Petroleum Development Oman L.L.C.

Reinstatement Testing Process Equipment and Pipework

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i Revision History

The following is a brief summary of the most recent revisions to this document. Details of all revisions prior to these are held on file by the issuing department.

Revision No.	Date	Author	Scope / Remarks
1.0	March 2018	Ian Campbell	First Issue

ii Related Business Processes

Code	Business Process (EPBM 4.0)
EP 72	Maintain and Assure Facilities Integrity
CP-115	Operation of Surface Product Flow Assets

iii Related Corporate Management System (CMS) Documents

The related CMF Documents can be retrieved from the *CMS Portal*.

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1 Introduction

1.1 Background

Process equipment and systems in hydrocarbon services are often subjected to periodic inspections and maintenance which may result in the pressure containment being broken. It is important that the integrity of the system has been confirmed prior to the reintroduction of any process fluids.

1.2 Purpose

To determine the integrity of any system, plant or equipment that has been reassembled after repairs, modifications or replacement, prior to it being returned to operation.

1.3 Scope

This document defines the testing required after the breaking of the hydrocarbon envelope before hydrocarbons are introduced. All modifications to the system must have previously been strength tested.

The methodology is intended for use on all pressurised systems and shall include, but not be limited to, the following systems: well flowlines and manifolds; separation; dehydration; compression; gas injection; fuel gas; blowdown and relief; oil and gas import and export, utility systems and hydraulics.

NOTE: Specifically excluded from the requirements of this document are vent/flare systems downstream of RVs which must be considered on a case by case basis according to risk, location and piping specification.

The leak paths to be tested shall include, but not be limited to flanged joints; other proprietary joints including clamp type connectors (i.e. Grayloc-type) and hammer-lugged unions (Chicksan); threaded joints; valve body/bonnet joints; valve stem glands; valve body vent and drains; and all piping connections to instrumentation.

Out of Scope

New Equipment strength testing and where repairs such as welding require full strength testing.

Any equipment upstream of the production choke shall be excluded as reinstatement testing shall be covered under the relevant drilling/well engineering standard.

IMPORTANT: *New equipment and projects shall be subject to SP-2051 SPECIFICATION FOR PRESSURE TESTING & SENSITIVE LEAK TESTING OF PIPING SYSTEM (ASME B31.3)*

1.4 Distribution / Target Audience

This specification is intended for the use of Operations and Maintenance personnel and Contractor staff involved in intrusive work on process equipment and systems.

1.5 Changes to the Document

Responsibility for the upkeep of the Document shall be with the Functional Production Manager UOP, the Owner. Changes to this document shall only be authorised and approved by the Owner.

Users of the Document who identify inaccuracy or ambiguity can notify the Custodian or his/her delegate and request changes be initiated. The Requests shall be forwarded to the Custodian using the “User Feedback Page” provided in this Document.

The Document Owner and the Document Custodian should ensure review and re-verification of this specification every 5 years.

1.6 Variance Approval

This specification is mandatory and shall be complied with at all times. Should compliance with the specification be considered inappropriate or the intended activity cannot be effectively completed or safely performed, then Variance (step out) authorisation and approval must be obtained in accordance with *PR-1001e – Operations Procedure Temporary Variance*, prior to any changes or activities associated with the specification being carried out.

1.7 ALARP

ALARP is the acronym for ‘As Low As Reasonably Practicable’ which simplified means, ‘reducing the risk to a level at which the cost and effort (time and trouble) of further risk reduction are grossly disproportionate to the risk reduction achieved’. **Full Compliance** to PDO Standards and Procedures is a key element in achieving ALARP.

For more details refer to *ALARP Definition*

2 Definitions

Vacuum Test	A test to prove that the equipment does not suffer from ingress of fluid or gas from external sources. Normally required for any equipment that is designed to operate under vacuum conditions.
Reinstatement Test	A pressure test carried out prior to returning an item of plant into service after the pressure containment envelope has been breached, to check integrity of the system and confirm absence of leaks.
Gross Leak Check	A test carried out normally using nitrogen at a positive pressure raised in steps up to approximately 3-5 bar(g) but not exceeding the Maximum Allowable Operating Pressure for gross leak identification. This is followed by an in-service test.
Sensitive Leak Test	A Nitrogen Leak Test carried out with a Nitrogen/Helium mixture, using Helium Sensing instruments to monitor for leakage from potential leak paths.
In-Service Reinstatement Test	A pressure test carried out using the service fluid under its maximum operating conditions and a leak search carried out. The test should be controlled with the pressure increased in stages with disturbed flanges and/or equipment checked at each hold point.
Method Statement	A document that details the way a work task or process is to be completed. The method statement shall outline the hazards involved and include a step by step guide on how to do the job safely.
Strength Test	A pressure test carried out at a pressure in excess of the Design Pressure to prove the mechanical strength and integrity of the vessels, piping system or components.
Operating Pressure (OP)	The OP is the gauge pressure which prevails inside equipment and piping during any intended operation. The OP is determined by the process engineer
Maximum Operating Pressure (MOP)	The maximum pressure that can occur under normal operating/working conditions. *NOTE: The MOP shall be determined by the process engineer.*
Maximum Allowable Operating Pressure (MAOP)	The maximum pressure at which a system is allowed to operate. Must not be exceeded in steady state conditions.
Design pressure (DP)	The design pressure for any pressure containing item be it a vessel or a compressor is based on what the maximum possible pressure that item might be subjected to.
Toxic	Gases such as H2S, SO2, CO are considered to be toxic. Hydrocarbons are not classified as toxic or corrosive. Toxic, in the case of H2S, is defined as greater than 300ppm *(PDO use 300 ppm as the level of concern for the Onset of Significant Health Effects for Hydrogen Sulphide – SP 1190-1).* Methanol for this standard will be classified as utility system and not toxic.
Explosive Mixture	Any substance above its Lower Explosive Limit (LFL). The LEL is the lowest concentration of a flammable gas or vapour, in air at atmospheric pressure, capable of being ignited.

3 Hazards

Nitrogen is an asphyxiant and connot sustain life. Controls applicable to the use of Nitrogen for reinstatement testing can be found in Appendix 3.

Failure or damage to the equipment during test might arise from:

Use of an excessive test pressure, due to either faulty calculation or faulty pressure control equipment.

Testing at too low a temperature.

Overloading, due to the weight of the test medium.

Drawing an unacceptable vacuum when removing the test medium.

Corrosion, due to use of unsuitable hydraulic test medium.

Internal explosion created by presence of explosive mixture and heat source, as a result of compressions.

When carrying out leak tests, consideration shall be given to adjacent systems operating under pressure. For example, if the system undergoing test were to fail, the adjacent pressurised system could suffer damage, thereby increasing hazards.

4 PDO Reinstatement Policy

The test methodology and acceptance criteria are dictated using a risk based approach which has 3 distinct steps defined in this process:

- Reinstatement Test Assessment Tool
- In Service Test Validation Check flowchart
- Acceptance Criteria Table

Compliance to this process is mandatory to prevent the uncontrolled release of hydrocarbons.

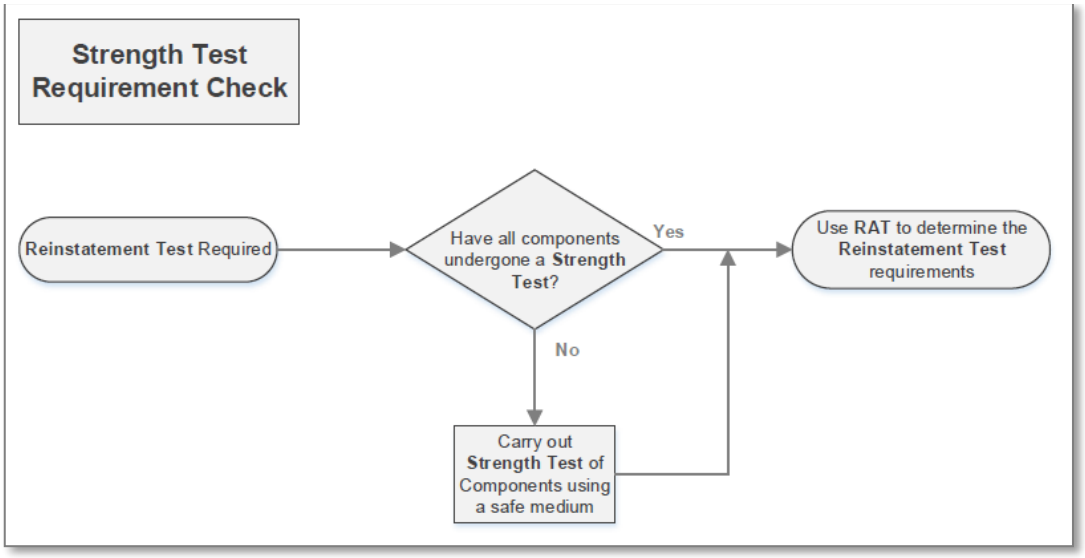
Note: Uncontrolled leakage of Hydrocarbons, during a reinstatement test, is:-

- A leakage of a quantity which is reportable under PR-1961 Process Leak Management.
- A leakage that remains unidentified by personnel or detection systems for an unacceptable period.

Leakage during re-pressurisation shall not be considered 'uncontrolled' if it is immediately discovered, controlled through stoppage of activity and of a quantity less than the reportable limits see PR-1961.

Any replaced or modified item of equipment, which forms part of the pressure envelope, must have previously undergone a successful strength test prior to installation. Also, any repairs to equipment shall have been carried out in accordance with the design specification and in its original location. See figure 1 below.

Figure 1: Strength Test Requirement Check

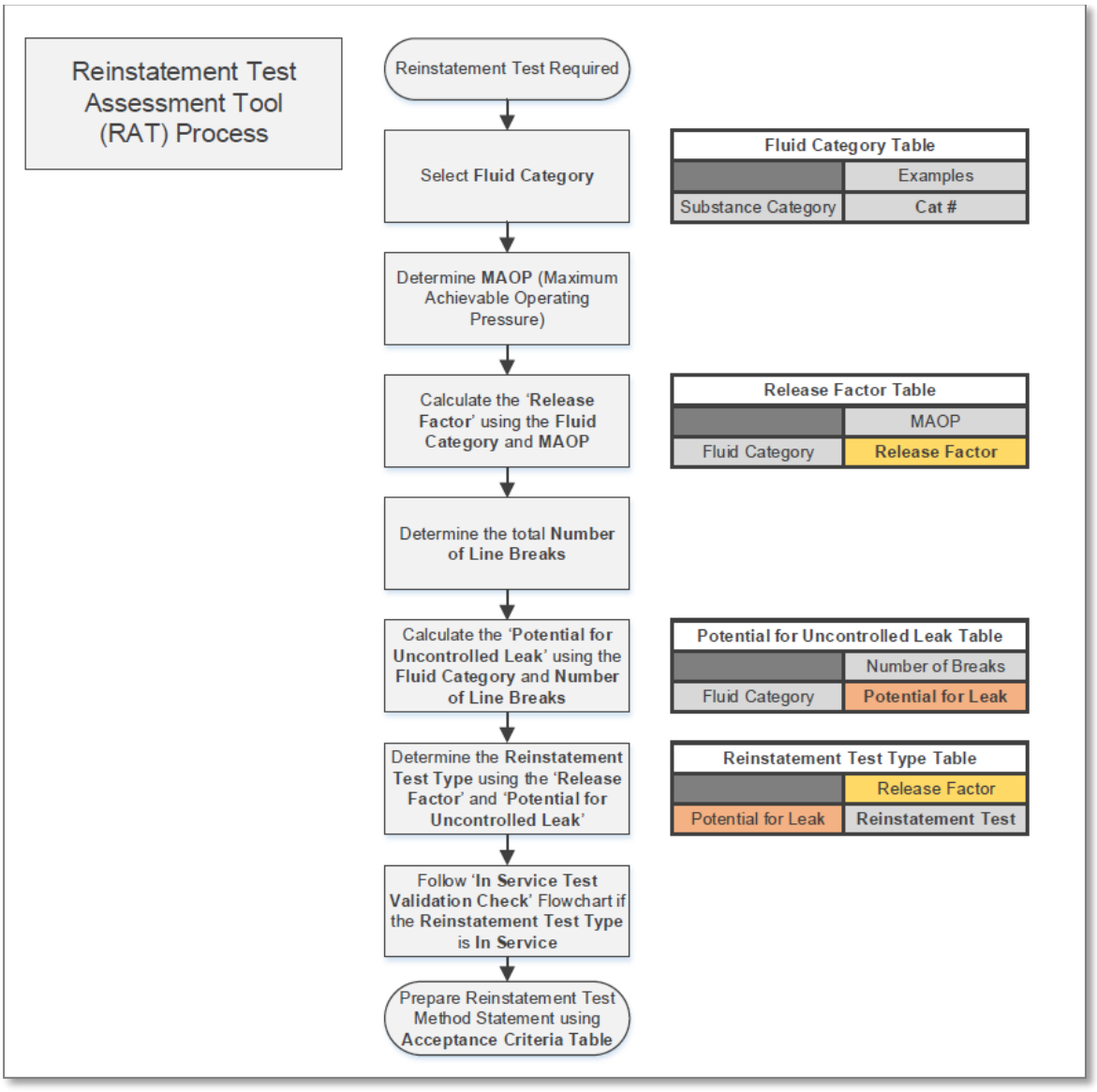


4.1 Reinstatement Test Assessment Tool (RAT) – Instructions and Use

This is a risked based approach to determine the minimum test methodology to use for operational tightness testing meeting ALARP. If there are special joints that do require additional testing levels then this can be carried out at the assets discretion.

The Reinstatement Test Assessment Tool (RAT) process can be seen in Figure 2 below.

Figure 2: RAT Process



The RAT has five simple steps to determine the correct testing Methodology.

Step 1: *Select the process fluid category from the following table.*

Fluid Category Table		
Fluid Category	Examples	Notes
Cat #1	Toxic – H2S or other toxic systems *(For fluid categories in reinstatement testing Cat #1 is taken as Critical Sour for H2S)*	Greater than or equal to 5 bar(a) H2S partial pressure*
Cat #2	Flammable Gases and Flammable Liquids above flash point *(For fluid categories in reinstatement testing Cat #2 is taken as Sour for H2S)*	Greater than 100ppm in the gas phase but less than 5 bar(a) H2S partial pressure*
Cat #3	Flammable Liquids below flash point e.g. Dead Crude	
Cat #4	Utility Systems – Cooling or Heating mediums, Lube Oil Systems, Steam Systems, Hydraulic Oil Systems, Chemicals (including Methanol), Nitrogen	

Step 2: *Select the Release Factor (High Medium or Low) as per following table*

Release Factor Table				
Fluid Category	**Maximum Achievable Operating Pressure**			
	<20 Bar	20 – 99 Bar	100 – 419 Bar	>420 Bar
Cat #4	Low	Low	Low	Low
Cat #3	Med	Med	Med	Med
Cat #2	Med	Med	High	High
Cat #1	High	High	High	High

STEP 3: *Select "Potential for Leak (High, Medium or Low)" as per complexity table below taking account the number of joints and connections that have been disturbed during the work within the test boundary.*

Potential for Uncontrolled Leak Table				
Fluid Category	**Number of Break Points within Test Boundary (Including Small Bore Tubing SBT)**			
	<10	10 - 19	20 - 29	>30
Cat #4	Low	Low	Low	Low
Cat #3	Med	Med	Med	Med
Cat #2	Med	Med	High	High
Cat #1	High	High	High	High

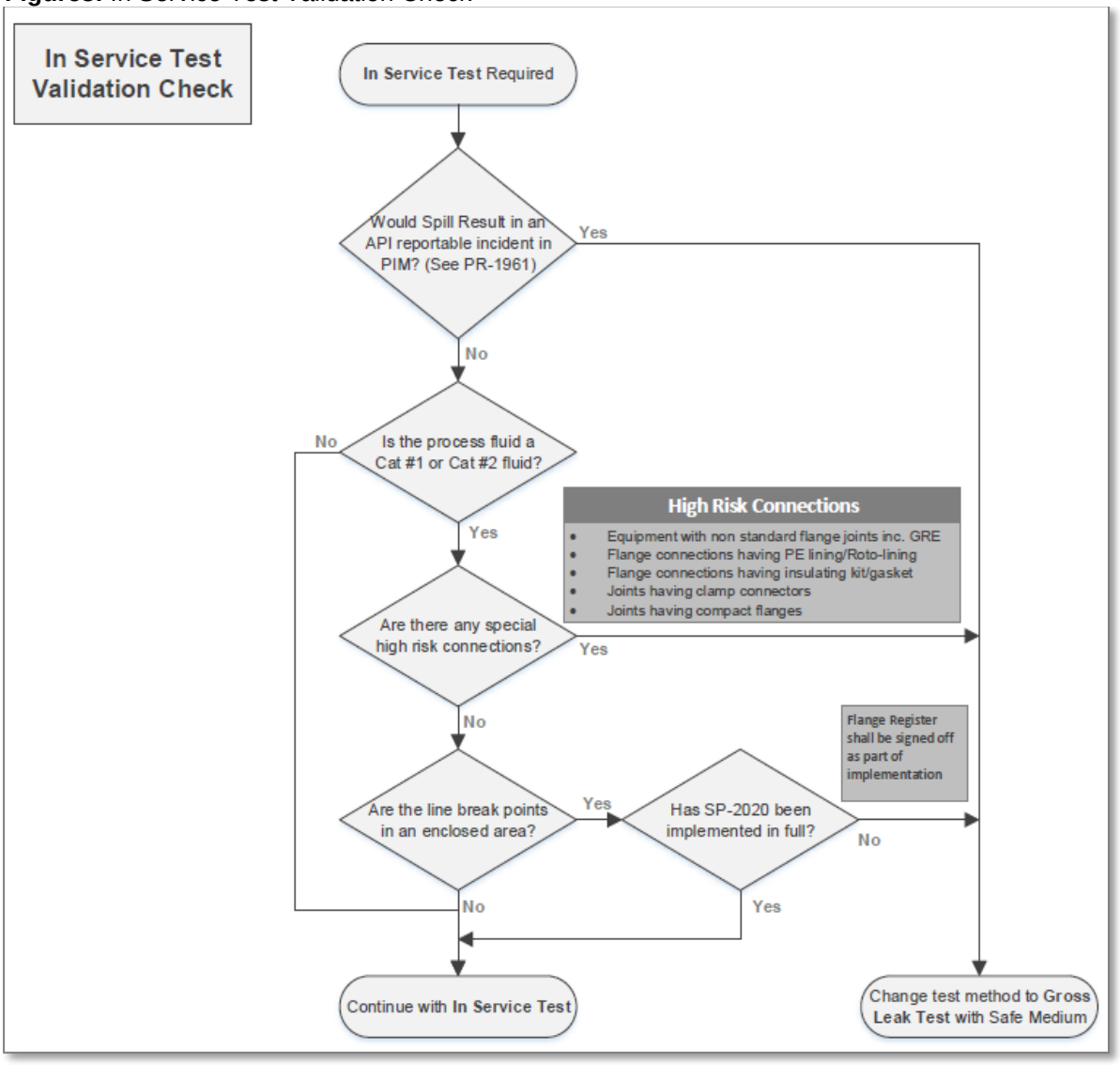
A proven control system must be used for Small Bore Tubing (SBT) control for this guideline to be valid otherwise a separate risk assessment must be completed.

STEP 4 : *Using the above categories for Release Factor and Potential now determine the minimum standard of test to be conducted from the "Assessment Outcome" table below.*

Reinstatement Test Type Table			
Potential for Uncontrolled Leak	**Release Factor**		
	Low	Med	High
Low	In Service	In Service	In Service
Med	In Service	Gross Leak then In Service	Gross Leak then In Service
High	Gross Leak then In Service	Gross Leak then In Service	Sensitive Leak Test (Helium Trace)

STEP 5: *Finally complete the In Service Test Validation Check for all in-service test outcomes to ensure risk is ALARP using the In Service Test Validation Check decision tree shown in Figure 3.*

Figure3: In Service Test Validation Check



5 General Leak Testing Requirements

5.1 Flange Management:

WARNING: An effective flange management sytem must be in place and is a pre-requisite for any In-Service testing. Total compliance with SP-2020 is key in reducing the likelihood of flanges failing during the test process. If flange management cannot be demonstrated as per SP-2020 then as a minimum a Gross Leak Test shall be carried out prior to the In Service Test.

Detection Devices:

Fixed detection systems shall not be solely relied upon as a means of monitoring for leakage of Hydrocarbons during reinstatement activity.

Personnel should not be used to monitor potential leak paths, in areas where there is a hazard to themselves from any leakage or where means of escape is limited by access, enclosed space, ladders etc.

Where a Gross Leak Test is required all flanges should be taped and a bubble test carried out using 'Snoop' or anther proprietory liquid leak detector solution. Where available Acoustic/Sonic leak detection guns can be used to assist with gas leak detection and provide confirmation of successful gross tightness testing with air or nitrogen.

Where In Service Testing is being undertaken on a hydrocarbon system then FLIR (Forward Looking Infra Red) HC leak detectors shall be available and operations staff shall be trained in their use. These devices allow for quick and efficient sweeps of process areas on start-up and in-service tests allowing early indication of leaks and confirmation of status without multiple personnel being used to effectively monitor many flanges and break points.

The use of a FLIR camera is not required where **all the following criteria are met:**

- The number of joints being tested is less than 10.
- All joints can be monitored concurrently during the test.
- None of the joints being monitored are in an enclosed space.
- All personnel monitoring the joints are in direct communication with the Control Room Operator by radio.
- The system is not critical sour.
- A method statement is available clearly stating the test pressure hold points and how to blow down the system safely in the event of a leak being discovered.

NOTE: FLIR does not detect nitrogen or air leaks and should not be used for Gross Leak Testing.

PROVISION OF AND TRAINING IN DETECTION DEVICES WHERE MULTIPLE BREAK POINTS ARE IN THE TEST SYSTEM IS A PREREQUISITE FOR THE USE OF THIS PROCESS.

5.2 Line Walks:

Line walks prior to testing shall be completed by personnel familiar with the system being tested. This will provide a visual check on all assembled parts, joints, small bore fittings and valve alignment.

5.3 Risk Assessment:

Consideration must be given to the risk of creating an explosive mixture within the process system, by the introduction of the process medium to air-filled pipework or equipment. If there is a greater than low risk of explosion, the system shall be inerted prior to the introduction of the process medium.

5.4 Method Statement:

A Method Statement must be prepared, and approved by the Production Coordinator, for all reinstatement pressure testing operations, and such operations must be controlled by the Permit to Work System.

The Method Statement shall be specific for the task and follow the template given in Appendix 2.

The Method Statement shall consider and include where necessary:

- details of the boundaries of the test including pressures, maximum and minimum temperatures, test medium, method of filling, venting and, if applicable, the method of draining the test medium from the system;
- drawings showing the relative positions of blanks, drains and vents, indicating where valves have been removed, defeated or mechanically locked;
- checklists of all system components Appendix 4.

5.5 Nitrogen Supply:

Nitrogen shall be supplied in ‘quads’ or for large operations tankers or portable high volume tanks. The nitrogen tanks and associated equipment are normally supplied by a contractor, who will also supply competent personnel to operate the equipment. However, this does not remove the responsibility of the PDO Operations staff for the overall supervision and the safe completion of the work under the PDO PTW System.

5.6 Systems Connected to Flare/Blowdown Headers

The removal for replacement, repair and recalibration of system “relief valves”, blowdown or manual vent valves requires that the flanges on the process and flare / relief sides of the valves be subject to a reinstatement leak test.

On the process side the type of leak testing will be in accordance with Section 5.1. Reinstatement testing of the flare / relief flange which is normally subjected to atmospheric pressure which is not ‘practicable’ on an open ended systems such as the flare and relief headers. In this instance it is acceptable to carry out the following;

- Ensure that SP-2020 – Flange Connections Bolt Torquing and Tensioning is adhered to, ‘flange make-up certificates’ are issued and the flange break register updated.
- Flange shall be ‘masked’ and a ‘single’ hole made for testing.
- Normal operating conditions (temperature & pressure) must be achieved.
- The flange shall be tested with an approved ‘bubble solution’.

Provided that the above is complied with a Procedure Variance is not required.

6 Sensitive Leak Testing Requirements

Sensitive Leak Testing combines nitrogen/helium to prove integrity together with inerting to render equipment and piping safe for the introduction of hydrocarbons.

Nitrogen and helium gases are inert and non toxic therefore following a sensitive leak test systems can be de pressurised to approximately 2 psig to blanket them until such times as the hydrocarbon gases and/or liquids are introduced into the system.

NOTE 1: Sensitive leak testing does not simulate the temperature of the operating conditions which can subsequently affect the leak tightness of the system at temperature. Packed valve glands in gate and globe valves that are over-tightened to achieve leak tightness at ambient temperature may become in-operable at elevated operating temperatures.

NOTE 2: This sensitive leak test is usually performed by a qualified contractor using trained and experienced technicians. These qualification/competency requirements should be specified in the contract and confirmed by the assset.

The sensitive leak test is performed using a 1% helium tracer (minimising cost) since the sensitive detectors will detect the smallest practical leak.

The test shall be performed at a pressure equal to the maximum achievable operating pressure of the system not protected by a relief valve, prior to examination the test pressure shall be held for a minimum period of 15 minutes.

Flanges should be taped to prevent gas dispersal in the distance between the gas ket outside diameter and the mass spectrometer probe. The tape is then punctured with the probe, and the gas sample analysed for the helium content using suitable equipment .

For method of detection and acceptance criteria for Sensitive Leak Testing refer to the Operational Reinstatement Testing Table Appendix 1

When unacceptable leakage is recorded, the position of the leak(s) shall be marked and recorded. The system will then be de-pressurised for remedial action by decanting helium/nitrogen gas to other systems to be tested. After repairs have been made, the repaired areas shall be retested inaccordance with this specification.

The Production Coordinator must be informed of the results of the Sensitive Leak test.

Sensitive Leak Test will not simulate process fluid flow, weight or temperatures as such a line walk shall take place immediately after the process start up. The puprpose of the line walk is to assure the operations team that there is no leakage from disturbed joints affected by process conditions.

7 Gross Leak Testing Requirements

The N2 reinstatement leak test, which shall be performed by trained and experienced technicians, is the direct pressure technique of bubble leak testing to locate leaks in a pressurised component, by the application of a solution that will form bubbles as leakage gas passes through it. An ultrasonic test tool can be also used to aid confirmation of leaks.

For this leak test, 100% nitrogen gas supplied from cylinders, tanks or a compressor shall be used for purging, testing and blanketing. When purging, the oxygen content should be reduced to the order of 1%, so that it is well below the lower limit that will form an explosive mixture. Oxygen levels may be measured using a suitable Oxygen Analyser. The test shall be performed at pressure up to 3-5 Barg. Prior to examination, the test pressure shall be held for a minimum period of 15 minutes.

After the N2 reinstatement leak test, the nitrogen shall be depressurised to approximately 2 psi(g) for inert blanketing the system.

The bubble forming solution shall produce a film that does not break from the area being tested and the bubbles formed shall not break rapidly due to air drying or low surface tension. Household soaps or detergents are not permitted as substitutes for bubble testing solutions.

The bubble forming solution shall be compatible with the temperature of the test condition.

NOTE: 'Snoop' liquid leak detector has an effective operating range of -2 to 93ºc this is sufficient to cover all likely scenarios encountered in Oman. The operator must check the manufacturers details in the event that another brand of leak detector is used.

The bubble forming solution shall be applied to the surface being tested by flowing, spraying or brushing the solution over the examination areas. The number of bubbles, produced in the solution by application, should be minimised to reduce the problem of masking bubbles caused by leakage.

For method of detection and acceptance criteria for Gross Leak Testing refer to the Operational Reinstatement Testing Table Appendix 1

The Production Coordinator must be informed of the results of the Gross Leak test.

8 In-Service Testing Requirements

In-service Tightness Testing incorporates the testing for leaks, with the recommissioning activity of reintroducing the process medium.

In all instances where there is a proposal to utilise a flammable fluid to perform an in-service reinstatement test, that proposal must be endorsed by the DTL at the planning stage.

A TRIC talk is required prior to any in service test the content of which shall be approved by the Responsible Supervisor.

The In-service Reinstatement test must be carried out to the Maximum Achievable Operating pressure obtainable under either operational or fault conditions. The process medium must be introduced slowly. The pressure shall be increased in stages of not more than 20% of the maximum pressure obtainable or 10 bar(g), whichever is the greater, up to 80% of the maximum pressure obtainable and thereafter in 10% or 10 bar(g) stages.

At each stage of pressurisation, all disturbed joints/flanges shall be monitored for leaks, both visually and using appropriate gas meters. FLIR Detectors shall be used to allow the ability to quickly detect any leaks through rapid surveillance of multiple joints. The person witnessing the test must satisfy themselves that there are no signs or detection of process fluid at any of the relevant areas, for the test to be accepted.

For method of detection and acceptance criteria for In-Service Testing refer to the Operational Reinstatement Testing Table Appendix 1

The Production Coordinator must be informed of the results of the In-Service test.

9 Vacuum Testing Requirements

Some systems are designed for vacuum service and must be tested for this service.

It is most important to determine that any equipment so tested is designed for vacuum conditions, and isolated properly before testing.

Items for vacuum service should be tested with a vacuum. The reason for this is that applying a pressure test to vacuum equipment does not necessarily detect places where there can be leakage in the opposite direction, e.g. a gasket fault. The vacuum should be of the order of 0.1 bar absolute or as low as design vacuum and this should be held for a period of time after the eductor has been shut off.

If the equipment is in hydrocarbon service, it should be remembered that any appreciable leak inwards, of air, may create the possibility of an air/hydrocarbon explosive mixture.

In addition to the vacuum test, items for vacuum service will be tested to 1.0 bar(g) with either nitrogen or air.

The Production Coordinator must be informed of the results of the Vacuum test.

10 Multi Stage Compressor Testing Requirements

There may be in stances, e.g. on a multistage gas compressor, where it is not reasonably practicable to perform a sensitive leak test to the expected operating pressure. This may be because it is not reasonably practicable to achieve:

- A satisfactory isolation between high and low pressure stages,
- The full pressure using the sensitive leak test medium.

In such circumstances, a test should be carried out to the maximum pressure that it is reasonably practicable to achieve. This should achieve the purpose of:

- Fully inerting the system
- Proving the system free from any significant leaks.

This should then be followed by an in-service reinstatement test using the process fluid, where all the foregoing conditions/requirements must be considered.

This methodology, if proposed, shall be incorporated into the Method Statement to be authorised by the Production Coordinator.

The Production Coordinator must be informed of the results of the reinstatement test.

Appendix 1 Testing summary table and acceptance Criteria

Operational Reinstatment Testing Method Specifics				
Nr	**Leak Test Type**	**Specifics**	**Leak Detection Method**	**Acceptance Criteria**
1	**N2/He**	N2 pressure at ***Maximum Operating Pressure*** *(MOP).* He concentration : 1%	Flanges and joints shall be sealed around the periphery with tape and the tape shall be punctured by the detector tip.	Leak rates: - Average for all flanges or joints : 20 scf/year. For individual flanges or joints leak rates in excess of 40 scf/year shall be reviewed and accepted subject to risk review by the appropriate TA. - Each valve stem : max. 50 scf/year - Intermittent used joints (e.g.pig launcher/receiver): max. 100 scf/year -Stuffing boxes: max. 175 scf/year
2	**N2**	N2 pressure at ***Maximum Operating Pressure*** *(MOP).*	Flanges and joints shall be sealed around the periphery with tape, be punctured (3 mm hole) and a proprietary bubble forming solution applied or at specific manufacturer's instructions for other approved test methods.	No leakage evidenced by absence of continuous bubble formation
3	**Gross Leak Test** (Nitrogen)	Max. at 3-5 barg or ***Maximum Allowable Operating Pressure*** *(MAOP),* whichever is lower	1. Flanges and joints shall be sealed around the periphery with tape, be punctured (3 mm hole) and a proprietary bubble forming solution applied, 2. Use of a proprietary bubble forming solutions without sealing the flanges and joints, 3. Ultrasonic leak testing (in case flanges or joints are not accessible). **Note:** Use of bubble forming solution is more effective than ultrasonic in detecting small leaks.	1 & 2. No leakage evidenced by absence of continuous bubble formation, 3. Ultrasonic sounds not detected.
4	**In- Service**	Use of product to	1. Visual inspection	1. No visible leaks

Operational Reinstatment Testing Method Specifics				
Nr	**Leak Test Type**	**Specifics**	**Leak Detection Method**	**Acceptance Criteria**
	Test with Hydrocarbon	pressurize in controlled manner with surveillance plan agreed.	2. FLIR leak testing inspection. 3. Ultrasonic leak testing	2. No detection with FLIR gun 3. Ultrasonic sound not detected
6	**In-Service Test with Steam**	Use of steam to pressurize in incremental stages with hold and “soak” time while observing the gradual, uniform increase of the temperature (warming-up).	1. Visual inspection 2. Ultrasonic leak testing inspection.	1. No visible leaks 2. Ultrasonic sounds not detected.
4A	**Service test with water** ***Compliant*** to ASME B31.3 Cat D service.*	Use of water with pressure gradually increasing to ***Normal Operating Pressure***	Visual inspection.	No visible leaks.
4B	**Service test with water** ***Not compliant*** to ASME B31.3 Cat D service.*	Use of water with pressure gradually increasing to ***Maximum Operating Pressure*** *(MOP).*	Visual inspection.	No visible leaks.
5A	Service test with air ***Compliant*** to ASME B31.3 Cat D service.*	Increase pressure in stages to ***Normal Operating Pressure***	Ultrasonic leak testing inspection.	Ultrasonic sounds not detected.
5B	Service test with air ***Not compliant*** to ASME B31.3 Cat D service.*	Increase pressure in stages to ***Maximum Operating Pressure*** *(MOP).*	Ultrasonic leak testing inspection.	Ultrasonic sounds not detected.

* Cat D Service is where the fluid handled by the pipework is non fammable, non toxic and not damaging to human tissue. The design pressure does not exceed 10 bar. The design temperature is greater than -29ºC and less than 186ºC

Appendix 2 – *Method Statement Template*

REINSTATEMENT TESTING METHOD STATEMENT		
HEADING	**CONTENT**	**SIGNATURE**
Isolation/Line Up	• Approved ICC number • Any specific isolation requirements, including additional blanks/spades fitted for testing purposes? • PEFS marked up detailing valve line up, test boundary, relief paths, pressure injection points, test points, and blowdown valves. • Boundaries between different classifications of pipework to be highlighted. • Mitigation to prevent overpressurization of adjacent systems to be detailed. (Marked up PEFS shall be attached to this method statement)	(Accountable Person)
Depressurization	• How will the line be depressurized in the event of a leak and at the end of test? • At end of test consider decanting test medium to adjacent system(s) if applicable. (Provide detailed instructions on what to do in the event of an emergency)	(Accountable Person)
Flange Break	• All Flange breaks have been witnessed as completed in the flange break regiser. (Provide details of flange break register location and sign off witness) • All flange breaks/disturbed joints have been clearly identified. • All flange breaks/disturbed joints have been taped up for the test. • Persons involved in the test have reviewed the location of all flanges on site and are fully aware of each test point location. • The Disturbed Joint Testing Checksheet has been prepared.	(Accountable Person)
Nitrogen Awareness	• If using nitrogen then an awareness session has been conducted with all those involved in line with the details provided in Appendix 3.	(Accountable Person)
Test Medium Details	• If using a test medium other than nitrogen give details and consider the effect that weight/loading may have on the system	
Pressure Control/Monitoring	• Gross leak test to be carried out to XX bar if applicable. • Pressure to be raised to XX pressure in steps of XX bar. • Pressure rise will be controlled by. (provide details of how pressure rise will be controlled, pressure hold points and where the pressure will be read) • MAXIMUM TEST PRESSURE NOT TO BE EXCEEDED	(Accountable Person)
Communication	• Communication between control room, N2 pressure work party and leak detection team will be carried out using XXXX.	(Accountable Person)

	(Give details with regards communication)	
FLIR HC Detector **(If Required)**	• Forward Looking Infra Red Hydrocarbon detector will be used by XXX person located at XXX. (Provide details of where the monitoring needs to take place to scan the whole test envelope. Note this needs to be done at each hold point until maximum test pressure is reached)	(Accountable Person)
Gas Detection	• All members of the team to have multi gas detectors • Plant gas detection system confirmed as operational	(Accountable Person)
Emergency Response	• What to do in the event of an uncontrolled leak. • Fire team informed of specific location prior to work start • Local emergency response equipment • Numbers to call in event of emergency • Communications and availability of phone signal • Emergency isolation plan	(Accountable Person)
Area Authority	The requirements of the method statement have been complied with and the reinstatement test can take place	(Area Authority at site)

Appendix 3- Using Nitrogen

Objective

This Appendix will identify the precautions and procedures that should be observed when using Nitrogen for gas freeing, purging and reinstatement testing.

WARNING: NITROGEN IS AN ASPHYXIANT AND WILL NOT SUSTAIN LIFE.

General

Nitrogen is the main component of breathable air and, as such, is often wrongly considered not to be a personal hazard. It is provided for use either in a gaseous form in `quads' or from a nitrogen- producing skid, or in a liquid state in cryogenic bulk tanks where it is stored at a temperature below its boiling point of -196°C.

If undiluted nitrogen is breathed, not only is the blood passing through the lungs not replenished with oxygen, but also much of the residual oxygen in the blood passes out into the lungs. The effect is therefore much worse than holding one's breath or re-breathing air. In practice it will take only a few breaths to fully exchange the air in the lungs for nitrogen, and unconsciousness will rapidly ensue. There is no warning because the normal stimulus to respiration is the build up of carbon dioxide, not lack of oxygen. Carbon dioxide will not build up while breathing continues if the gas being breathed is nitrogen.

Fatalities and serious injuries have occurred when performing activities on equipment that has recently contained nitrogen. This has happened when, in order to make progress with the work, sheeting, tarpaulins, boarding etc have been used to screen or protect the work site, and a confined area has been created around the equipment. Great care must be taken to ensure that a confined space is not created, whether deliberately or inadvertently, which might allow the uncontrolled build up of nitrogen and the consequent exclusion of oxygen. Where it is deemed necessary to operate within a confined space that has recently contained nitrogen, an oxygen meter shall be used to continuously monitor the atmosphere.

Liquid nitrogen, released into the atmosphere in an uncontrolled manner, will quickly change form to a gas, thus producing an asphyxiation hazard from the nitrogen-enriched atmosphere.

Precautions when using Nitrogen

Prior to using nitrogen in either a gaseous or cryogenic form, an assessment of the risks to both personnel and equipment, from leaks or spills, shall be carried out. Particular attention should be paid to:

- Provision of drain paths for spills and leaks.
- Routes for temporary hoses.
- Provision of First Aid equipment and competent persons to use it.
- Written procedures for the operation, including emergency procedures for dealing with spills and leaks.

All work involving the use of nitrogen shall be controlled by the Permit to Work (PTW) System. Barriers and warning notices shall be erected around the work area. All openings, man ways, pipe ends etc must be clearly marked, and oxygen monitoring and rescue equipment provided. All personnel involved in the operation shall be instructed in the hazards associated with nitrogen operations and the types and functions of monitoring equipment being used.

Where habitats or partial enclosures are required, these shall be treated as Confined Spaces, and the controls and precautions associated with Confined Space entry shall be applied.

Liquid Nitrogen (Cryogenic)

Cryogenic Liquids - Occurrence

Cryogenic liquids are defined as those that are manufactured, stored or handled at, or below -85 ° C. Liquid nitrogen is the cryogenic liquid in common use within the oil industry.

Handling materials at low temperatures requires specialised procedures and safety precautions, due to the hazards from spills or accidental damage to cryogenic tanks and associated pipework.

Cryogenic Liquids - Personal Protection

PVC or leather gloves must always be worn when handling anything that contains, or has been in contact with, cryogenic liquids. Such gloves should be loose fitting so that they may be easily removed if liquid is splashed onto or into them.

Where spraying or splashing may occur, a face visor shall be worn.

Coveralls should be worn outside gloves and boots to ensure that liquid contamination will run off and not become trapped.

Cryogenic Liquids - Mechanical Hazards

The physical properties of materials at low temperatures are markedly different from those at ambient temperatures. This change, not a gradual one, takes place over a short temperature range, resulting in an increased brittleness of the material at lower temperatures. In this state, normal stresses or shock can result in brittle fracture, which can be both sudden and extensive.

In the event of spillage of liquid nitrogen over a steel deck, the resultant drop in temperature could cause the steel to crack. In such circumstances, the deck should be flooded with copious amounts of water, which should assist the spilled liquid to `boil off'.

Wooden boards or rubber mats should be positioned under cryogenic tanks and hoses to prevent them contacting the deck.

Drip trays are to be positioned under all cryogenic hose connections to catch any minor spills.

Cryogenic Liquids - General Hazards

Warming, to ambient temperature, of vessels initially containing a cryogenic liquid may result in high pressures.

When introducing cryogenic liquids to a system at ambient temperatures, care must be taken with respect to the rate of flow of the liquid since sudden cooling may result in fast contraction of pipework, which will stress joints thus causing damage.

Before cool down of plant, it is essential that all parts that may contain free moisture are carefully dried as water freezing in the pipework may expand to a sufficient degree to cause rupture.

Vapour fog clouds can form during draining of systems containing cryogenic liquid. This vapour fog is composed of atmospheric water vapour condensed by the cooling effect of the liquid being vaporised.

The fog should also be assumed to contain a possible hazardous concentration of the vaporised liquid. This can, depending on the quantity of product being vaporised, create asphyxiation and a visibility hazard.

Cryogenic Liquids - Fire Hazard

At equal pressure the boiling point of some cryogenic liquids, especially liquid nitrogen, is lower than that of liquid air. Air will condense on the external surfaces of pipework containing liquid nitrogen at an equilibrium pressure less than 1.5 bar(a) if the vessels are either unlagged or lagged with a porous cellular type insulant that has not been properly vapour sealed.

The liquid air produced can result in oxygen enrichment of the atmosphere local to the equipment and, if the insulant is combustible there is a serious risk of fire. Special care must therefore be taken before any maintenance or repair work is started, particularly where the use of naked flames or other potential sources of ignition is intended.

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Appendix 4 – *Disturbed Joint Testing Check Sheet*

Disturbed Joint Testing Check Sheet

Area/System

Note: Flanges to be identified by suitable code number on attached P&ID(s)

Date	Flange Joint Number	Bolts Torqued to Correct Setting (Tick)	Leak Test Result (Pass/Fail)	Re- Test Result (Pass/Fail)	Tape Removed From Flange (Tick)	Name	Signature	Comments

Appendix 5 – Reference Material

PDO Procedures

PR-1001e – Operations Procedure Temporary Variance

PR-1076 - Isolation of Process Equipment

PR-1077 - Preparation of Static Equipment for Internal Maintenance and Inspection.

PR-1078 Hydrogen Sulphide Management

PR-1081 The Buddy System

PR-1086 - Locked Valve Control

PR-1148 - Confined Space Entry

PR-1154 - Gas Testing

PR-1172 - Permit to Work

PR-1515 – Onsite Mercury Management Procedure

PR-1721 Shutdown Management

PDO Standards

SP-1005 HSE Specification - Emissions to Atmosphere

SP-1006 HSE Specification - Aqueous Effluents

SP-1170 Naturally Occurring Radioactive Materials (N.O.R.M.)

SP-1207 – Specification for Vacuum Tankers

SP-2020 – *Flange Connections Bolt Torquing and Tensioning*

SP-2087 – Specification for Onsite Mercury Management

Appendix 6 - User Feedback Page

	SP-2290–Reinstatement Testing		
	Any user who identifies an inaccuracy, error or ambiguity is requested to notify the custodian so that appropriate action can be taken. The user is requested to return this page fully completed, indicating precisely the amendment(s) recommended.		
Name:			
Ref ID		**Date:**	
Page Ref:	**Brief Description of Change Required and Reasons**		

To: UOP6 Surface Operations and Integrity Team Leader		
Custodian of Document	**Date:**	