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| | | Rev: 01 |
| | | April 2011 |
| KLM Technology Group #03-12 Block Aronia, Jalan Sri Perkasa 2 Taman Tampoi Utama 81200 Johor Bahru Malaysia | PRE COMMISSIONING SPECIFICATION FOR CLEANING OF LINES AND EQUIPMENT (PROJECT STANDARDS AND SPECIFICATIONS) | |

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SCOPE

The purpose this Project Standard and Specification is to describe the way in which Systems, piping and Units shall be cleaned during pre-commissioning.

PROCEDURE

General

Manufacturer's instructions for cleaning their equipments shall be followed and implemented. The Contractor shall also follow the procedure of the Vendor after the equipment

Control valves, orifice plates, flow meter elements, safety valves and permanent in-line blinds shall all be removed and lines flushed to open ends. Do not flush at any time into equipment.

Utility Systems

1. Sewer Piping

Before line flushing is started, a check shall be made on the sewer piping system to ensure that water drainage at design rates can be achieved. Care must be taken that hydrocarbon liquid or vapor cannot back up into any Unit via the sewers.

2. Water Lines

Water systems shall be flushed out with water from the main supply headers using water of designed specification quality. Disconnect supply lines to users and shut off their supply valves. Flush the supply headers and then flush out each off-take in turn, taking larger lines first.

3. Instrument Air Line

The instrument air lines shall be cleaned using the following procedure. Disconnect all supplies to instruments and shut off all off-takes. Make pressure up to Pipe header by instrument air at normal working pressure.

Shut off battery limit valves and blow each off-take in turn, taking first for the larger lines.

Continue blowing until each line is dry and free of dust and oil and in accordance with the quality specification for instrument air.

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Never blow out lines when the battery limit valve is open.

4. Utility Air Lines

Utility air lines shall be flushed in a similar manner to those of instrument air.

Slowly pressure up the header and blow out each off-take starting with the larger lines first.

5. Nitrogen Lines

These lines shall be blown out with instrument air. Air shall be purged out afterwards using the nitrogen supply.

6. Pump Systems

The line from the suction vessel to the pump shall be water flushed by gravity to the pump suction. Do not flush through the pump. Lines to slop tankage or another vessel shall be water flushed using the installed pump. Product and shipping lines shall be cleaned by Contractor using procedures such that no product will have to be slopped.

Process Unit/ Piping

1. Flushing, Blowing and Shock Blowing

Process lines shall be flushed after hydrotesting was done and supervised by commissioning personnel. The Contractor shall avoid over-pressuring lines, equipment or vessels and also avoid creating negative pressures.

Where process compressors are intended to be used for air blowing of lines, the specification shall be checked to ensure that the compressor design will allow for this.

Process lines if service for air, gas and steam shall be blown with air or steam. During this operation, all instruments shall be isolated, all orifice plates, flow meter elements, control valves and safety valves shall be removed. The flushing and blowing shall be carried out through both block valves and bypasses. Hydrostatic test water shall be drained thoroughly before air or steam blowing is carried out.

The Contractor shall select the section of the systems for the flushing, blowing or shock blowing such that the lines in the selected section shall be thoroughly cleaned. The manual cleaning for the line shall not be allowed for the project.

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Where pipelines are made of stainless steel, duplex stainless steel or carbon steel with internal stainless steel cladding, the requirements concerning chloride content in water must be followed.

2. Drying

All natural gas handling piping, vessels and equipments shall be dried to a water dew point of -22 °F (-30 °C) and inerted with nitrogen. The Contractor shall submit his procedure for this drying and inerting to approve with the mechanical completion plan document.

Reinstallation

On completion of cleaning, orifice plates, control valves, etc, shall be reinstalled and previously disconnected lines re-connected.

After flushing out and circulation operations with water have been completed, water shall be thoroughly drained from the Unit. All low point drains and vents of piping or equipment which may retain water must be opened. Other necessary steps for complete water removal such as air blowing shall be carried out where required.

The Contractor shall perform all required work according to the Vendor procedure for the equipments which touch with the water after these operations are completed

Where specified by process conditions or process specifications, all lines and equipment within the process Units shall be dried and preserved under an inert gas.

RECORDS

The records for flushing and blowing to approve standards of cleanliness shall be retained in each Systems Completion Manual.

PRECOMMISSIONING CLEANING OF PIPEWORK AND ROTATING EQUIPMENTS

Scope

Debris, rust, scale or welding slag carried into rotating equipment through inlet piping or present in lube, seal or control oil systems can cause damage in service. Therefore, upstream pipework and equipment must be thoroughly

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cleaned. Equipment and pipework in modules/packages shall be cleaned prior to dispatch to site unless this is impractical, e.g. as may be the case with steam generators.

This procedure lists the type of pipework and equipment to be cleaned, defines the required degrees of cleanliness and outlines acceptable mechanical or chemical methods of achieving these. Mandatory precautions and minimum quality control requirements are included. Requirements shall be regarded as minimum acceptable.

Compliance with this standard, or Vendor's/Subcontractor's standard, shall not relieve the Vendor/Subcontractor of the responsibility of properly and safely cleaning pipework and equipment so as to be fit for specified operating duties.

Cleaning Requirements

Lists of the piping systems and equipment to be cleaned and refers to applicable "Internal Surface Finish Class" and "Acceptable Methods" which are defined in Table 2. The cleaning requirement shall apply following:

1. Internal Surface Finish Class

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| Class 1 | Removal of all loose material and adherent material which could become detached during operation of the plant. |
| Class 2 | a) Removal of all loose material and adherent material which could become detached during operation of the plant. b) Removal of all oil, grease and protective coatings |
| Class 3 | a) Removal of all loose material and adherent material that could be detached during operation of the plant. b) Removal of all oil, grease, and protective coatings. c) Removal of adherent mill scale, rust and welding slag to achieve bare metal. d) Protection of cleaned surfaces to prevent rusting after cleaning |

2. Acceptable Methods of achieving required internal surface finish.

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| Method 1 | Before fabrication, remove rust and scale mechanically (not necessary for stainless steels and high alloys) and use inert gas shielded arc welding processes for root runs. |
| Method 2 | Use cold drawn tubing and cold bending. Weld using inert gas shielded arc processes for root runs. |
| Method 3 | If fabricated without inert gas shielded arc welded roots, |