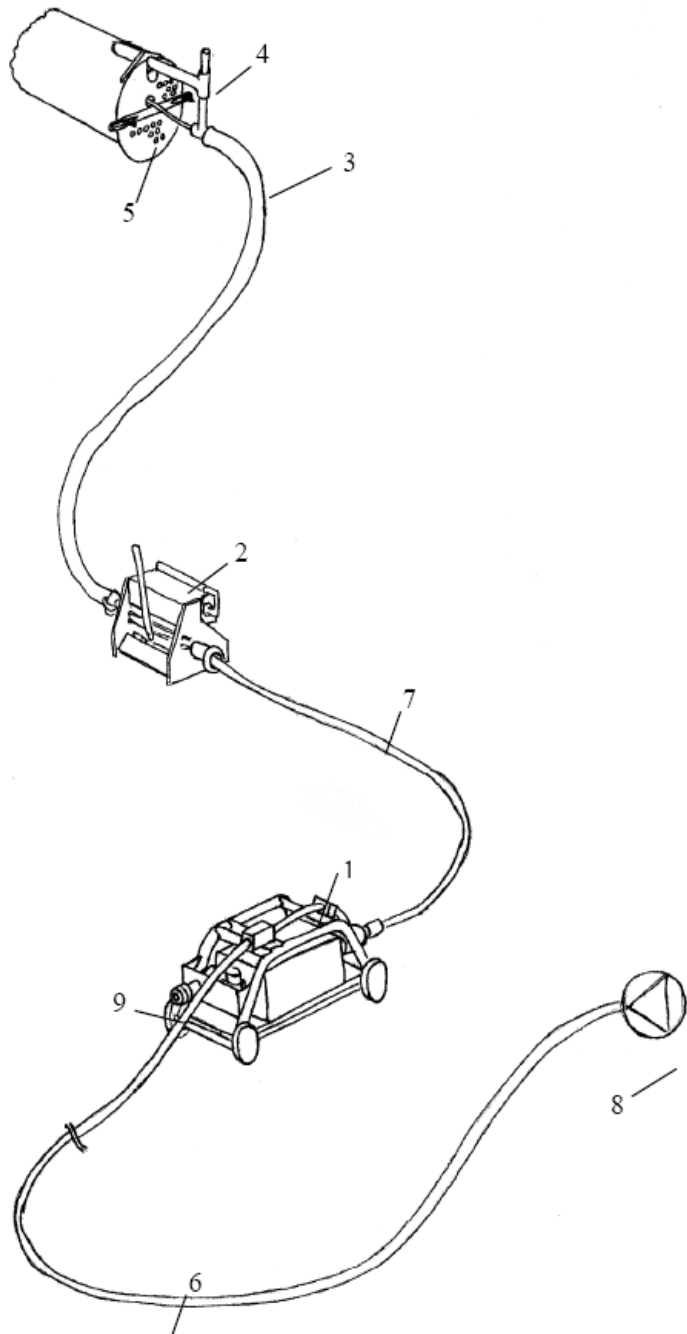
Prior to starting hydro-jetting operations, the system to be cleaned shall be arranged as follows:



- Install hydro-jetting equipment near entry point;
- Connect feed water hoses between water source and high pressure water pump;
- Locate hose rotating machine and hose feed mechanism close to pipe entry;
- Locate air compressor as close as possible to hose rotating machine (where no plant air is available);
- Connect remote pump control unit to pump control panel;
- Locate remote pump control unit close to hose rotating machine and hose feed mechanism;
- Connect air hoses to plant air outlet/air compressor and hose rotating machine; hose couplings to be secured with anti-whip restraints;
- Connect high pressure water “feed” hoses to high pressure water pump and hose rotating machine; hose couplings to be secured with anti-whip restraints;
- Connect high pressure water “run” hose to hose rotating machine, to be lead through hose feed mechanism and safety protection hose;
- Connect cleaning nozzle to high pressure water “run” hose;
- In presence of water recycle facility, water collection basin shall be placed under water drainage point and connected to the filtering/re-pumping unit;
- Insert cleaning nozzle into pipe;
- Connect safety protection hose using standard pipe entry connecting device.

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5.5 Typical Arrangement for Hydro-Jetting

1. Hose rotating machine, to rotate high pressure water hose.
2. Pneumatic/Hydraulic Feed Unit, to feed high pressure water hose in/out of pipe at continuously adjustable feed.
3. Safety Protection Hose, to lead high pressure water hose from Feed Unit to pipe entry..
4. Protection Hose Connector, to connect Safety Protection Hose to pipe entry to convey forces from the hydraulic Feed Unit to the point of entry.
5. Smash Plate, to close pipe entry, to avoid debris being shot out of pipe uncontrolled and to keep the nozzle from exiting the pipe uncontrolled.
6. High pressure water hose, feed hose.
7. High pressure water hose, run hose.
8. High pressure water Pump.
9. Air connection.



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6. Hydro-Jetting Operation

Once preliminary activities and mechanical preparation are completed and all safety measures taken, hydro-jetting can start as follows:

- Open water supply valve;
- Start drive engine for high pressure water pump;
- Start air compressor/Open air supply valve;
- Open water shut-off valve at hose rotating machine;
- Start high pressure water pump;
- Open air valve at hose rotating machine;
- Start and adjust the “run” hose rotation at hose rotating machine;
- Adjust water output pressure;
- Start water filtering/re-cycling unit;
- Adjust movement of “run” hose into (out) of pipe with hose feed mechanism;
- Remote pump control unit shall be operated by specialized operator, who monitors hose rotating machine and “run” hose all the way into pipe. High pressure supply can be stopped immediately with remote control unit at any time.

After hydro-jetting completion proceed as follows:

- Stop high pressure water pump;
- Close water shut off valve at hose rotating machine;
- Pull high pressure water hose back to initial start position;
- Stop drive engine for high pressure water pump;
- Stop water filtering/re-cycle unit;
- Close water supply valve;
- Stop air compressor/Close air supply valve.



7. Passivation

A passivation agent product can be applied using the hydro-jetting equipment. It offers a long-lasting passivation leaving a protective film to avoid surface corrosion and recontamination of the piping. The passivation agent shall be accepted and approved by Owner during method statement preparation.

The passivation agent/water solution will be premixed and stored in a tanker for use at each stage, following flushing. Depending on the level of system fouling and the pipework configuration it may be possible to combine the flushing and passivation stages, thus offering both water and time savings.

8. Cleanliness Criteria

Final acceptance of the cleanliness of pipe or equipment is based on internal inspection. Lines will be accepted as cleaned if the inner surface will be free of rust, mill scale, weld slugs, sand, etc.

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9. Quality Control Report

Test results shall be reported in the relevant Pre-commissioning Quality Control Form (refer to attachment 2) or attachment to it and it shall be integral part of the System Dossier.

10. Hse Precautions

The risks related to hydro-jetting are personnel injuries, equipment damage and environmental pollution. The most important source of these risks is a possible blow off of high pressure water, especially if personnel are working around. The environmental aspect to evaluate relates to jetting effluent spillage.

The following represent minimum precautions:



- Inspect affected area to avoid conflict with other activities;
- Verify suitability of water disposal facilities;
- Place warning signs and fence off the entire hydro-jetting area with strips of colours distinguishable from those used for construction activities;
- Restrict access into hydro-jetting area to authorized personnel only;
- Instruct involved personnel to monitor hydro-jetting operations and to safely stop hydro-jetting activity when required;
- Ensure that personnel involved in hydro-jetting activity wear, appropriate personal protective equipment, such as gloves, boots, helmets and goggles;
- Care shall be taken to protect electrical cables and power distribution boards;
- Ensure that water is properly disposed.

All the preventive measures identified in the attached JHA shall be followed.



11. Attachments

Attachment 1: Job Hazard Analysis for Hydro-jetting of Piping and Equipment.

Attachment 2: Pre-commissioning QCP1300P01 - PCF-03P – Flushing / Blowing.

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Attachment 1: Job Hazard Analysis for Hydro-jetting of Piping and Equipment



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Pre-Commissioning phase: TYPICAL- JOB HAZARD ANALYSIS FOR HYDROJET CLEANING ACTIVITY

GENERAL RISKS	Poor Planning	<ul style="list-style-type: none"> Method statement and specific JHA available – application of the control measures hierarchy PTW available
	Poor Worksite - physical	<ul style="list-style-type: none"> Good means of access/egress – ladders Good work place - space available, illumination, housekeeping, scaffolding Weather conditions, surfaces status
	Poor Worksite – concurrent operations	<ul style="list-style-type: none"> Isolation of the Area with precommissioning tape during the operations Warning signs Coordinate with adjacent areas to ensure air blowing operation does not affect / conflict with other activities
	Poor Information	<ul style="list-style-type: none"> Orientation for Pre-commissioning phase of work Daily tool-box meeting – review of JHA and related PTW
	Poor Physical State	<ul style="list-style-type: none"> Workers fit for work Daily stretching
	Poor Logistics	<ul style="list-style-type: none"> Use appropriate working tools for the job; carry out material lifting using appropriate lifting devices, if handling weights above 20kg;
	Residual Risks	<ul style="list-style-type: none"> Full time fall protection PPE Area isolation (flagging, barricades). Barricade area with pre-commissioning tape Signals
	Emergency	<ul style="list-style-type: none"> Emergency instructions: phone/radio numbers, signals, muster point, actions to take Availability of first aid boxes

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	Slips trips hazards	<ul style="list-style-type: none"> Housekeeping: keep work area clean Remove all trip hazards
TASK	HAZARDS	CONTROLS
Preparation / Secure the area	Slips, trips, falls Personnel injury	<ul style="list-style-type: none"> Instruct involved personnel what to do, how to monitor operation, how to safely stop the activity if necessary Proper Permit to Work issued and fully complied with Housekeeping: keep work area clean Remove all trip hazards Proper communication shall be arranged and radios shall be available Barricade area around either the hydro-jetting area and the pipe circuit inlets and outlets with pre-commissioning tape Place warning signs indicating the hazards and the ongoing activity Keep non-essential persons clear. Restrict access to authorized personnel only. Inspect affected area to ensure it does not conflict with other activities. Special attention to be given for potential electrical hazards from flushing water. High pressure unit, heater, air compressor and other special equipment shall be properly identified by warning signs Protect electrified equipment near flushing water outlets to prevent water contact with electric motors, instruments, electrical cable, power distribution boards, etc... Define suitable areas or adequate draining facilities to avoid flooding of working areas. Preliminary walk down of the system is recommended to ensure that the system is ready to be cleaned

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Equipment set up	<p>High pressure</p> <p>Contact with moving equipment</p> <p>Electrical fire</p> <p>Equipment damage</p>	<ul style="list-style-type: none"> Inspect the equipment and ensure that tools and material are certified, suitable and rated for the job specifications. Locate hydro-jetting equipment and the pump unit in such a way to minimize the length of hoses required, to avoid obstructing walkways. Care must be taken to protect hoses from damage by vehicular traffic, hot lines/equipment, or external abrasion. Check calibration for safety relief valve and ensure safety relief valve on the equipment is working properly Fire extinguishers shall be available Grounding of electrical equipment
Mechanical preparation (Remove plates, strainer, Install or remove valves or blinds as required)	<p>Personnel Injury Muscle</p> <p>Strains Equipment</p> <p>Damage</p>	<ul style="list-style-type: none"> Select correct tools for job Mechanical lifting devices are to be used to prevent manual handling injuries When manual handling is required, correct manual handling techniques is to be used The use of two people or a team to lift heavy items should also be considered Positive isolate system under flushing from connected systems by means of valve or blind Apply lock out / tag out procedure to each isolating valve
Lifting and work at height	<p>Personnel injury</p> <p>Equipment damage</p> <p>Muscle strain</p> <p>Fall from height</p>	<ul style="list-style-type: none"> Proper trainings attended by the involved personnel Certified mechanical lifting devices shall be used to prevent manual handling injuries Barricade affected area under the load Hook the load in the correct way Never pass or stand under the load Check the weather condition (fog, wind speed and gusts) Use proper scaffold or platform when working at height. Scaffolds erection shall be arranged only by certified company A full body harness shall be worn at all times

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Connection of temporary supplies	Personnel injury Whip effect	<ul style="list-style-type: none"> Temporary hoses shall be identified and arranged in such a manner that they do not create a tripping hazard. Temporary hoses shall be protected if they cross roads All temporary line/hose shall be rated for the working pressure and free from leaks. All valves isolated while making connection All connections to be checked for tightness and security, ensure that correct hose clamps and safety pins are in properly installed Hose couplings to be secured with anti-whip restraints.
High pressure water jetting	Personnel injury High pressure Whip effect	<ul style="list-style-type: none"> Instruct and inform the involved personnel, only trained personnel can operate the high pressure water jets Provide the fail safe (anti withdrawal) devices of the hose for the circuit inlet Check the proper connection of the fail safe (anti withdrawal) devices with the circuit inlet Before water introduction each valve isolating connecting lines or branches within the system shall be verified to be in the closed position by visually inspecting the valve stem or with the checking of the presence of the blind. Further PPE shall be worn such as spray suit, gloves and boots, face shield and ear protection Operation to be supervised by pre-commissioning engineer Use foot / hand operated fail safe control with guard to operate hydro-jetting machine Discharged water shall be managed according to the waste management procedure Circuit outlets shall be continuously monitored by an operator equipped with communication

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Water flushing	Personnel injury	<ul style="list-style-type: none"> During water introduction walk down through the system to check its proper alignment and integrity (no major visual leaks) Water to be introduced slowly to allow for close inspection for leaks During first water introduction, to verify the tight close of each isolation valve, an open bleeder or existing opening downstream of the isolation valve shall be monitored until it has been assured as positively shut off
Preparation for passivation and Passivation	Contact With Chemicals Spillage to the environment	<ul style="list-style-type: none"> MSDS for each chemical shall be provided Tank used to premix the solution shall be barricaded with precommissioning tape and warning signs shall be applied Transport all chemicals in sealed containers, drums or tanks Provide adequate arrangement for concentrated chemicals Arrange proper disposal of drum and any contaminated materials Define suitable area where discharge the chemicals Arrange for safe disposal of passivation agents via a neutralization unit or tank Provide emergency shower for personnel to wash off splashed hazardous chemicals Instruct passivation personnel to wear additional protective clothes (pvc parons, gloves, boots, goggles and face shields when handling passivation agents) For further details refer to the JHA for the Chemical Cleaning

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Reinstatement after completion / Cleaning up	Personnel injury	<ul style="list-style-type: none"> All temporary water supply to be removed Care is to be taken to ensure that the correct lock and tag are removed Job site to be restored to original condition Remove barricade when complete Clean up for next worker is safe from injury All hoses and electric cables and temporary equipment are to be removed once the task has been completed The area is to be left clean and tidy with all rubbish and debris removed.
Environmental aspects	Noise Water discharged and consumption Waste Streams to discharged Spills	<ul style="list-style-type: none"> Programmed activities to minimize disturb Collect water to pit or sewer system – dispose or reuse properly Clean the area after discharge Material handling as per MSDS – Discharge streams to sewer or suitable point (vac. truck, etc.) Kit spills available – job supervised at all time

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