

ID	Description	Notes	Error Description	Consequences	Consequence Type	PIF (for MAH)	Existing Safeguards	Actions
<b>1</b>	<b>Confirm system status</b>							
1.1	Visually check the status of all disturbed joints		Check incomplete - one or more joints are not checked	May result in nitrogen leaks during the test	Personal safety			
1.2	Carry out line-walk of the whole system		Check incomplete - whole system is not checked	Discrepancies between the test design and plant status may not be detected. May mean hazards are created during leak testing.	Personal safety			
1.3	Confirm integrity of outboard isolations		Check incomplete - integrity of one or more isolations is not checked	If inboard isolation valves have to be open for the leak test a passing outboard isolation would allow gas to flow into the system before the leak test is complete. If a joint leaked there would be a (Loss of Containment) LOC.	Potential MAH	J1 - Valve ID. J6 - Preparation (isolation). J11 - Access (to valves) P5 - Competence (isolation integrity)	Isolation integrity would have been checked before the maintenance work and monitored routinely. Work process ensures leak testing does not start until all joints have been re-made (mechanical completeness signed off). Joints are made by Technicians with defined competence.	
<b>2</b>	<b>Set-up test equipment</b>							
2.1	Visually check the test manifold, hoses etc.		Check incomplete - problems with test equipment are not detected	Possible failure during testing.	Personal safety			Develop a standard design for leak test manifolds.

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2.2	Ensure a correctly rated regulator is connected to the nitrogen quad		Check omitted - regulator is not rated correctly	May contribute to plant being over pressurised during leak testing. Potential to damage adjacent live plant.	Potential MAH	J8 - Tools (regulator). P5 - Competence (potential to over pressurise).	Plant will be protected by PSV (on plant and/or on test rig). Pressurisation is controlled by the operator in defined stages. Pressure gauge on manifold manifold allows the operator to monitor pressure throughout. Plants instrumented systems would provide alarms to the control room.	
2.3	Confirm the PSV on the test manifold is set for test pressure		Check omitted - PSV is not rated correctly	If there is no online PSV on the plant, setting the PSV incorrectly on the test manifold could contribute to plant being over pressurised during leak testing - as above. Additionally, potential for personal harm due to test equipment being over pressurised.	Potential MAH	J8 - Tools (PSV). P5 - Competence (potential to over pressurise).	Pressurisation is controlled by the operator in defined stages. Pressure gauge on test manifold allows the operator to monitor pressure throughout. Plants instrumented systems would provide alarms to the control room.	Develop guidance for systems with an LP/HP interface inside the leak test envelope.
2.4	Confirm pressure gauge on test manifold is the correct range		Check omitted - pressure gauge is not rated correctly	Leak test may not be carried out at the required pressure due to inappropriate scale on the gauge. May mean leaks are not detected, leading to LOC on return to service. May contribute to over pressurisation of plant during leak testing.	Potential MAH	J8 - Tools (PSV / test manifold).	Gauge range is clearly indicated by the analogue display. Gauges are readily available on the platform.	

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2.5	Fit a Druck pressure recorder of correct range to the test manifold		Check omitted - Druck is not rated correctly	A second indication of pressure would not be available.				
2.6	Connect a hose between test manifold and identified test point		Action misaligned - connect to wrong point on plant	If wrong side of Non-Return Valve (NRV) or isolation valve the leak test would not be effective, which may contribute to LOC on return to service.	Potential MAH	J1 - valve ID. J6 - Preparation (test design) J11 - Access (to connection) P5 - Competence (potential for incomplete test).	Leak test design identifies the suitable connection in advance.	
2.7	Ensure whip checks are fitted to the hose ends		Action omitted - whip checks not fitted	Harm to personnel if hose joints fail	Personal safety			
<b>3</b>	<b>Leak test the test equipment and hoses</b>		Check omitted - leaks from test equipment not detected	Nitrogen leaks from test equipment	Personal safety		Controls in place for all uses of nitrogen	
3.1	Open nitrogen supply and pressurise to the determined test pressure		Action omitted - do not pressurise	Nitrogen leaks from test equipment not detected	Personal safety			
3.2	Shut the nitrogen supply		Action omitted - valve left open	Nitrogen leaks from test equipment detected by decay test because nitrogen supply compensates	Personal safety			
3.3	Check joints for leaks		Check incomplete - one or more sections not checked	Nitrogen leaks from test equipment	Personal safety			
3.4	Monitor pressure gauge on test manifold for decay		Monitoring omitted - decay not detected	Nitrogen leaks from test equipment	Personal safety			
<b>4</b>	<b>Line-up the system for the leak test</b>							

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4.1	Receive authorisation and open PSV isolations	Authorisation required because PSV isolation is removed whilst remaining isolations stay in place.	Action omitted - PSV isolation valve is closed	May contribute to plant being over pressurised during leak testing. Potential to damage adjacent live plant.	Potential MAH	J6 - Preparation (STT). P5 - Competence (PSV online)	Requirement for PSV de-isolation will be identified in advance in the leak test design. Pressurisation is controlled by the operator in defined stages. Pressure gauge on test manifold allows the operator to monitor pressure throughout. Plants instrumented systems would provide alarms to the control room.	
4.2	Ensure an open path from injection point to vent valve that can be operated from a safe location if a leak occurs.	Ideally a remotely operated vent should be used (not local / manual)	Check incomplete - system is not fully lined up	If the plant was over pressurised in error, there may not be a safe way to recover. May lead to plant over pressurisation during the leak test - as above.	Potential MAH	J1 - valve ID. J6 - Preparation (test design / STT) J11 - Access (to connection) P5 - Competence (potential for incomplete test).	Procedural control only	
4.3	Ensure the route will pressurise every disturbed joint		Check incomplete - system is not fully lined up	One or more disturbed flanges may not be pressurised during the leak test. May result in LOC on return to service.	Potential MAH	J1 - valve ID. J6 - Preparation (test design / STT) J11 - Access (to connection) P5 - Competence (potential for incomplete test).	Procedural control only	

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4.4	Ensure downstream HP-LP interfaces cannot be over pressurised by a passing isolation valve (may require downstream valves to be opened to create a vent route)		Check incomplete - downstream HP-LP interfaces are not protected	Downstream systems are over pressurised due an isolation valve passing during the leak test.	Potential MAH	J1 - HP/LP interfaces. J6 - Preparation (test design) P5 - Competence (HP/LP interface).	HP-LP interfaces are identified on the P&ID which are used when designing the leak test. This assessment has highlighted the need to consider potential issues outside of the system isolations to identify potential hazards if isolations pass.	Create guidelines for handling aspects of leak testing that are particularly vulnerable to human error during design and execution. Examples of complexing include HP-LP interfaces, NRV, trip valves, bypasses etc.
4.5	Ensure pressure will not be trapped behind NRV or can be vented if required.	Not an issue for the leak test but may be a hazard for corrective action if a leak is detected.	Check incomplete - NRV downstream of vent point not identified	Pressure may be trapped causing a hazard to personnel if corrective action is required due to leaks being detected.	Personal safety			
<b>5</b>	<b>Carry out the leak test in defined stages</b>							
5.1	Pressurise the system to the 1st stage pressure		Action too much - pressurise to greater than correct 1st stage pressure	If there was a leak there would be a greater volume of nitrogen that may leak causing a hazard.	Personal safety			
5.2	Shut the nitrogen supply		Action omitted - nitrogen supply is left open	Either the pressure would continue to increase or the leak would continue.	Personal safety			
5.3	Check upstream / downstream for any pressure rise		Check omitted - pressure rise not detected	Passing boundary isolation (i.e. test gas flowing beyond the isolation) could result in downstream plant being over pressurised.	Potential MAH	J6 - Preparation (test design) P5 - Competence (isolation integrity).	Outboard isolation integrity is checked before starting the leak test. Passing isolation would be detected by pressure decay tests at each stage of the pressurisation, so the problem would be known about before a high leak pressure is introduced.	

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5.4	Check all disturbed joints for leaks (use snoop)		Check incomplete - one or more joints are leaking	Leaks from joints on return to service.	Potential MAH	J1 - Joint ID P5 - Competence (check joints)	Work process ensures leak testing does not start until all joints have been re-made (mechanical completeness signed off). Joints are made by Technicians with defined competence. All joints to be tested will be identified in the leak test pack and will all have break of containment tags on them. Pressure decay will also be monitored.	
5.5	Monitor for pressure decay		Check incomplete - one or more joints are leaking	Leaks from joints on return to service.	Potential MAH	J7 - Time available P5 - Competence (decay test)	Work process ensures leak testing does not start until all joints have been re-made (mechanical completeness signed off). Joints are made by Technicians with defined competence. All joints to be tested will be identified in the leak test pack and will all have break of containment tags on them. Joints are also snoop tested	
5.6	Repeat for the remaining pressurisation stages (50%, 75%, 100%)		Action incomplete - leak test not carried out at all pressures	Leaks from joints on return to service.	Potential MAH	J7 - Time available P5 - Competence (pressurisation stages)	Procedural control only	
5.7	Monitor at full test pressure for 30 minutes		Action too short - do not monitor for 30 minutes	Leaks from joints on return to service.	Potential MAH	J7 - Time available P5 - Competence (decay test)	Procedural control only	

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<b>6</b>	<b>De-pressurise system and de-rig test equipment</b>							
6.1	Depressurise the test equipment and process system to safe location		Action incomplete - pressure remains	Harm of people when de-rigging	Personal safety			
6.2	If the leak test has failed, ensure the system is isolated as shown on the original isolation certificate	Some valves may have been moved during the testing - with formal authorisation.	Action omitted - isolation is not re-established	Leaks identified in leak test may be fed with gas if the isolation integrity has been reduced due to actions taken during test.	Potential MAH	P5 - Competence (disturbed isolation).	Isolations remain in place throughout testing but may be to a lesser standard (i.e. double block may have been reduced to single block to allow leak testing). No intrusive maintenance (i.e. to fix the leak) will take place until the full isolation is in place and proven.	
6.3	Ensure the nitrogen hose is depressurised and disconnect from plant		Action omitted - hose is not disconnected	No immediate consequence. However, the plant will not be in its design state.	Non-compliance of control of work			
<b>7</b>	<b>Complete paperwork</b>		Action omitted - paperwork not updated	No formal record of the leak test for future reference.	Non-compliance of internal integrity management system			