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RECORD OF REVISIONS

Rev	Date	Description	POC	RM
0	9/17/2014	Initial issue. Some material had been Section I Rev 3 Article 10 and was updated.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*
1	4/15/2015	Added boilers to risk eval table EXIST-0. Changed relief device grace period to 30 days in Table 2D.1 and moved vessels to new Table 2D.2, adding inspection interval paras from NBIC NB-23. New boiler table 2D.3 with NMAC requirements.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*

1.0 Definition of Legacy

A. Systems that were operational as of March 10, 2009 when the ESM Chapter 17 revision 0 was released are considered legacy pressure systems. They are a special subset of existing systems.

B. Projects Underway: Projects in design or fabrication stages must follow this chapter.

1. In addition, existing systems are subject to the certification and preventive maintenance requirements herein, as well as being expected to maintain (but generally not reproduce) required documentation.[1]

2.0 Code of Record

A. The code of record (COR) refers to the code and year of the code that was specified in the original construction.

B. Legacy pressure systems must be evaluated to the latest revision of this document and the COR of the system's construction (COR defined in ESM Ch 1 Z10). If original codes or standards are unavailable, or with the Owner's approval newer editions may be applied.

1. Engineering calculations for flexibility, piping supports, and thrust when evaluating systems with small pipe size, indoor location, adequate supports, low changes in fluid system temperature, and low relief discharge energies.

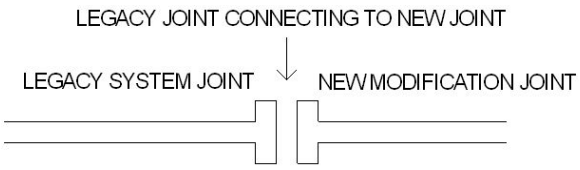
[1] Unlike most ESM chapters, this is a complete program and not only for new installations.

3.0 Modification or Maintenance of an Existing System

A. New construction addition to an existing system may be either in accordance with Section ASME or Section NASME of this Chapter as appropriate.

B. Testing of Modifications to Existing Systems

1. For existing (not only legacy as illustrated below) pressure systems that require system modifications, or any other action which requires the system to be opened and modified by installing a new joint (or removal and replacement of components for calibration purposes), the affected section of piping must be tested/examined as follows:



a. For welded connections where elevated pressure leak test is not possible:

1) Full Penetration Weld – Perform volumetric examination (N/A for Cat D per B31.3)

2) Partial Penetration weld – Perform surface examination (N/A for Cat D per B31.3)

3) Perform Initial Service Leak Test as follows:

i. Gradually increase pressure in steps until the operating pressure (pressure during normal system operating conditions) is reached, holding the pressure at each step long enough to equalize piping strains.

ii. Between each pressure step, examine the affected joints for indications of leaks.

b. For welded connections that can be leak tested at elevated pressure:

1) CPSO must approve test method and test pressure.

c. For mechanical (e.g., threaded, flanged) connections:

1) Fluid Category M systems: CPSO must approve test method.

2) All other fluid category systems: Perform in-service leak test as described in 1.a.3) above.

d. For leak testing pressure system modifications that only consist of ASME B31.3 or LANL CPSO-approved components with mechanical connections and/or code tested sub-assemblies, where mechanical connections are assembled in accordance with manufacturer's instruction or the applicable code or standard:

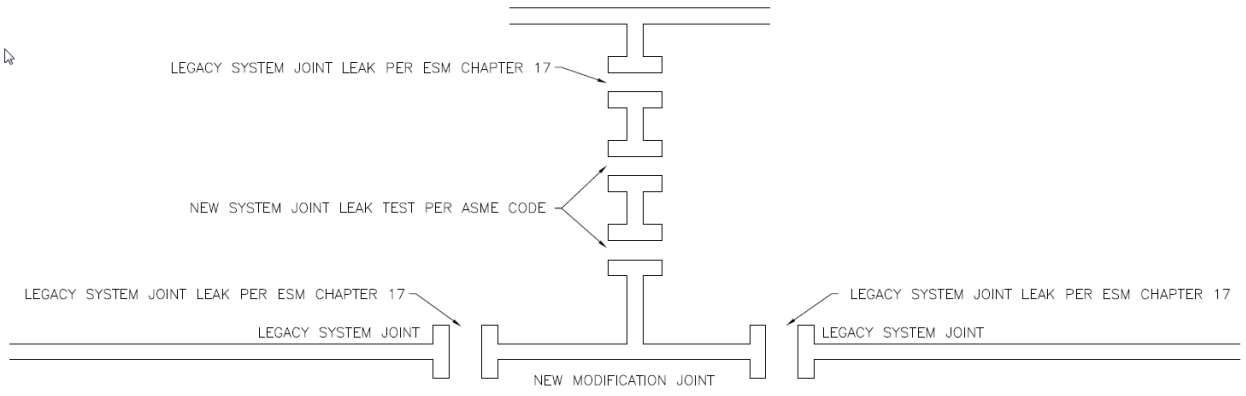
1) The initial-service leak test described by 1.a.3) above may also be performed by either or both tests as follows:

i. Vacuum rate-of-rise method: To execute a vacuum rate-of-rise leak test, the relevant sections of the system are evacuated to a predetermined absolute pressure level. The evacuation stopped

and the system monitored for absolute pressure for at least five minutes. The acceptance criteria will be specified by the responsible engineer/designer and will be determined independently for each unique leak test situation based on system parameters for example volume, number of joints, and system function. Acceptance criteria will be specified as an acceptable rate of absolute pressure rise. PSO approval is required for specified acceptance criteria greater than 10^{-3} standard cc/sec.

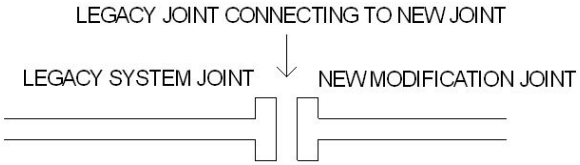
ii. Trial run of substitute referee inert gas(s) at same operating conditions as will exist with process gas(s): A trial run at the same pressure, temperature, and other salient operating conditions as process gas(s) with substitute inert gas(s) prior to introduction of the process gas(s). Pressure system will be examined for evidence of leakage at the joint(s) in accordance with the Gas and Bubble Test method specified in the B&PV Code, Section V, Article 10, or by another method demonstrated to have equal or greater sensitivity. Sensitivity of the test method shall not be less than 10^{-3} atm/ml/sec under test conditions. Allowable leakage rates higher than 10^{-3} standard cc/sec may be specified by engineering and approved by the PSO.

2. Pressure systems that that are modified as stated in "d" above but include new joints connecting to new joints (not existing construction) must undergo a code-required leak test as defined in the most applicable code. (e.g. B31.3 Part 345). Example illustration shown below.



C. Post Maintenance Testing

1. For existing (not only legacy as illustrated below) pressure systems that require system maintenance, the affected section of piping must be tested/examined as follows:



a. For mechanical (e.g., threaded, flanged, fitting) connections see paragraph 3.0.B.1.c above.

i. For leak testing pressure system maintenance that only consists of ASME B31.3 or LANL CPSO-approved components with mechanical connections and/or code-tested subassemblies, where mechanical connections are assembled in accordance with manufacturer's instruction or the applicable code or standard, see paragraph 3.0.B.1.d.1) above.

4.0 Disposition Requirements for Existing (Legacy, etc.) Pressure Systems

A. General

1. This subsection is for systems with known successful operating experience, and is intended to allow continued use of currently operating systems with a graded approach to risk reduction. New systems and components must meet all code and ESM requirements in the other Chapter 17 sections.

2. If a deficiency is identified which constitutes an imminent danger, the system shall be immediately placed in a safe configuration.

3. If the disposition of a deficiency requires a hardware modification, then that disposition should be tracked by the CPSO or delegate in accordance with PD322.

4. Risks are binned in three levels; examples are shown in Table EXIST-0 below.

5. The CPSO shall bin the risk if it is not listed in the Table EXIST-0.

Table EXIST-0 Deficiency Risk Levels and Bins

Risk Level 1 High Risk	Risk Level 2 Moderate Risk	Risk Level 3 Low Risk
RL1-A. Missing pressure relief device or undersized pressure relief device[2]	RL2-A. Vessel pressure rating indeterminate (unknown MAWP)	RL3-A-XXX. Missing weld examination documentation, if required Where XXX = either: IGB: Inside glovebox OGB: Outside glovebox

[2] Unless device is not required per ASME Code Case 2211 and/or ASME Section VIII, Division 1, Part UG-140. Information required by the UG-140 analysis may be documented in various formats, but must be referenced and

Risk Level 1 High Risk	Risk Level 2 Moderate Risk	Risk Level 3 Low Risk
RL1-B. Component, piping, or vessel known to have a MAWP less than the relief device set point	RL2-B. Piping component pressure rating indeterminate (unknown MAWP)	RL3-B. Missing pressure test documentation
	RL2-C. Missing relief device calculation.	RL3-C. Missing piping flexibility or piping support analysis, if required
	RL2-D. Vessel, boiler, or pressure relief device maintenance overdue	
	RL2-E. Missing or inadequate piping supports or restraints	
	RL2-F. Relief device sizing or set point indeterminate	

B. Risk Actions

1. For the risk category examples in the table above, perform the following corrective actions (graded by FS category).[3] Along with the corrective actions identified below, grace periods are provided which define the time frame during which the corrective action is to be implemented. Longer grace periods may be granted by the CPSO on a case-by-case basis using the variance process.

C. Risk Level 1 – High

Table EXIST-1, High Risk Deficiency Required Actions

	RL1-A. Missing pressure relief device RL1-B. Component, piping, or vessel known to have a MAWP less than the relief device set point
FS1-FS3	Implement compensatory measures and/or the system will be placed in a safe configuration as soon as practical and promptly correct deficiency Grace Periods: With regard to the requirement to resolve this level of deficiency “as soon as practical”, the FOD for facility systems or RAD for programmatic systems must prepare and submit a risk-based corrective action plan for approval by the Chief Pressure Safety Officer and the Site Chief Engineer, using the alternate method/variance process.

readily available for review. The evaluation shall be considered a record and must be managed per LANL P1020, P1020-1, and P1020-2

[3] Replacement of indeterminate components with new ones fully meeting requirements is always allowed and is the preferred approach, but must be balanced with operational/cost needs, thus this graded approach.

NOTE: The remaining tables (below) provide standard/default dispositions for Risk Level 2 and 3 (Moderate and Low) deficiencies. Alternatively, for these deficiency bins and where explicitly authorized below, a risk-based engineering evaluation may be performed to establish the required corrective action. These evaluations must be performed by a qualified design engineer and approved by a pressure safety officer qualified per Section GENERAL. See Attachment EXIST-1 for established risk-based evaluations for legacy systems.

D. Risk Level 2 – Moderate

Table EXIST-2A, Moderate Risk Deficiency RL2-A Required Actions

	RL2-A. Vessel pressure rating indeterminate, or non-ASME stamped vessel without design documentation (unknown MAWP)
FS1	Perform calculations as defined by the ASME Section VIII to establish MAWP or replace with a code-stamped vessel
FS2	Perform calculations as defined by the ASME Section VIII to establish MAWP or replace with a code-stamped vessel, or install shielding to protect personnel
FS3	Perform calculations as defined by the ASME Section VIII to establish MAWP, or replace with a code-stamped vessel, or install shielding to protect personnel
Grace periods: FS1: 40 working days; FS2: 80 working days; FS3: 120 working days	
Risk-based engineering evaluations may be applied for FS3 deficiencies	

Table EXIST-2B, Moderate Risk Deficiency RL2-B Required Actions

	RL2-B. Piping component pressure rating indeterminate, or unlisted piping component (unknown MAWP)
FS1	Perform calculations as defined by the code to establish MAWP or replace with a listed component
FS2	Perform calculations as defined by the code to establish MAWP or perform code pressure test (i.e., hydrostatic or pneumatic test) based on system design pressure (CPSO or designee to approve test pressure), or install shielding to protect personnel
FS3	Perform calculations as defined by the code to establish MAWP or perform code pressure test (i.e., hydrostatic or pneumatic test) based on system design pressure (CPSO or designee to approve test pressure), or install shielding to protect personnel
Grace periods: FS1: 40 working days; FS2: 80 working days; FS3: 120 working days	
Risk-based engineering evaluations may be applied for FS2 and FS3 deficiencies	

Table EXIST-2C, Moderate Risk Deficiency RL2-C Required Actions

	RL2-C. Missing relief device calculation
FS1-FS3	Perform calculation and take appropriate corrective action, if required
Grace periods: Relief valve calculations are being performed by the pressure safety implementation project, when information becomes available from the walkdown teams. The prioritization is risk-based, with the FS1 system calculations being performed first, followed by the FS2 and then the FS3.	
Risk-based engineering evaluations may not be applied for this category of deficiency	

Table EXIST-2D.1, Moderate Risk Deficiency RL2-D Required Actions

	RL2-D Relief device maintenance overdue	
	Grace Period for Removal from Service (or Variance Approval) ()3F[4]	
	Non-corrosive Service	Corrosive Service
FS1	90 days	90 days
FS2	90 days	90 days
FS3	90 days	90 days
Risk-based engineering evaluations may be applied to extend the grace period with variance approval, but not to eliminate requirement to perform maintenance		

Table EXIST-2D.2, Moderate Risk Deficiency RL2-D Required Actions

	RL2-D Vessel maintenance overdue (not repair or alteration)	
	Grace Period for Removal from Service (or Variance Approval)[5]	
	Non-corrosive Service	Corrosive Service
FS1	Paragraph D.1 (below)	Paragraph D.2 (below)
FS2	Paragraph D.1 (below)	Paragraph D.2 (below)

[4] Ref. Section ADMIN-4 2.0 Inspection and Testing Intervals. Once any required PM has been performed on a component, that PM must be performed within the required maximum interval thereafter, and PMs outside of the grace period will require an approved variance to continue operation.
[5] Ibid

FS3	Paragraph D.1 (below)	Paragraph D.2 (below)
Risk-based engineering evaluations may be applied to extend the grace period with variance approval, but not to eliminate requirement to perform maintenance		

1. (D.1). Estimating Inspection Intervals for Pressure-Retaining Items Where Corrosion is Not a Factor.[6]

   When the corrosion rate of a pressure-retaining item is not measurable, the item need not be inspected internally provided all of the following conditions are met and complete external inspections, including thickness measurements, are made periodically on the vessel.

   a. The non-corrosive character of the content, including the effect of trace elements, has been established by at least five years' comparable service experience with the fluid being handled.

   b. No questionable condition is disclosed by external inspection.

   c. The operating temperature of the pressure-retaining item does not exceed the lower limits for the creep range of the vessel metal. *Refer to NBIC Part 2 (Table 4.4.8.1 in 2013)*

   d. The pressure-retaining item is protected against inadvertent contamination.

2. (D.2). Determining Inspection Intervals

   a. The maximum period between internal inspections or a complete in-service evaluation of pressure-retaining items shall not exceed one-half of the estimated remaining service life of the vessel or 10 years, whichever is less. *For further information, see NBIC Part 2, (4.4.7.1 and 4.4.7.2 in 2013) for estimating inspection intervals of pressure-retaining items subject to internal erosion or corrosion.*

   b. Inspection intervals can be revised beyond the maximum period stated above, provided the owner-user has submitted technical justification for revising the inspection interval, subject to review and acceptance by the Jurisdiction, where required.

   c. Data used in engineering assessment methods to develop revised inspection intervals for pressure-retaining items shall be re-evaluated every five years, when a change in operation occurs, or after discovery of new and/or altered damage mechanisms.

Table EXIST-2D.2, Moderate Risk Deficiency RL2-D Required Actions

	RL2-D Boiler maintenance overdue (not repair or alteration)
	Grace Period for Removal from Service (or Variance Approval)[7]

[6] NBIC-2013 Part 2 Sect. 4.4 is basis for D.1 and D.2
[7] See footnote for Table EXIST-2D.2

FS2	Comply with NMAC 14.9.4.25

Guidance: At time of writing[8], NMAC 14.9.4.25 INSPECTION METHODS AND FREQUENCY stated: The owner or user of such inspected equipment shall be responsible for obtaining a certificate of inspection. The method and frequency of boiler inspections shall be as follows:

a. The following equipment shall be inspected internally annually. A certificate inspection may be issued with an external inspection; however, an internal inspection must be made within six (6) months of the external inspection. When the construction does not permit an internal inspection, one external inspection annually is required:
1. high-pressure boilers; [and]
2. high-pressure steam generators.

b. Every twenty-four (24) months, an external and internal inspection shall be performed on the following:
1. direct fire steam jacketed kettles;
2. low-pressure steam boiler; [and]
3. low-pressure hot-water heating boilers

Table EXIST-2E, Moderate Risk Deficiency RL2-E Required Actions

	RL2-E. Missing or inadequate piping supports or restraints
FS1-FS3	Install required pipe supports
Grace periods: FS1: 40 working days; FS2: 80 working days; FS3: 120 working days	
Risk-based engineering evaluations may not be applied for this category of deficiency	

Table EXIST-2F, Moderate Risk Deficiency RL2-F Required Actions

	RL2-F. Relief device sizing or set point choice indeterminate
FS1-FS3	Locate required design information and perform calculation(s), or replace indeterminate components with components having known design characteristics and perform calculation(s).
Grace periods: FS1: 40 working days; FS2: 80 working days; FS3: 120 working days	
Risk-based engineering evaluations may not be applied for this category of deficiency	

E. Risk Level 3 – Low

Table EXIST-3A-IGB, Low Risk Deficiency RL3-A-Inside GB Required Actions

RL3-A-IGB. Missing weld examination documentation (**within a glove box**[9]) – Refer to

[8] Revision of NMAC supersedes this snapshot

	Table EXIST-3A-WELD for code weld examination requirements for full penetration welds
FS1	Perform code pressure test (CPSO to approve test methodology)
FS2	Perform in-service leak test (CPSO to approve test methodology and test pressure)
FS3	Not applicable
Grace periods: FS1: 120 working days; FS2: 160 working days; FS3: N/A	
Risk-based engineering evaluations should be applied for FS1 and FS2 system deficiencies to determine if further action is required	

Table EXIST-3A-OGB, Low Risk Deficiency RL3-A-Outside GB Required Actions

	RL3-A-OGB. Missing weld examination documentation (**outside a glove box**) – Refer to Table EXIST-3A-WELD for code weld examination requirements for full penetration welds
FS1	Perform code weld examination (or other sampling methodology or technique as approved by CPSO)
FS2	Perform code weld examination (or other sampling methodology or technique as approved by CPSO)
FS3	Not applicable
Grace periods: FS1: 120 working days; FS2: 160 working days; FS3: N/A	
Risk-based engineering evaluations should be applied for FS1 and FS2 system deficiencies to determine if weld examination is required	

Table EXIST-3A-WELD Weld Examination Requirements for Full Penetration Welds when documentation is missing/insufficient

ASME B31.3			
FS3 Category D	FS2 Normal	FS1 Category M	FS1 High Pressure
None	Volumetric examination (RT or UT) of 5% of welds	Volumetric examination (RT or UT) of 20% of welds	Volumetric examination (RT or UT) of 100% of welds

[9] Or other inaccessible location; could also apply to non-toxic systems behind a barrier that protects personnel

ASME B31.1			
	All others	Temperatures between 350°F and 750°F and pressures above 1025 psig	Temperatures over 750°F and all pressures
	None	Volumetric Examination (RT or UT) for over NPS 2 and wall thickness over ¾ inch; Visual Examination for all sizes with thickness ¾ inch or less	Volumetric Examination (RT or UT) for over NPS 2 and Surface Examination (PT or MT) for NPS 2 or less
ASME B31.9			
Nondestructive examination is not required for existing pressure systems that fall within the scope of ASME B31.9, Building Services Piping			

Note: If a piping code other than ASME B31.1, B31.3, or B31.9 is applicable, the CPSO will provide the appropriate weld examination requirements.

Table EXIST-3B Low Risk Level Deficiency RL3-B

	RL3-B. Missing pressure test documentation
FS1	Perform code pressure test (e.g., hydrostatic or pneumatic test) based on system design pressure (CPSO or designee to approve test methodology and test pressure)
FS2/FS3	Perform in-service leak test (CPSO to approve test methodology and test pressure)
Grace periods: FS1: 120 working days; FS2: 160 working days; FS3: 200 working days	
Risk-based engineering evaluations may be applied for FS2 and FS3 system deficiencies	

Table EXIST-3C Low Risk Level Deficiency RL3-C Required Actions

	RL3-C. Missing Piping Flexibility or Piping Support Analysis, if required
FS1-FS3	Perform code compliant analyses and take appropriate corrective action, if required (see Section 11.0.R of this Chapter)
Grace periods: FS1: 120 working days; FS2: 160 working days; FS3: 200 working days	
Risk-based engineering evaluations may be applied for FS2 and FS3 system deficiencies	

F. Evaluations and Alternative Methods

1. Generic risk-based engineering evaluations have been prepared for the most common fluids have been prepared. See Attachment EXIST-1 *Risk-Based Engineering Evaluation of Legacy Pressure Systems*; these should be consulted for applicability prior to preparing an evaluation for a specific system. *Guidance: Available evaluations include but may not be limited to:*

   a. *Compressed air systems*

   b. *Inert gas cylinders*

   c. *Low pressure steam and condensate*

2. Alternate Method/Variance Approval

   a. Approval of an alternate method or variance can occur under the following circumstances:

      1) To permit continued operation prior to correction of deficiencies

      2) To permit a long-term operation with a condition that deviates from this document.

   b. Approval is requested per ESM Chapter 1 Section Z10. System Owner must submit a Conduct of Engineering Request for Variance or Alternate Method, (*LANL Form 2137, ideally using the ES Division Engineering Service Request System available from ES-Div homepage*).

   c. The alternate method or variance (with duration, if applicable) must be approved by the CPSO and the Site Chief Engineer.[10]

   d. Approval of an alternate method must be based on establishing a level of worker safety consistent with the requirements of 10CFR851.

   e. Deactivation of a pressure system is an acceptable method of closing pressure safety deficiencies. Deactivating a pressure system renders the pressure system safe, and no longer a personnel hazard. There are two options for deactivation. First the system remains intact, and the second it is disassembled. The selection of the option resides with the System Owner. If the system is to be reactivated, any pressure safety issue must be resolved and it must be certified prior to operational use.

   f. FS1 or steam at or above 15 psig may be evaluated as follows:

      1) RL2B (FS1 or Steam): For existing systems with good operating history, reputable manufacturer's data may be used for MAWP. This data may

[10] On 8/14/09, NNSA Field Office and LANL agreed that FO would be copied on all LANL approved variances associated with FS1 systems; that FO would be copied on all LANL approved variances associated with safety class or safety significant systems, regardless of the fluid system category (Ref: "Pressure Safety at WETF....Nuclear Facilities," Email, J. Vozella to K. Carr et al, 8/14/2009); and FO notified of any deficiencies discovered in safety class or safety significant systems. On 4/14/2015, NNSA delegated certain authorities to the Site Chief Engr (OPS: 26CF-608295) on the condition that NNSA would have variance involvement per AD-NHHO-14-217, *Proposed Revisions to the LANL Conduct of Engineering Variance and Alternate Method Process, 10/30/14 (NNSA COR-OPS-10.31.2014-601215).* See Ch. 1 Z10 and Form 2137 for latest VAR policy.

include the stated operating range, operating pressure, do-not-exceed values, or similar statements.

2) RL3-A (FS1 or Steam) inside or outside glove box: For existing systems with good operating history, welds shall be visually examined for defects in accordance with the most applicable code.

3) RL3-B: For existing systems with good operating history, an in process inspection shall be performed to verify the system is free from leakage at the highest normal operating pressure.

4) RL3-C: For existing systems with good operating history shall be visually inspected for sagging from inadequate support or damage from thermal expansion. If visual evidence found of these conditions is observed then the issue shall be evaluated and corrected in accordance with the most applicable code.

g. FS2 and FS3 systems may be evaluated as follows:

1) RL2B (FS2 or FS3): For existing systems with good operating history, reputable manufacturer's data may be used for MAWP. This data may include the stated operating range, operating pressure, do-not-exceed values, or similar statements.

2) RL3-A (FS2 or FS3) inside or outside glove box: For existing systems with good operating history no additional weld evaluation is required.

3) RL3-B (FS2 or FS3): For existing systems with good operating history no additional pressure testing is required.

4) RL3-C (FS2 or FS3): For existing systems with good operating history no additional analysis RL3-B (FS2 or FS3): For existing systems with good operating history no additional pressure testing is required.

h. Closure of pressure safety PFITS issues must include evaluation and acceptance by a PSO (Duty Area A minimum).

Attachments

EXIST-1 Risk-Based Engineering Evaluation of Existing (Legacy, etc.) Pressure Systems