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RECORD OF REVISIONS (GEN)

Rev	Date	Description	POC	RM
0	9/17/14	Initial issue. Section I rev. 3 separated into alpha-named sections. Incorporation of lessons learned, variances, and clarifications in material remaining in GEN. NA-LA concurred with chapter/changes (EMRef-69)	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*

HISTORY OF CHAPTER (Chapter 17 Section I)

0	3-10-09	Initial issue.	Charles DuPre, *ES-DE*	Kirk Christensen, *CENG-OFF*
1	7-29-09	Revised 1.0.E scope; 5.0 FS categories; 7.0(A) excluded systems; 8.0(B) requirements for relocated or removed systems; 9.I discrepancy actions; 10.T.16 fire sizing; 10.T.18, boiler requirements (from D30HVAC); 11.B future pre-testing of certain PRVs; 12.C required PMTs and PMs; 13.0.B.3 cylinder retest (corrected); FM01 and 06.	Charles DuPre, *ES-DE*	Gary Read, *CENG-OFF*
2	8-2-09	Clarified 9.0.B, C, and G and 9.0.I regarding	Charles DuPre,	Gary Read,

		handling of deficiencies.	ES-DE	CENG-OFF
3	5-11-10	General revision to incorporate approved clarifications, alternate methods, and lessons learned. LASO concurred with changes (Vozella email EMRef-62).	Charles DuPre, ES-DE	Larry Goen, CENG-OFF

Contact the Standards POC for upkeep, interpretation, and variance issues.

Chapter 17	**Pressure Safety POC and Committee**

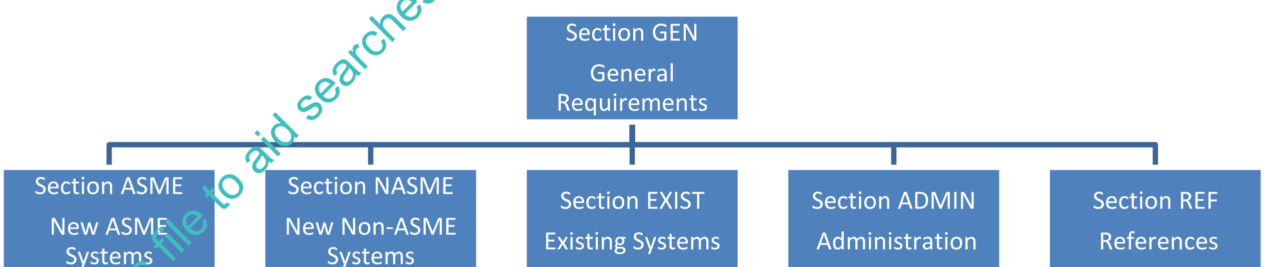
This document is online at http://engstandards.lanl.gov

1.0 GENERAL

A. Introduction and Applicability

1. Engineering Standards Manual Chapter 17 *Pressure Safety* contains the requirements for management of pressure systems to ensure that both new and existing systems are compliant with applicable 10CFR851 Appendix A, Part 4 requirements (*reproduced as REF-1 of this chapter*).[1]

2. The structure of this chapter was changed in 2014 to clearly group requirements for new ASME construction, new non-ASME construction, existing systems, and the program's administrative requirements (including maintenance). References are also included:



Note: In the event of a conflict between this Chapter and guidance or referenced documentation, this document shall take precedence.

[1] At time of writing, the Engineering Services Division Leader is the safety management program owner for pressure safety

3. This Section also has attachments that apply to all sections of the pressure safety program that include the following:

- Definitions and Acronyms
- Exclusions from the Program
- OSHA Requirements for all Pressure Systems

4. This chapter establishes the design, review, inspection, fabrication, testing, and pressure program management requirements for pressure systems in use at LANL. Operational safety requirements can be found in LANL Procedure P101-34, *Pressure Safety*; however, such safety requirements must be taken into account when designing and working with pressure systems.

    a. Examples of such safety requirements not covered by this chapter are: personal protective equipment, skin injection, moving of gas cylinders, securing of gas cylinders, cryogen burns, chemical hazards, oxygen deficiency, operation and maintenance training requirements, etc.

5. Throughout this document there are references to specific ASME code paragraphs or sections. For most cases across the Laboratory, the appropriate codes are B31.3[2] and Section VIII of the Boiler and Pressure Vessel Code. However, the most applicable code must be used for design, fabrication, inspection, and testing; take requirements in this document referring to or taken from B31.3 to mean the corresponding provisions in the applicable B31 code.

    a. For example, use B31.1 for site steam distribution, B31.5 for refrigeration piping, and B31.9 for building services where the LANL-adopted plumbing code[3] does not apply.

    b. The UPC stops applying when chemicals are added to the water (e.g. boiler treatment) or after the water is run through a process (e.g., DI water).

    c. A summary listing of the applicable ASME B31 and DOT codes is presented in Chapter 17 document ASME-1, *Code and Regulation Application (Scope Summaries).*

    d. Attachments to NASME titled Equivalency Evaluations for New Non-ASME Pressure systems (1-a, 1-b, etc.) contain engineering equivalencies for piping not associated with pressure vessels, boilers, air receivers, or supporting piping systems (see GEN-1 definition of supporting piping systems).

6. Pressure and vacuum systems (including but not limited to facility, utility, environmental, R&D, and programmatic) are subject to the requirements of this program except as noted below:

    a. Vacuum systems that do not have the potential for catastrophic failure due to backfill pressurization or internal pressure generation.
    b. Others as noted under Exempt below.

[2] For the applicability of ASME B31.3 see B31.3 Para 300.1.1 regarding the content and coverage.
[3] Plumbing code adopted by ESM Chapter 16, IBC-GEN Att A. (*e.g., IAPMO UPC)*

7. New pressure systems in preliminary design as of March 10, 2009 (original issuance of this Chapter) must be certified according to this Chapter prior to use.

8. Projects Underway: Projects in design or fabrication stages must also follow this chapter and must be in full compliance prior to fluid introduction including system pressure testing (not component or pipe section testing).[4]

   a. In addition, existing systems are subject to the certification and preventive maintenance requirements herein, as well as being expected to maintain (but generally not recreate) required documentation.[5]

9. Documentation, including forms, generated by this program must be considered records, and must be managed per LANL P1020, P1020-1, and P1020-2 located here.

10. ASME Boiler and Pressure Vessel Codes and the B31 series of piping codes are designed to be so that when applied personnel close proximity to the finished pressure system are exposed to a low risk level.

11. Mobile and portable pressure systems are also included in this program. These can include tube trailers, vehicle-mounted vessels, and skid-mounted vessels.

12. Pressure systems must have documentation proving compliance with the ASME code, or indicating excluded status, where the definition of excluded is defined in this document.

B. Exempt

1. Pressure systems with a design pressure [or existing system with MAWP below 15 psig provided the fluid handled is nonflammable, nontoxic, and not damaging to human tissues as defined in 300.2, and its design temperature is from −29°C (−20°F) through 186°C (366°F)] are exempt from the majority of requirements of this chapter provided there is documented adequate relief protection.

2. The first relief device of an exempt system is NOT exempt and must be entered into CMMS or other approved data repository for tracking.

3. Applicable requirements are inventory and System Identification Tag with "Exempt" printed in the sticker area; Pressure System Certification Status Form (*Section ADMIN-1-1 Form 1*), an evaluation showing the system cannot be pressurized to greater than 15 psig (without relief device activation), and inclusion of the relief device into the maintenance tracking system. The regulator and the relief device must be close-coupled with no intervening stop valves. A copy of a simplified system sketch and the documentation showing the system is adequately protected against overpressure shall be maintained as records.

[4] ESM Ch 1 Section Z10 normally grandfathers projects underway for new requirements; however, the need to comply with 10 CFR 851 as implemented by this chapter supersedes that allowance; furthermore, compliance prior to startup ensures safety and is more cost-effective than program backfit after fluid introduction.
[5] Unlike many ESM chapters, this is a complete program and not only for new installations.

C. Excluded

1. Excluded systems are those pressure system categories that were not inventoried during the pressure safety project. See Attachment GEN-2

D. Chapter Overview

1. This Chapter addresses the process by which new pressure systems are made or existing systems are modified and both are certified for use. The key areas of this document are: ASME code requirements, configuration control, inspection and testing, design oversight, documentation requirements, and pressure systems accountability and traceability.[6]

2. Contact the Chief Pressure Safety Officer (CPSO) for questions regarding the subject matter of this document, applicability, or interpretations. When greater levels of assistance are required, an Engineering Services Request must be submitted.

3. The CPSO may perform or participate in an annual assessment to evaluate institutional compliance with requirements of the Pressure Safety Program as defined in this chapter.

E. Alternate Method/Variance

1. Request for variance from compliance with this chapter, or alternate methods and clarifications, must be submitted to the CPSO, for review and approval processing.

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

   a. To permit continued operation prior to correction of deficiencies

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

   c. Systems where installation of pressure relief devices is impossible or unnecessary (such variances must be reviewed for applicability against ASME Code Case 2211 and ASME Section VIII, Division 1, Part UG-140).

3. Approval is requested per ESM Chapter 1 Section Z10. (*Owner submits a Conduct of Engineering Request for Variance or Alternate Method, LANL Form 2137)*

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

5. Approval of an alternate method must be based on establishing a level of worker safety consistent with the requirements of 10 CFR 851.

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[6] Programs in similar industries and national standards were used in the generation of this program. Industries include White Sands Test Facility (NASA) and Savannah River Site (DOE). Primary national standards and guidelines used: NBIC, Code of Federal Regulations, API, and the ASME Boiler and Pressure Vessel and B31 series codes.

6. Variance approvals must be documented and maintained with the pressure system documentation package

   a. The master list of approved variances, alternate methods and clarifications is maintained on the Engineering websites.

   b. Variances cannot conflict with a Safety Basis.

7. Extension of variances will not be granted without justification by the Requestor, the Design Authority Representative (if assigned), and the LANL Owning Manager (FOD or RAD); see ESM Chapter 1 Section Z10 and Form 2137. Extensions will be processed as a revision to the original request. Documentation provided with the extension request will be current and support the justification request.

8. Variances to code are not allowed for new ASME code-compliant pressure construction.

9. Alternative Methods are used to document alternatives allowed by code.

2.0 QUALIFICATION REQUIREMENTS

A. Pressure Safety Officers (PSO)

LANL Pressure Safety Officers (PSOs) shall be trained and qualified in accordance with requirements stipulated in Qualification Standard QS-CT-LANL-QS-319 or its successor.

NOTE: The PSOs qualification standard has different duty areas of responsibilities and the PSO may or may not be qualified depending on the type of work being performed. The current official qualifications are maintained in UTrain, but quick reference is located on the Pressure Protection Program page with the title “Pressure Safety: Officer Qualification Status.”

PSO Duty Area	ASME B31 Code	Training Plan (TP)
A	None	11957
B	B31.3	11958
C	B31.9	11959
D	B31.1	11960
E	B31.8	11961

B. Pressure System Designers[7]

1. The Designer is the person in charge of the engineering design of a piping system and shall be experienced in the use of the applicable ASME Code. The qualifications and experience required of the Designer will depend on the complexity and criticality of the

[7] ASME B31.3 Article 301.1 Qualifications of the Designer

system and the nature of the individual's experience. The Designer shall meet at least one of the following criteria:

a. Completion of an Accreditation Board for Engineering and Technology (ABET) accredited or equivalent engineering degree, requiring the equivalent of at least 4 years of study, plus a minimum of 5 years of experience in the design of related pressure piping.

b. Professional Engineering registration, recognized by the local jurisdiction, and experience in the design of related pressure piping.

c. Completion of an accredited engineering technician or associates degree, requiring the equivalent of at least 2 years of study, plus a minimum of 10 years of experience in the design of related pressure piping.

d. Fifteen (15) years of experience in the design of related pressure piping.

e. Experience in the design of related pressure piping is satisfied by piping design experience that includes design calculations for pressure, sustained and occasional loads, and piping flexibility.

C. Owner's Inspectors[8]

1. The owner's Inspector shall have not less than 10 years of experience in the design, fabrication, or inspection of industrial pressure piping each 20% of satisfactorily completed work toward an engineering degree recognized by the Accreditation Board for Engineering and Technology (Three Park Avenue, New York, NY) shall be considered equivalent to 1 year of experience, up to 5 years total. (B31.3 340.21-340.4)

2. It is the owner's responsibility, exercised through the owner's Inspector, to verify that all required examinations and testing have been completed and to inspect the piping to the extent necessary to be satisfied that it conforms to all applicable examination requirements of the code and of the engineering design. (B31.3 340.2)

3. The owner's Inspector and the Inspector's delegates shall have access to any place where work concerned with the piping installation is being performed. This includes manufacture, fabrication, heat treatment, assembly, erection, examination, and testing of the piping. They shall have the right to audit any examination, to inspect the piping using any examination method specified by the engineering design, and to review all certifications and records necessary to satisfy the owner's responsibility; to verify that all required examinations and testing have been completed and to inspect the piping to the extent necessary to be satisfied that it conforms to all applicable examination requirements of the code and of the engineering design. (B31.3 340.2 and 340.3)

4. The Owner's Inspection program is implemented by CM-CE (Project Field Engineering).

5. If personnel qualified as Pressure Safety Officers have the code-required experience, they may be granted the authority of the Owner's Inspector or the Owner's Inspector

[8] ASME B31.3 Article 340.4 Qualifications of the Owner's Inspector

Designee by Construction Management per the duty areas shown above under PSO qualification.

a. PSOs acting for the Owner's Inspector must follow the requirements of the Owner's Inspector program including utilization of the appropriate check lists and the designated mandatory inspection points.

NOTE: The Owner Inspector qualification standard has different duty areas of responsibilities and the PSO may or may not be qualified depending on the type of work being performed. The current official qualifications are maintained in UTrain, but quick reference is located on the Construction Management site with the title "LANL Owner's Inspectors."

D. Examiners

1. Examiners shall have training and experience commensurate with the needs of the specified examinations. (B31.3 342.1)

2. The employer shall certify records of the examiners employed, showing dates and results of personnel qualifications, and shall maintain them and make them available to the Inspector. (B31.3 342.1)

3. Examiners are assigned by the Responsible Line Manager (RLM) in accordance with LANL Policy P330-8, paragraph 3.6. This procedure applies LANL wide, and the document is for Inspection and Tests required for acceptance.

4. An example of required code Examination is for pneumatically tested, pressure systems an assembly tubing components for a piping systems meeting the scope of B31.3 would need examination in accordance with B31.3 341.4.1(a)(4) "When pneumatic testing is to be performed, all threaded, bolted, and other mechanical joints shall be examined".

5. The examiner shall provide the Inspector with a certification that all the quality control requirements of the code and of the engineering design have been carried out. (Normal fluid 341.4.1(c)).

6. ESM Chapter 13 Volume 6, *Welding Inspection and General NDE*, contains LANL NDE qualifications.

E. Pressure Safety Committee

1. The Pressure Safety Committee (also known as Chapter 17 Technical Committee) is chaired by the CPSO (POC of ESM Chapter 17). Members are appointed by the CPSO and typically include the PSOs and others from around the laboratory whom the CPSO may call upon to review and provide input as requested on variances, alternate methods, clarifications, and interpretations with respect to Chapter 17.

2. SMEs are not permanent members of the pressure safety committee but have experience in areas relevant to the topic of discussion. For example, a welding SME may be engaged on welding or brazing questions but their involvement is not required when evaluating a pressure system that will be assembled with compression fittings.

3.0 ATTACHMENTS

Attachment GEN-1 Definitions and Acronyms

Attachment GEN-2 Exclusions from Program

Attachment GEN-3 OSHA Requirements for Pressure Systems

RECORD OF REVISIONS

Rev	Date	Description	POC	RM
0	9/17/2014	Initial issue as GEN-1. Formerly Subsection 5.0 of Section I of chapter.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*
1	3/15/2016	Removed reference to ML-1/2 for NCRs.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*

Definitions and Acronyms

Alteration – The change of a pressure-boundary component that changes the original design structure. Does not include the removal and replacement of components, but modification of the component itself (e.g., welding an additional port to a U-stamped vessel).

ASME B31 - American Society of Mechanical Engineers Piping codes.

ASME BPVC – American Society of Mechanical Engineers Boiler and Pressure Vessel Code.

Asset Suite – Name of LANL's Computerized Maintenance and Management System (CMMS) Ventyx software package that includes the Master Equipment List. Required by this pressure safety program for tracking facility and utility relief valve testing, vessel inspections, and flex hose inspections. Formerly PassPort.

Authorized Inspector (AI) – An inspector regularly employed by an ASME accredited Authorized Inspection Agency in accordance with the requirements in the latest edition of ASME QAI-1.

Category D fluid – A fluid service which is nonflammable, nontoxic, not damaging to human tissues, does not exceed 150 psig, and the design temperature is between –20 °F to 366 °F [ASME B31.3].

Category M fluid – A fluid service in which the potential for personnel exposure is judged to be significant and in which a single exposure to a very small quantity of a toxic fluid, caused by leakage, can produce serious irreversible harm to persons on breathing or bodily contact, even when prompt restorative measures are taken [from ASME B31.3 300.2 definition for fluid service].

Certification – All requirements of this document have been met and CPSO or delegate has approved pressure system for use. Is not to be understood as an ASME or NBIC certification, it is only a permit to operate the pressure system, granted by the CPSO.

Check valve – (see system interaction below) – A spring loaded poppet valve that has one flow direction to keep system contents from back flowing.

CMMS – Computerized Maintenance Management System (See Asset Suite).

Code equivalent – A pressure vessel or other component that, through documentation, proves that the design meets all of the design, fabrication, test, and inspection requirements established by the applicable code, but does not have a code stamp and does not require a code certified Inspector.

Code non-compliance – A violation of a national consensus code (e.g., ASME, UPC), or the lack of documentation demonstrating code-equivalent fabrication.

Code of Record – The codes and standards (by year) used to perform the design and construction are considered the code of record (COR). (see ESM Chapter 1 Section Z10 - General Requirements for all Disciplines/Chapters)

Components – The set of items within a piping system that are joined together to make up a functioning process. Piping components are a sub-set of all components in a piping system. See definition of Piping Components below for those components which are within the scope of the B31 pressure piping codes. Other components that make up a process (pumps, heat exchangers, etc.) are designed and fabricated in accordance with other industry codes and standards. Acceptable component acronyms for design documents, labels, and CMMS are addressed in ESM Chapter 1 Sections 200 and 230.

Corrosive service – A fluid service in which the internal fluid, or external environment, is expected to produce a progressive deterioration in the pressure boundary material.

CPSO – Chief Pressure Safety Officer. Point of Contact (POC) for this chapter and thus the LANL Pressure Safety Program. Final approver in system certification. Is a subject matter expert in pressure systems design, will assist system owners with applicable codes for pressure system design. Reviews and approves variations and alternate methods. May delegate certain functions to Pressure Safety Officers.

Cryogenic fluids – Fluids with a normal boiling point below -200 °F. Other fluids (e.g., CO_2, refrigerants, etc.) that are not necessarily considered cryogenic must be taken into consideration as having similar pressure hazards as that of cryogenics.

Damage ratio: A damaged rupture disk will burst at some pressure other than that predicted. This disparity can be reported by a value called the "damage ratio." The damage ratio is equal to the actual burst pressure of a damaged disk divided by the stamped burst pressure. A damage ratio of 1 or less provides assurance that the disk, even damaged, will burst at or below the stamped burst pressure, while a value higher than one would indicate the actual burst pressure could exceed the stamped burst pressure. As an example, a damaged disk with a 100 psig stamped burst pressure and a damage ratio of 1.5 could have an actual burst pressure of 150 psig. This information can be provided by the burst disk manufacturer.

DCF – Design Change Form. See AP-341-517. Used to make permanent modifications to configuration controlled structures, systems, and components (SSCs) in hazard category 2 and 3 nuclear facilities, and high and moderate hazard non-nuclear facilities.

Deputy Chief Pressure Safety Officer – Delegated by the CPSO. Alternate POC for this Chapter. Has signature authority for final approval of pressure system documentation packages.

Design pressure –Design Pressure is that pressure determined by the designer, for which the system or component must operate at worst case conditions/temperatures during normal operation (see ASME Section VIII Div 1, Part UG-21 and B31.3 Para. 301.2). Basically, the final design temperature and design pressure are that combination that gives the most critical result in terms of stresses and forces. It is commonly called the concurrent temperature and pressure that requires the thickest-wall pipe or highest rating of the components.

Dewar – A vacuum flask or vacuum-insulated shipping container used for storage of cryogenic fluids. Named for the inventor, Sir James Dewar.

Engineering calculation – Formal document performed in accordance with AP-341-605 (or equivalent for R&D) on all pressure relief valves, and as required by the applicable ASME code.

Engineering Services Division – Performs or facilitates detailed calculations and other design functions to aid PSO and system owners.

ESM – LANL Engineering Standards Manual (STD-342-100) mandated by P342.

Examiner – An individual with the training and experience commensurate with the needs of the specified examinations. It is the person who performs the quality control examinations and is performed by the manufacturer, fabricator, or erector. See ASME B31.3 Chapter VI, paragraph 341.

Excluded systems – Pressure systems that are not considered to be within the scope of the pressure safety program. Examples include, but are not limited to: vehicle pneumatic systems, propane-powered vehicles, and garden irrigation systems.

Exempt System – A system that by virtue of its design features is not required to meet code; the non-toxic material is being used at 75 F maximum and less than 15 psig with no possibility of over pressure.

Existing pressure system - Existing systems are all installed pressure systems (post construction) of which Legacy Pressure Systems are a subset.

Facility pressure system – Any liquid or gas pressure system that is maintained by the facility operations director, or where the cost of maintenance or repair is paid for by the facility or institution, not directly by the program it supports. Normally either a utility proper or found in utility rooms that provide building services (e.g., building heating boilers, instrument air system, etc.). See programmatic pressure system for that definition.

Fault condition – Any failure caused by component failure, human error, chemical reaction, or environmental conditions that may cause an increase in pressure above the MAWP of the component or system.

Flexible element – A flexible element of a pressure or vacuum system including hoses, used in place of a pipe or rigid metal tubing. Also referred to as flexible tubing or flex-hoses.

Fluid – A chemical in gaseous or liquid (or sometimes solid) state which can be pressurized or be the pressure source in a pressure system.

FS categories – LANL-specific fluid service category which allows a graded approach for deficiency resolution in existing systems for both pressure vessels and piping. LANL fluid services are based on the fluid categories defined by ASME B31.3 Paragraph 300.2, thus:[1]

- **FS1-** Fluid systems for which fluid category has been determined to be either Category M or High Pressure as defined in ASME B31.3, where these categories are defined as follows:
  - Category M: A fluid service in which the potential for personnel exposure is judged to be significant and in which a single exposure to a very small quantify of a toxic fluid, caused by leakage, can produce serious irreversible harm to persons on breathing or bodily contact, even when prompt restorative measures are taken.
  - High Pressure Fluid Service: Pressure in excess of that allowed by the ASME B16.5 Class 2500 rating for the specified design temperature and material group (see full definition below).
- **FS2 -** Fluid systems not FS1 or FS3. Here, the fluid category is or would equate to Normal as defined in ASME B31.3 (i.e., not Cat D, M, or High Pressure).[2] Steam and hot water systems above 180 °F.[3]
- **FS3 -** Fluid systems for which the fluid category is or would equate to Category D as defined in ASME B31.3, thus: 1) the fluid handled is nonflammable, nontoxic, and not damaging to human

[1] Similarly, a graded approach can be found in API 570 "Piping Inspection Code." FS Categories are fluid categories, not ASME Code categories. FS categories are not intended to provide design guidance (e.g., an FS1 pressure system does not necessarily need to be designed and built for ASME Category M fluid service, unless of course the system contains fluids that meet the ASME definition of Category M). Where consensus cannot be reached, the CPSO makes the final determination of fluid service category.

[2] "Equate to" appears here (and for FS3) so that piping subject to B31 codes other than B31.3 can use the FS definitions which are largely based on B31.3 definitions.

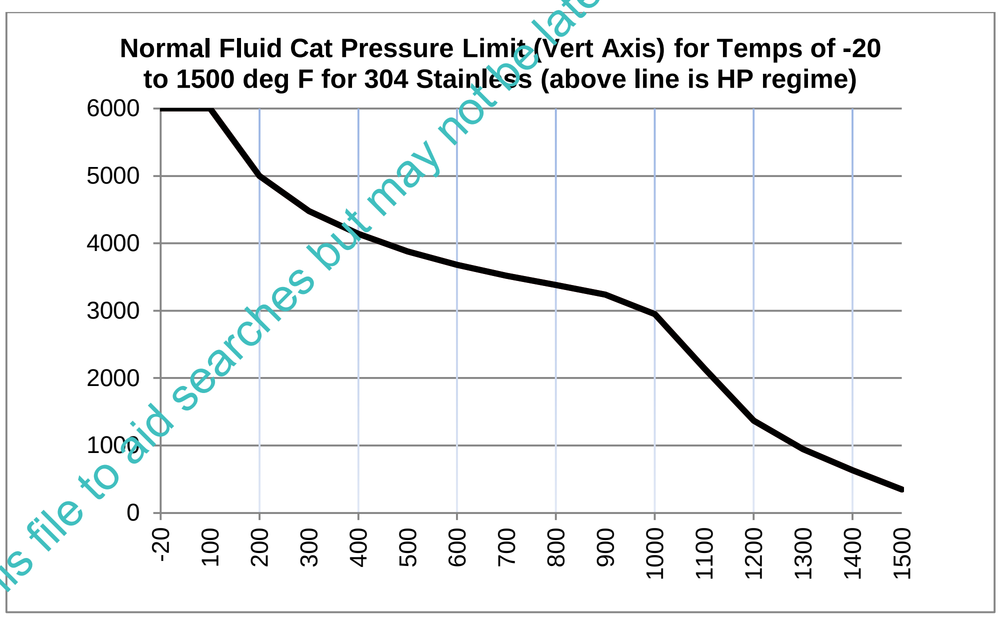
[3] Because steam is damaging to human tissue, LANL chooses to treat as FS2 for deficiency resolution reasons.

tissues; 2) the design gage pressure does not exceed 150 psig; and 3) the design temperature is from -20°F through 366°F.

Note: FS Categories are a designation of the most stringent requirements within a given system. They are not necessarily the appropriate requirements for every item within a system. Appropriate designation of the subsystems within a system is allowed with concurrence of the PSO. For example, an ambient temperature, B31.3 high-pressure nitrogen gas system at 10,000 psig is an FS1 system. If a regulator is used to drop the pressure to 1,500 psig (less than the rating requirement for a high pressure system), and there is appropriately sized pressure relief protection, the items of this subsystem could be classified as FS2. Grace periods of ESM Chapter 17 for FS2 would then be applicable to those items. However, the overall designation of FS1 would remain for the system.

Good operating history - is defined as service history of an existing pressure system, where a record of successful service may be created by the System Owner confirming that no failures have occurred in the system pressure boundary, that no pressure or temperature transients have occurred which exceeded the system design basis, and that personnel have not been harmed while operating or in close proximity to the system.

High pressure fluid service – Pressure in excess of that allowed by the ASME B16.5 Class 2500 flange rating for the specified design temperature and material group. This category depends on material type at temperature. The chart below is only one example using B16.5 table data to illustrate the function of temperature versus pressure for Type 304 stainless (for which "high pressure" could be as low as 345 psig at 1,500 degrees F). See also Chapter IX of ASME B31.3.



Hydraulic systems – Those systems which use an incompressible fluid as the pressure media to perform work. These systems normally include pumps, piping, pressure safety valves, and accumulators.

Hydrostatic test – A test performed on a pressure vessel or system in which the vessel or system is filled with a liquid (usually water) and pressurized to a designated level.

In Service leak test – Joint examination at normal operating conditions to verify absence of leakage.

Inspector – Verifies all required examinations and testing have been completed and inspects to the extent necessary to be satisfied that the design of the system conforms to all applicable examination requirements of the Code and of the engineering design (see ASME B31.3, Chapter VI, 340).

IRM – Information Resource Management – the Pressure Safety Program utilizes a dedicated server, Pressure System Certification System. Contact the CPSO for access to the database.

Leak test – A general term used to describe a pressure test which proves the integrity of a pressure boundary. More specific terms are: hydrostatic leak test, hydro-pneumatic leak test, pneumatic leak test, initial service leak test, and sensitive leak test. These tests are described in ASME B31.3, Section 345.

Legacy pressure system - Systems that were operational as of March 10, 2009 (when ESM Chapter 17 revision 0 was issued) are considered legacy pressure systems.

Lethal substance – Poisonous gases or liquids of such a nature that a very small amount of the gas or of the vapor of the liquid mixed or unmixed with air is dangerous to life when inhaled. This class includes substances of this nature, which are stored under pressure or may generate a pressure if stored in a closed vessel.

Major system modification – Term used by the pressure program only, the addition of or modification to a pressure vessel, removal of a pressure relief device, replacement of a pressure relief device that is not an exact replacement or engineered equivalent, modification of the pressure relief path that materially changes its capacity, or any other change which calls into question the capacity or set point of the relief device(s). Major system modifications require recertification of the system.

Manufacturer's service rating – The service rating (MAWP and design temperature) of a component, pipe, or tube available on the open market which has been designed and tested to a recognized guideline or standard.

Maximum allowable working pressure (MAWP) – Typically stamped on individual components (or sub-components) of a pressure system. Is the maximum permissible pressure (internal or external) of a pressure component (or system) when operated in its normal operating position at the designated coincident temperature specified for that pressure using the code ratings. It is the least of the values found for maximum allowable working pressure for any of the essential pressurized components of a pressure system as defined in ASME Section VIII Div 1, Part UG-98 (see also Part UG-23). Value is typically less than the component burst pressure by a factor of safety used by the ASME Code.

Maximum operating pressure (MOP) – The maximum intended operating pressure, typically less than the MAWP to prevent premature system leakage through pressure-relieving devices.

Minor non-compliance – A LANL self-imposed requirement that is not a violation of a DOE policy directive or a national consensus code; e.g., missing/loose pipe brackets or unlabeled components.

Mobile pressure containers – Pressure vessels designed for travel on streets and highways; e.g., tube trailers, cryogen tankers, and other vessels mounted on trailers, trucks, etc. [ASME B&PV Code Section XII].

Modification – Any pressure system component change, addition, or deletion other than replacement of components with similar performance characteristics such as flow capacity and strength. This definition does not include alteration of pressure-boundary components (e.g., welding additional ports to pressure-bearing component – see “Alteration”).

Non-conformance report (NCR) – Process defined in LANL Procedure P 330-6.

Non-destructive examination (NDE) – Examinations including visual examination, radiographic examination, ultrasonic examination, and dye-penetrant testing used to qualify the condition of a pressure vessel or component. At LANL, regulated by ESM Chapter 13 Volume 6.

Non-hazardous fluids – Any fluid or mixture that is nonflammable, nontoxic, and is not corrosive. Cryogenic fluids are considered hazardous.

Normal fluid service – A fluid service pertaining to most piping covered by the B31.3 Code but not subject to the B31.3 rules for Category M, Category D, or High Pressure fluid services. [B31.3, 300.2]

Operating pressure – A pressure less than the MAWP at which the system is normally operated.

Operating temperature – A temperature between the lower and upper design temperatures of the pressure system or component.

Out-of-service system – A system that is formally designated inactive or not in use.

Owner – While DOE owns the pressure systems at LANL (except vendor owned), day-to-day fulfillment of the codes' Owner role is by the LANL Design Authority (Site Chief Engineer; see also ESM Chapter 1 Section Z10 regarding delegation). Owner's Representative is an agent of the Owner. System Owner is the user (see definition below).

Pilot-operated pressure relief valve – A pressure relief valve in which the major relieving device is combined with and is controlled by a self-actuated auxiliary pressure relief valve (commonly used in hydraulic systems and some steam systems).

Piping components – Mechanical elements suitable for joining or assembly into pressure-tight fluid-containing piping systems. Components include pipe, tubing, fittings, flanges, gaskets, bolting, valves, and devices such as expansion joints, flexible joints, pressure hoses, traps, strainers, inline portions of instruments, and separators [ASME B31.3, 300.2]

Pneumatic test – A test performed on a pressure system or component in which a gas is introduced and pressurized to a designated level in a manner prescribed in the applicable code.

Poly tubing – Term used for many types of flexible polymer tubing. Examples include Poly-Flo® and Tygon®.

Portable pressure vessels – Pressure vessels easily transported from one location to another but without mobile gear attached. Examples include portable Dewars, Department of Transportation (DOT) compressed gas cylinders, and sample bottles (e.g., Hoke bottle, Swagelok sample cylinders).

Pressure pipe – A relatively heavy-walled tubular fluid container/transporter that is normally attached or connected to fittings or components with threads or welds.

Pressure qualification test – A pressure test performed above the MAWP (may assume design pressure) using a non-hazardous fluid to ensure the integrity of the pressure system, or component. For example see ASME Section VIII Div 1 Part UG-99, UG-100, and UG-101 for further information.

Pressure relief valve (PRV) – Most common and preferred term for pressure protection valves at LANL used for a pressure relief valve which is actuated by inlet static pressure that opens in proportion to the increase in pressure over the opening pressure (typically liquid use).

Pressure safety valve (PSV) – Also known as a Pressure Relief Valve (PRV). A pressure relief device that is designed to re-close and prevent the further flow of fluid after normal conditions have been restored (typically gas or vapor service).

Pressure system – One or more items that fall within the scope of an ASME code.

Pressure tubing – Different from “Pressure Pipe.” Is a relatively thin-walled tubular fluid container/transporter that is normally suitable for bending and is attached or connected by flared fittings, compression type fittings, or welding.

Pressure vessel – Containers for the containment of pressurized fluids, either internal or external. Excluded are pipe runs; however, a vessel may be fabricated from a section of pipe if the construction conforms to ASME code requirements. For this program, storage vessels such as 55-gallon drums are not considered pressure vessels and must not be pressurized by an external source.

Programmatic pressure system – Any gas or liquid pressure system which is used for testing, manufacturing, research purposes, or used in support of testing, manufacturing, research processes. Maintenance or repair of these systems is normally both directly paid for and performed by the program, not the facility (see facility pressure system for that definition).

Proof test – A pressure test performed to establish the maximum allowable working pressure of a vessel, system, or component thereof when the strength cannot be computed with a satisfactory assurance of accuracy. This test will be performed in a manner equivalent to one of the methods specified in paragraph UG-101 of the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

PSCS – Pressure Safety Certification System is the ES-EPD managed database for pressure system certification, pressure safety document repository, and tracking program for programmatic relief valve testing, vessel inspections, and flex hose inspections.

PSO – Pressure Safety Officer. Person familiar with ASME code and who performs system certification reviews (per this document) of pressure systems. Not required to perform design calculations, but aids system owners in compliance with this procedure and the use of the ASME code. A PSO can request an alternate or designee to help perform the functions defined in this document upon approval of the CPSO.

RAD – Responsible Associate Director

Relief valve – PRV designed for liquid or liquid mixed with steam or gas.

Reversal ratio: Is equal to the actual burst pressure of a rupture disk installed in reverse divided by stamped burst pressure. If the value is one or less, the disk will relieve at or below its stamped burst pressure even when installed in reverse. If the value is greater than one, the actual burst pressure will be greater than the stamped burst pressure. This information can be provided by the rupture disk manufacturer.

Rupture disk device – Also known as burst disk. A non-closing pressure relief device actuated by inlet pressure and designed to remain open after operation. The device performs its function by bursting a pressure-containing disk.

Safety relief valve – A pressure relief valve characterized by rapid opening or pop action or by opening in proportion to the increase in pressure over the opening pressure. Used for compressible or incompressible fluids.

Safety valve – A pressure relief valve actuated by inlet pressure and characterized by rapid opening or pop action. Normally used to relieve compressible fluids.

Set pressure – Set pressure is the value of increasing inlet static pressure at which a pressure relief device displays one of the operational characteristics as defined by opening pressure, popping pressure, start-to-leak pressure, burst pressure or breaking pressure.[4] Measured at the pressure relief valve inlet, at which there is a measurable lift, or at which discharge of a fluid becomes continuous. The terms open pressure, relief pressure, cracking pressure, and set points are equivalent when testing valves.

[4] ASME Section VIII, Division 1, 2007 edition, footnote 61

Source pressure – The pressure supply source that provides pressure to a system. Examples include: gas cylinder, pump, heated vessel (boiler), cryogen Dewar, trapped cryogen expansion, chemical reaction, etc. Is not a regulated pressure.

SCFM - Standard cubic feet per minute evaluated at 14.7 psia, 58 °F, and 36% relative humidity.

Stop valve – A valve that is installed between the piping or component being protected and its protective device (e.g., PRV) or between the protective device and the point of discharge. Although allowed by the ASME code, this design scenario is discouraged. Designs using stop valves in any manner that is not allowed by the ASME code must be approved by the CPSO.[5]

Sub-component – Term used to describe an element which together with other elements comprise a component. For example: A boiler can be a component of a steam system, but the boiler itself is made up of sub-components (shell, tubes, PRV, etc.).

Supporting piping systems – Term shall be considered any and or all the piping necessary for the function of the process or system for all pressure vessels, boilers, and air receivers. Piping that is attached in excess of that required for the process or system operation is not "supporting piping". For LANL, new system boundary rules are defined by ESM Chapter 1, Section 220 (existing may not always conform) and Chapter 1, Section 210, Attachment A lists existing systems and general boundaries. In practical applications to separate "supporting piping" from non-supporting piping, a unique pressure safety system identification number in accordance with ESM Chapter 17 will be used to identify piping that is considered to be non-supporting piping.

System – For this chapter, a **c**ombination of multiple components (and possibly subcomponents) which together make a pressure system. Example 1: A steam system can be comprised of two main components: The boiler and the steam piping which runs throughout a building. Example 2: A gas chromatograph system may consist of a combination of components (or sub-components) such as: gas cylinder, manual valves, tubing, pressure transducers, flexible hoses, vacuum pump, and the GC.

System interaction – Interactions among pressure systems that may cause a system to be over pressurized, or cause unwanted mixture of separate fluids, which necessitates the evaluation of all system interfaces (e,g., determination of check valve installation and placement). In extreme cases could warrant the use of dual check valves placed in series.

System owner – The individual responsible for the overall operation, maintenance, design (code compliance), documentation, and/or construction of a pressure system.

Tank – A container whose contents are maintained at atmospheric pressure or below 15 psig at all times, and cannot be pressurized above 15 psig, even during fault conditions.

Test article – An excluded pressure system/component. A component or system of components provided by a vendor, or is part of a research and design deliverable. It is temporarily installed in LANL facilities exclusively for the purpose of being tested for data purposes, or destructive purposes. Included in this definition are those test articles that are being designed by LANL personnel, which are considered product, and must undergo numerous design changes, modifications, and alterations.

Examples of excluded test article systems include flight hardware such as: WR pressure components and systems (e.g., vehicle-specific flight-weight tritium reservoirs and associated flight-weight plumbing/components), or space vehicle pressure components and systems (e.g., vehicle flight-weight propulsion or hydraulic systems/components). However, pressure systems that support the design, testing and/or evaluation of such hardware are not excluded.

[5] See ASME B31.3 paragraph 322.6.1

Vacuum system – An assembly of components which may include vessels, piping, valves, relief devices, flex hoses, gages, etc., operated with the internal pressure reduced to a level less than that of the surrounding atmosphere. Some vacuum systems can be subjected to a positive pressure because of vacuum break and purging capabilities.

Vacuum vessel – A vessel operated with the internal pressure reduced to a level less than that of the surrounding atmosphere.

Vendor-owned equipment - Pressure vessels and/or equipment owned by a vendor to transport, store fluids or gases, or to perform a support function on LANL property.

Vessel – For the purpose of this program, any pressure chamber, regardless of formed heads (e.g., dished, concave, convex, etc.) or cylindrical shape, which has been installed into a pressure system that can, through normal operation or fault conditions, be pressurized above 15 psig.

Volumetric weld examination – Examination of a full penetration weld by x-ray or ultrasonic testing.

RECORD OF REVISIONS

Rev	Date	Description	POC	RM
0	9/17/2014	Initial issue. Formerly Subsection 7.0 of Section I rev. 3.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*
0.1	08/21/2017	Admin change to add word *not* to section 1.A.3.a.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*

Contact the Standards POC for upkeep, interpretation, and variance issues.

Chapter 17	**Pressure Safety POC and Committee**

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Systems Excluded from Pressure Safety Program

Note: Excluded-from-walkdown column refers to inventory effort circa 1999-2001, not entire program.

Type of system	Excluded from walk-downs but included in program	Excluded from pressure safety program
Domestic potable water systems designed per Universal Plumbing Code (UPC)		✓
Chilled water systems (except radiation contaminated)	✓	
Systems under NFPA Fire suppression systems covered by NFPA Codes and Standards [e.g., NFPA 13 (sprinklers) and NFPA 14 (standpipes)]. Natural gas systems from the service meter to the appliance meeting NFPA requirements.		✓
Fire extinguishers covered by 29 CFR 1910 and NFPA 10		✓
Control, instrument, and shop air or inert gas piping systems with MAWP not to exceed 150 psig and line sizes not to exceed NPS 3/8”	✓	
Gloveboxes *(design pressure less than 15 psig)*		✓
Fuel storage pressure systems supplied with licensed motorized vehicles and meeting applicable DOT regulatory requirements		✓
Temporary non-LANL owned construction or maintenance related systems		✓

Attachment GEN-2, Exclusions from Program

Type of system	Excluded from walk-downs but included in program	Excluded from pressure safety program
Vent or drain systems that are open to the atmosphere at all times, including storage tanks (open to the atmosphere at all times) that only are subjected to hydrostatic pressure and that comply with the applicable American Petroleum Institute (API) or Underwriters Laboratories Incorporated (UL) standards.		✓
Self-contained pressure eye wash systems, provided over pressure protection devices are periodically tested or replaced in accordance with manufacturer's recommendation		✓
DOT specification containers periodically retested and re-qualified strictly in accordance with 49CFR180, provided that the owner's OSHA inspection requirements of 29 CFR 1910.101 are met. (e.g. DOT gas cylinders)		✓
Natural gas distribution systems covered by DOT or 49CFR192 or other monitoring/maintenance regulation	✓	
Facility water and sewer systems such as drinking fountains, faucets, garden hoses lawn sprinkler systems, and the like that are not governed by ASME BPV or B31 codes[1]		✓
Packaged refrigeration (to include HVAC and refrigerators) units bought commercially, off-the-shelf, without modification not subject to B31.5		✓
Facility water wells, water tanks, and water distribution piping not subject to B31 codes. [2]		✓
Welding, brazing, or soldering equipment covered by other standards, for example CGA or 29CFR1910.		✓
Commercially available alternative fuel vehicles, such as propane-powered vehicles (49 CFR)		✓
Test Articles, flight weight, flight vehicle pressure systems (e.g. space vehicle propulsion systems and weapon gas systems) Test Articles (as defined in Section I Attachment I-1 Definitions) and Test Article Systems must be shielded to prevent possibility of personnel injury; however, pressure systems that support the design, testing and/or evaluation of such hardware are not excluded.[3]		✓
Pressure relief protection on commercially-available, off-the-shelf (COTS) systems	✓	

[1] These are governed by the LANL-adopted plumbing code (see ESM Ch 16) or other non-ASME document.
[2] Ibid
[3] All research and development systems that must undergo continuous design changes must be reviewed by the CPSO

Type of system	Excluded from walk-downs but included in program	Excluded from pressure safety program
Pressure vessels in COTS systems	✓	

1. Excluded Pressure Vessels, Relief Devices, and Systems

A. Excluded Pressure Systems (in addition to table above; in case of conflict, most stringent applies and contact CPSO).

CAUTION: Pressure systems, regardless of whether excluded or in this program, must be designed with appropriately sized pressure relief/vent systems and included in the LANL maintenance process. *For example, water holding tanks filled by pumps are considered excluded from this program; however, if the original pump on the water tank is replaced, a design review should be performed to ensure the pumping capacity of the new pump will not "out-flow" the capacity of the existing vent system.*

1. Pressure systems and/or components of pressure systems that cannot under any circumstance be designed in accordance with the ASME Boiler and Pressure Vessel Code or the B31 piping codes or Chapter 17 Section NASME or equivalent.

   a. These items shall be shielded behind blast containment designed to withstand the explosive forces and release of shrapnel in the event of over pressurization. Only after sufficiently designed shielding has been installed to protect the work force may the pressure system or components be considered excluded from the pressure safety program and the requirements of this document. They are not considered excluded without the protective shielding.

   NOTE: Prior to determining that a pressure system cannot be designed in accordance with the codes, the owner and designer shall consider equivalency provisions in 10CFR851, Appendix A, Part 4, Section (c) (*Att. REF-1 of this chapter*) which provides an alternate methodology to be invoked in cases when codes are not applicable.

   b. Items that do not pose a risk to personnel and where the risk of damage or system loss is acceptable to the CPSO do not have to comply with the requirements of ESM Chapter 17. To apply this exclusion, two items must be satisfied:

      1) The adequacy of the shielding to protect personnel from the potential failure of the pressurized components must be verified.

      2) Adequate documented controls must be in place to prevent inadvertent pressurization when personnel are not protected by the shielding, for example

         i. Disconnection of all pressure sources

         ii. Double block-and-bleed of all pressurization sources

2. Temporary non-LANL-owned construction- or maintenance-related systems provided the hazards to personnel are low and the operating subcontractor is contractually obligated to meet, and demonstrates compliance with, all applicable Federal, State and local safety regulations.

3. Commercially-available, off-the-shelf (COTS) equipment such as tools, gas chromatographs and mass spectrometers. However, when connected to a pressure source, the pressure source hardware is not excluded and must be designed per ASME B31.3.

   a. Program does not include modified or custom fabricated/assembled systems.

   b. Program does require a temperature and pressure rating of the COTS, and the COTS item will be treated as pressure system component.

   c. Relief devices and vessels included as COTS will be included into the LANL maintenance processes. LANL may elect not to perform maintenance on the items until the manufacturer's warranty has expired.

   d. Design calculations are not required for package systems (e.g. boilers, air-compressors, or hydraulic power units) built by a reputable manufacturer that are not of unique design, with a retrievable model number. Such package units must be readily found in a catalog, or manufacturer's inventory, with proven design reliability. However, manufacturers data reports (e.g. U-1, U-1A), and system drawings (to include schematics) must be maintained in the pressure system documentation package.

   e. Modification or an alteration to the above package systems voids this exemption. Drawings must be updated, and calculations must be performed to prove compliance with the applicable code.

4. Pre-packaged, unmodified, and off-the-shelf hydraulic power units (piping systems connected to such hydraulic units are not exempt if not designed and installed by the hydraulic unit manufacturer).

5. Gloveboxes alone are excluded; however, purge and other pressure systems that interface with gloveboxes must have pressure relief that meets the requirements of ASME Section VIII, Division 1 Part UG-125 to keep the glovebox from being overpressurized.[4]

6. Vacuum systems not pressurized internally or externally by a pressure source that is greater than 15 psig (source pressure can either be internal chemical reaction, or external pressure source) which is either temporarily or permanently connected.[5]

B. Excluded Pressure Vessels

1. Tanks and low pressure vessels that cannot accumulate above 15 psig.

2. Non-code building service or heating water surge tanks under 50 gallons.

[4] Gloveboxes should be protected from over pressurization with bubblers or other pressure relief device which exits through a vent system. Glove failure (popping off), window seal failure, or other such failures are not acceptable pressure relief methods. Glovebox design is covered by ESM Ch 6, LANL Master Spec 11 5311.08, AGS-G001, etc.

[5] Guidance on vacuum system design can be found in American Vacuum Society publications.

3. Although not specifically included by the requirements of 10 CFR 851, vessels regulated by the Department of Transportation (DOT)[6] must follow the recertification frequency intervals as defined in this document.

    a. Relief valves attached to such DOT vessels must follow the test/replacement schedule as defined in this document.

    b. DOT vessels are not required to be entered into MEL or CMMS (if the DOT vessel is permanently installed in the system; refer to Ch. 17 Section NASME)

    c. DOT vessels must be maintained within inspection interval dates.[7]

4. Pressure vessels in vehicle pneumatic and hydraulic systems.

5. Drained, depressurized, and vented out-of-service pressure systems that are so labeled.

6. Self-Contained Breathing Apparatus (SCBA) air cylinders.

7. Portable eyewash stations built to ANSI Z358.1 or ISEA Z358.1

8. Excluded vessels that are utilized in vapor condensation processes must have appropriate vacuum breathing mechanisms to prevent vessel collapse from the resulting vacuum, or be designed to withstand the associated forces.

9. Fire extinguishers covered by 29 CFR 1910 and NFPA 10.

NOTE: The following vessels cannot be excluded without acceptance by the CPSO or delegate through the variance process:

- Any vessel that is either permanently or temporarily connected to a pressure source (e.g. gas cylinder or dry ice) that is greater than 15 psig, or that can pressurize the volume to greater than 15 psig.
- Pressure containers that rely solely on interlocks to limit the pressure to less than 15 psig[8]
- Vacuum vessels that can be internally pressurized to greater than 15 psig.

C. Excluded Pressure Relief Devices

1. Rupture disk and fusible plugs on DOT gas cylinders.

2. Pressure relief devices on vehicle pneumatic and hydraulic systems.

3. Pressure relief devices on drained, depressurized, and out-of-service vessels.

[6] Relief valves on DOT vessels are not excluded from this program, and must be maintained as defined in this document. Vessels must be within their inspection date as defined in the DOT, UN/IM section of this chapter.
[7] A cylinder may be requalified at any time during or before the month and year that the requalification is due. However, a cylinder filled before the requalification becomes due may remain in service until it is emptied (49CFR180.205).
[8] See Code Case 2211 and ASME Section VIII, Division 1, Part UG-140.

4. Non-metallic, non-Code pressure relief valves on portable eyewash stations
5. Fusible plugs on refrigeration equipment that conforms to ASHRAE 15.
6. Pressure relief devices that do not provide a pressure protection function.
7. Pressure relief devices on transformers.
8. Hydrostatic bubblers, e.g., on gloveboxes.

RECORD OF REVISIONS

Rev	Date	Description	POC	RM
0	9/17/2014	Initial issue.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*

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OSHA Pressure Safety Requirements

Pressure system shall meet the requirements of 29 CFR 1910.

1. A table that summarizes the applicable code requirements of the CFR is below; see CFR for the complete text and all the requirements.
2. Following the document(s) in the "LANL Applied Code" column satisfies the OSHA requirement for the systems listed.

29CFR1910 Section	Citation	Code Reference	LANL Applied Code	Summary
1910 Subpart H - Hazardous Materials				
1910.101 - Compressed gases (general requirements).	1910.101(a)	CGA C-6 (1968) Standards for Visual Inspection of Compressed Gas Cylinders	CGA C-6	Visual Inspection
	1910.101(a).	CGA C-8 (1962) Standard for Requalification of ICC-3HT Cylinders	CGA C-8	Requalification
	1910.101(b)	CGA P-1	CGA P-1	Cylinder Use
	1910.101(c)	CGA S-1.1 (1963) and 1965 Addenda. Safety Release Device Standards--Cylinders for Compressed Gases	CGA S-1.1	CGA S-1.2 (1963) Safety Release Device Standards, Cargo and Portable Tanks for Compressed Gases
	1910.101(c)	CGA S-1.2 (1963) Safety Release Device Standards, Cargo and Portable Tanks for Compressed Gases	CGA S-1.2	CGA S-1.2 (1963) Safety Release Device Standards, Cargo and Portable Tanks for Compressed Gases
1910.102 - Acetylene.	1910.102(a).	CGA G-1-2003 Acetylene	CGA G-1	Use
1910.103 - Hydrogen.	1910.103(c)(1)(i)(a)	API 620, Fourth Ed. [1970] Including Appendix R, Recommended Rules for Design and Construction of Large Welded Low Pressure Storage Tanks	API 620	Hydrogen containers shall comply with the following: Storage containers shall be designed, constructed, and tested in accordance with appropriate requirements of the ASME Boiler and Pressure Vessel Code, Section VIII - Unfired Pressure Vessels (1968) or applicable provisions of API Standard 620, Recommended Rules for Design and Construction of Large, Welded, Low-Pressure Storage Tanks, Second Edition (June 1963) and appendix R (April 1965), which is incorporated by reference as specified in Sec. 1910.6.
	1910.103(c)(1)(i)(a)	ASME Boiler and Pressure Vessel Code, Section VIII - Unfired Pressure Vessels (1968) or applicable provisions of API Standard 620, Recommended Rules for Design and Construction of Large, Welded, Low-Pressure Storage Tanks, Second Edition (June 1963) and appendix R (April 1965),	ASME Boiler and Pressure Vessel Code Section VIII	Hydrogen containers shall comply with the following: Storage containers shall be designed, constructed, and tested in accordance with appropriate requirements of the ASME Boiler and Pressure Vessel Code, Section VIII - Unfired Pressure Vessels (1968) or applicable provisions of API Standard 620, Recommended Rules for Design and Construction of Large, Welded, Low-Pressure Storage Tanks, Second

				Edition (June 1963) and appendix R (April 1965), which is incorporated by reference as specified in Sec. 1910.6.
	1910.103(c)(1)(i)(b)		49 CFR	Portable containers shall be designed, constructed and tested in accordance with DOT Specifications and Regulations.
	1910.103(c)(1)(iv)(a)(1)	CGA Pamphlet S-1, Part 3, Safety Relief Device Standards for Compressed Gas Storage Containers	CGA S-1, Part 3	Stationary liquefied hydrogen containers shall be equipped with safety relief devices sized in accordance with CGA Pamphlet S-1, Part 3, Safety Relief Device Standards for Compressed Gas Storage Containers, which is incorporated by reference as specified in Sec. 1910.6
	1910.103(c)(1)(iv)(a)(2)	CGA Pamphlet S-1, Safety Relief Device Standards, Part 1, Compressed Gas Cylinders and Part 2, Cargo and Portable Tank Containers.	CGA Pamphlet S-1, Safety Relief Device Standards, Part 1, Compressed Gas Cylinders and Part 2, Cargo and Portable Tank Containers.	Portable liquefied hydrogen containers complying with the U.S. Department of Transportation Regulations shall be equipped with safety relief devices as required in the U.S. Department of Transportation Specifications and Regulations. Safety relief devices shall be sized in accordance with the requirements of CGA Pamphlet S-1, Safety Relief Device Standards, Part 1, Compressed Gas Cylinders and Part 2, Cargo and Portable Tank Containers.
	1910.103(c)(1)(iv)(d)		ASME B31.12	Safety relief devices shall be provided in piping wherever liquefied hydrogen could be trapped between closures.
	1910.103(c)(1)(v)(b)	Pressure Piping Section 2 - Industrial Gas and Air Piping, ANSI B31.1-1967 with addenda B31.1-1969; Petroleum Refinery Piping ANSI B31.3-1966; Refrigeration Piping ANSI B31.5-1966	ASME B31.12	Gaseous hydrogen piping and tubing (above -20 deg. F.) shall conform to the applicable sections of Pressure Piping Section 2 - Industrial Gas and Air Piping, ANSI B31.1-1967 with addenda B31.1-1969. Design of liquefied hydrogen or cold (-20 deg. F. or below) gas piping shall use Petroleum Refinery Piping ANSI B31.3-1966 or Refrigeration Piping ANSI B31.5-1966 with addenda B31.5a-1968 as a guide, which is incorporated by reference as specified in Sec. 1910.6.
	1910.103(c)(1)(viii)(b)		ASME B31.12	The vaporizer and its piping shall be adequately protected on the hydrogen and heating media sections with safety relief

				devices.
	1910.103(c)(2)(i)(f)		ASME B31.12	If liquefied hydrogen is located in (as specified in Table H-3) a separate building, in a special room, or inside buildings when not in a special room and exposed to other occupancies, containers shall have the safety relief devices vented unobstructed to the outdoors at a minimum elevation of 25 feet above grade to a safe location as required in paragraph (c)(1)(iv)(b) of this section.
	1910.103(c)(1)(iv)(a)(2)	CGA S-1.1 (1963) and 1965 Addenda. Safety Release Device Standards--Cylinders for Compressed Gases	CGA S-1.1	CGA S-1.2 (1963) Safety Release Device Standards, Cargo and Portable Tanks for Compressed Gases
	1910.103(c)(1)(iv)(a)(2)	CGA S-1.2 (1963) Safety Release Device Standards, Cargo and Portable Tanks for Compressed Gases	CGA S-1.2	CGA S-1.2 (1963) Safety Release Device Standards, Cargo and Portable Tanks for Compressed Gases
	1910.103(c)(1)(iv)(a)(2)	CGA S-1.3 (1959) Safety Release Device Standards-Compressed Gas Storage Containers	CGA S-1.3	Gas cylinders, portable tanks, & bulk Oxygen, Anhydrous Ammonia relief
	1910.103(b)(1)(iii)(b)	ANSI B31.1-67 and Addenda B31.1 (1969) Code for Pressure Piping,	B31.12	Code of record
	1910.103(b)(3)(v)(b)	ANSI B31.3-66 Petroleum Refinery Piping,	B31.12	Code of record
	1910.103(b)(3)(v)(b)	ANSI B31.5-66 Addenda B31.5a (1968) Refrigeration Piping	B31.12	Code of record
	1910.103	ASME Boiler and Pressure Vessel Code, § VIII, 1968,	ASME Boiler and Pressure Vessel Code Section VIII	Code of record
1910.104 - Oxygen.	1910.104(b)(6)(iii)	CGA S-1.3 (1959) Safety Release Device Standards-Compressed Gas Storage Containers	CGA S-1.3	Gas cylinders, portable tanks, & bulk Oxygen, Anhydrous Ammonia relief
	1910.104(b)(5)(ii)	ANSI B31.1-67 and Addenda B31.1 (1969) Code for Pressure Piping,	B31.3	Code of record
	1910.104(b)(4)(ii)	ASME Boiler and Pressure Vessel Code, § VIII, 1968,	ASME Boiler and Pressure Vessel Code Section VIII	Code of record
	1910.104(b)(4)(ii) and (b)(5)(iii)	ASME Boiler and Pressure Vessel Code, §VIII, Paragraph UG-84	ASME Boiler and Pressure Vessel Code Section VIII	Code of record
1910.105 - Nitrous oxide.	1910.105	CGA G-8.1	CGA G-8.1	Design
1910.106 -	1910.106(i)(3)(i)	ASME Code for Pressure Vessels, 1968	ASME Boiler and	Code of record

Flammable and combustible liquids.		Ed	Pressure Vessel Code Section VIII	
	1910.106(b)(1)(iv)(b)(2) and (i)(3)(ii)	ASME Boiler and Pressure Vessel Code, § VIII, 1968	ASME Boiler and Pressure Vessel Code Section VIII	Code of record
1910.107 - Spray finishing using flammable and combustible materials.	1910.107	ASME Boiler and Pressure Vessel Code, § VIII, 1968	ASME Boiler and Pressure Vessel Code Section VIII	Code of record
1910.109 - Explosives and blasting agents.	1910.109(i)(1)(ii)(b)	CGA P-3	CGA P-3	Storage
1910.110 - Storage and handling of liquefied petroleum gases.	1910.110(b)(10)(iii) (Table H-26), (d)(2) (Table H-31); (e)(3)(i) (Table H-32), (h)(2) (Table H-34)	ASME Boiler and Pressure Vessel Code, § VIII,	ASME Boiler and Pressure Vessel Code Section VIII	Code of record
	1910.110(b)(11)(i)(b) and (iii)(a)(1)	ASME Boiler and Pressure Vessel Code, § VIII, 1968	ASME Boiler and Pressure Vessel Code Section VIII	Code of record
	1910.110(g)(2)(iii)(b)(2)	ASME Code for Pressure Vessels, 1968 Ed	ASME Boiler and Pressure Vessel Code Section VIII	Code of record
	1910.110(b)(3)(iii)	Code for Unfired Pressure Vessels for Petroleum Liquids and Gases of the API and the ASME, 1951	ASME Boiler and Pressure Vessel Code Section VIII	Code of record
1910.111 - Storage and handling of anhydrous ammonia.	1910.111(d)(1)(ii)	API 620, Fourth Ed. [1970] Including Appendix R, Recommended Rules for Design and Construction of Large Welded Low Pressure Storage Tanks	API 620	Containers with a design pressure exceeding 15 psig shall be constructed in accordance with paragraph (b)(2) of this section, and the materials shall be selected from those listed in API Standard 620, Recommended Rules for Design and Construction of Large, Welded, Low-Pressure Storage Tanks, Fourth Edition, 1970, Tables 2.02, R2.2, R2.2(A), R2.2.1, or R2.3, which are incorporated by reference as specified in § 1910.6.
	1910.111(d)(4)(ii)(b)	CGA S-1.3 (1959) Safety Release Device Standards-Compressed Gas Storage Containers	CGA S-1.3	Gas cylinders, portable tanks, & bulk Oxygen, Anhydrous Ammonia relief

	1910.111(b)(7)(iii)	ANSI B31.5-66 Addenda B31.5a (1968) Refrigeration Piping,	ANSI B31.5	Code of record
	1910.111(b)(2)(vi)	ASME Boiler and Pressure Vessel Code, § VIII	ASME Boiler and Pressure Vessel Code Section VIII	Code of record
	1910.111(b)(2)(i), (ii), and (iv)	ASME Boiler and Pressure Vessel Code, § VIII, 1968	ASME Boiler and Pressure Vessel Code Section VIII	Code of record
1910 Subpart I - Personal Protective Equipment				
1910.134 - Respiratory Protection.	1910.134(d)(1)	CGA G-7.1		Breathing air specification
1910 Subpart M - Compressed Gas and Compressed Air Equipment				
1910.169 - Air receivers.	1910.169(a)(2)(ii)		ASME Boiler and Pressure Vessel Code Section VIII	All safety valves used shall be constructed, installed, and maintained in accordance with the ASME Boiler and Pressure Vessel Code
	1910.169(b)(3)(iv)			All safety valves shall be tested frequently and at regular intervals to determine whether they are in good operating condition.
	1910.169(a)(2)(i) and (ii)	ASME Boiler and Pressure Vessel Code, § VIII, 1968	ASME Boiler and Pressure Vessel Code Section VIII	Code of record
1910 Subpart O - Machinery and Machine Guarding				
1910.217 - Mechanical power presses.	1910.217(b)(12)	ASME Code for Pressure Vessels, 1968 Ed	ASME Boiler and Pressure Vessel Code Section VIII	Code of record
1910.218 - Forging machines.	1910.218(d)(4) and (e)(1)(iv)	ANSI B31.1-67 and Addenda B31.1 (1969) Code for Pressure Piping,	B31.3	Code of record
1910 Subpart Q - Welding, Cutting, and Brazing				
1910.252 - General requirements.	1910.252(d)(1)(vi)	API 2201 (1963) Welding or Hot Tapping on Equipment Containing Flammables,	API 2201	Flammable substance lines. The connection, by welding, of branches to pipelines carrying flammable substances shall be performed in

				accordance with Welding or Hot Tapping on Equipment Containing Flammables, API Std. PSD No. 2201-1963, which is incorporated by reference as specified in Sec. 1910.6.
	1910.252(d)(1)(v)	API 1104 (1968) Standard for Welding Pipelines and Related Facilities	API 1104	Construction standards. The welded construction of transmission pipelines shall be conducted in accordance with the Standard for Welding Pipe Lines and Related Facilities, API Std. 1104-1968, which is incorporated by reference as specified in Sec. 1910.6
1910.253 - Oxygen-fuel gas welding and cutting.	1910.253(e)(4)(v) and (5)(iii)	CGA 1957 Standard Hose Connection Standard	CGA 1957	Ox/Ace station termination in union & hose connections
	1910.253(e)(5)(i)	CGA and RMA (Rubber Manufacturer's Association) Specification for Rubber Welding Hose (1958)	CGA and RMA (Rubber Manufacturer's Association) Specification for Rubber Welding Hose (1958)	Oxy-Fuel hoses
	§1910.253(e)(4)(iv) and (6)	CGA 1958 Regulator Connection Standard	CGA 1958 Regulator Connection Standard	Detachable regulator & regulatory requirements
	1910.253(d)(4)(ii)	ANSI A13.1-56 Scheme for the Identification of Piping Systems	ANSI A13.1	Above ground Pipe marking Oxygen-Fuel Gas
	1910.253(d)(1)(i)(A)	ANSI B31.1-67	B31.3	Code of record
1910.254 - Arc welding and cutting.	1910.254(b)(1)			General. Assurance of consideration of safety in design is obtainable by choosing apparatus complying with the Requirements for Electric Arc-Welding Apparatus, NEMA EW-1-1962, National Electrical Manufacturers Association or the Safety Standard for Transformer-Type Arc-Welding Machines, ANSI C33.2-1956, Underwriters' Laboratories, both of which are incorporated by reference as specified in Sec. 1910.6

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RECORD OF REVISIONS

Rev	Date	Description	POC	RM
0	9/17/2014	Initial issue. Revision of content formerly in Section I, Rev. 3.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*
1	12/11/2018	Added Att ASME-2 for NB-23, Att ASME-5 for ASME B&PV Code. VAR-2015-011, Copper Tubing Alternative, was incorporated by the Allowed Unlisted Component Listing.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*

Contact the Chapter POC for upkeep, interpretation, and variance issues.

Chapter 17	**Pressure Safety POC and Committee**

This document is online at http://engstandards.lanl.gov

1.0 NEW FABRICATION

All boilers, pressure vessels, air receivers, and supporting piping shall meet the appropriate ASME Boiler and Pressure Vessel Code Section and B31 piping section as applicable.[1]

A. Application of Codes

1. ASME Code-Stamped Boilers and Vessels

    a. A manufacturer holding an ASME Code stamp as defined by the applicable ASME B&PVC Section must be designed and have vessel stamped accordingly.

    b. A copy of the manufacturer's data reports (e.g. "P-2", "U1", "U1A", "U2", etc.) must be supplied with the vessel, and must be maintained in the pressure system documentation package. An NBIC registration number must be applied to the item.

    c. For pressure vessels without an ASME stamp, the ASME Code design calculations must be obtained [e.g., LANL or an external design agency (Architect/Engineer)].

    d. Receipt inspection of fabricated vessels must include verification of manufacturer's data reports (e.g., "P2", "U1" form, etc.), and visual identification of appropriate stamping, or availability of design calculations.

    e. Installation of new boilers shall comply with NBIC Section I, Installation.

2. Repairs and Alterations

    a. Repairs and alterations that require welding to code stamped vessels ("S", "H", "U", "U2", etc.) must be performed as instructed per the applicable ASME Boiler and Pressure Vessel Section (as referenced by NBIC NB-23), and must be performed by an institution holding an "R" stamp.

    b. ASME PCC-2 must be used as a guide for repair of pressure equipment and piping.

    c. Repairs to support piping and piping components must be performed as defined in ASME B31.1 or other applicable B31 piping code.

    d. Repairs to pressure relief, or pressure safety valves displaying the "UV" stamp, must be performed by an institution holding a "VR" stamp.

    e. Repairs and modifications to pressure vessels and piping must be verified through engineering calculations prior to performing the operation.

[1] Invokes 10CFR851 as described in PD100, DOE/NNSA Approved Los Alamos National Laboratory 10 CFR 851 Worker Safety and Health Program Description.

f. Completion of repairs (including routine repairs) and alterations must be verified by inspection and testing as defined by the applicable ASME BPV or B31 code, and NBIC/NB23, Part 3, Section 4. Inspectors Forms (R-1, R-2, etc.) must be maintained in the pressure system's documentation package.

g. Although not anticipated at LANL, repairs and alterations made to ASME Section III stamped nuclear facility components (e.g., "NV", "NB") must be performed by an institution holding the "NR" stamp.

h. Boilers: Repair or alteration of boilers must meet New Mexico Administrative Code (NMAC) 14.9.4 "Housing and Construction, Mechanical Codes, Boilers."

   1) Routine repairs as defined by NB-23 include re-tubing a boiler when no welding is performed.

   2) NMAC 14.9.4 requires boilers be maintained and operated in compliance with the manufacturer's requirements.

2.0 ATTACHMENTS

Attachment ASME-1 – B31 Code and Regulation Application

Attachment ASME-2 – NB-23 Application

Attachment ASME-3 – Category M Fluids

Attachments ASME-4–X – Acceptable Items for Code Construction

  Attachment ASME -4-1 Designer-Approved Alternative Hose Restraints

  Attachment ASME -4-2 Swagelok Flex Hoses

Attachment ASME-5 – ASME B&PV Code Application

RECORD OF REVISIONS

Rev	Date	Description	POC	RM
0	9/17/14	Initial issue.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*

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Code and Regulation Application

This attachment contains paraphrased code and regulation scope summaries with discussion of how these mandates shall be applied at LANL.[1]

[1] Many of these mandates and their adoption by LANL are listed in SD100, *Integrated Safety Management System Description Document with embedded 10 CFR 851 Worker Safety and Health Program.*

B31.1 Power Piping

Power piping systems include but are not limited to steam, water, oil, gas, and air services. This Code covers boiler external piping and non-boiler external piping for power boilers and high temperature, high pressure water boilers in which: steam or vapor is generated at a pressure of more than 15 psig [100 kPa (gage)]; and high temperature water is generated at pressures exceeding 160 psig [1,103 kPag] and/or temperatures exceeding 250°F (120°C).

This Code does not apply to building heating and distribution steam and condensate piping designed for 15 psig [100 kPag] or less, or hot water heating systems designed for 30 psig [200 kPag] or less.

B31.2 Fuel Gas Piping

LANL does not follow this code. This code has been withdrawn and replaced by NFPA 54, *National Fuel Gas Code*. The authority having jurisdiction of NFPA 54 is the DOE/LANL Fire Marshal.

B31.3 Process Piping

Pressure greater than 15 psig or if the fluid is flammable, toxic, or damaging to human tissues as defined in ASME B31.3 300.2 or the design temperature is outside the range of −29°C (−20°F) through 186°C (366°F). Toxic is defined as a category M fluid. Category M fluids are identified in ESM Chapter 17 Att. II-4.

B31.4 Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids

LANL does not apply this code because there are no known systems that are within the scope of the code.

This Code prescribes requirements for the design, materials, construction, assembly, inspection, and testing of piping transporting liquids such as crude oil, condensate, natural gasoline, natural gas liquids, liquefied petroleum gas, carbon dioxide, liquid alcohol, liquid anhydrous ammonia, and liquid petroleum products between producers' lease facilities, tank farms, natural gas processing plants, refineries, stations, ammonia plants, terminals (marine, rail, and truck), and other delivery and receiving points.

This Code does not apply to (a) auxiliary piping, such as water, air, steam, lubricating oil, gas, and fuel (b) pressure vessels, heat exchangers, pumps, meters, and other such equipment including internal piping and connections for piping except as limited by para. 423.2.4(b) (c) piping designed for internal pressures (1) at or below 15 psi (1 bar) gage pressure regardless of temperature(2) above 15 psi (1 bar) gage pressure if design temperature is below minus 20°F (−30°C) or above 250°F (120°C)

B31.5 Refrigeration Piping and Heat Transfer Components

This Code prescribes requirements for the materials, design, fabrication, assembly, erection, test, and inspection of refrigerant, heat transfer components, and secondary coolant piping for temperatures as low as −320°F (−196°C), whether erected on the premises or factory assembled, except as specifically excluded in the following paragraphs.

This Code shall not apply to any of the following: (a) any self-contained or unit systems subject to the requirements of Underwriters Laboratories or other nationally recognized testing laboratory (b) water piping, other than where water is used as a secondary coolant or refrigerant (c) piping designed for external or internal gage pressure not exceeding 15 psi (105 kPa) regardless of size (d) pressure vessels, compressors, or pumps, but does include all connecting refrigerant and secondary coolant piping starting at the first joint adjacent to such apparatus

B31.8 Gas Transmission and Distribution Piping Systems

Note: These systems are also be required to meet DOE O 460.1 *Packaging and Transportation Safety* requiring 49 CFR 190-193, 195, and 199

802.1 Scope

(a) This Code covers the design, fabrication, installation, inspection, and testing of pipeline facilities used for the transportation of gas. This Code also covers safety aspects of the operation and maintenance of those facilities. (See Appendix Q for scope diagrams.) This Code is concerned only with certain safety aspects of liquefied petroleum gases when they are vaporized and used as gaseous fuels. All of the requirements of NFPA 58 and NFPA 59 and of this Code concerning design, construction, and operation and maintenance of piping facilities shall apply to piping systems handling butane, propane, or

mixtures of these gases.

(b) This Code does not apply to

(1) design and manufacture of pressure vessels covered by the BPV Code[1]

(2) piping with metal temperatures above 450°F (232°C) or below −20°F (−29°C) (for low temperature considerations, see para. 812.)

(3) piping beyond the outlet of the customer's meter set assembly (refer to ANSI Z223.1/NFPA 54.)

(4) piping in oil refineries or natural gasoline extraction plants, gas treating plant piping other than the main gas stream piping in dehydration, and all other processing plants installed as part of a gas transmission system, gas manufacturing plants, industrial plants, or mines (See other applicable sections of the ASME Code for Pressure Piping, B31.)

(5) vent piping to operate at substantially atmospheric pressures for waste gases of any kind

(6) wellhead assemblies, including control valves, flow lines between wellhead and trap or separator, offshore platform production facility piping, or casing and tubing in gas or oil wells (For offshore platform production facility piping, see API RP 14E.)

(7) the design and manufacture of proprietary items of equipment, apparatus, or instruments

(8) the design and manufacture of heat exchangers (refer to appropriate TEMA[2] standard.)

(9) liquid petroleum transportation piping systems (refer to ASME B31.4.)

(10) liquid slurry transportation piping systems (refer to ASME B31.11.)

(11) carbon dioxide transportation piping systems

(12) liquefied natural gas piping systems (refer to NFPA 59A and ASME B31.3.)

(13) cryogenic piping systems

[1] BPV Code references here and elsewhere in this Code are to the ASME Boiler and Pressure Vessel Code.
[2] Tubular Exchanger Manufacturers Association, 25 North Broadway, Tarrytown, NY 10591.

B31.8S Managing System Integrity of Gas Pipelines

This Code applies to onshore pipeline systems constructed with ferrous materials and that transport gas. The principles and processes embodied in integrity management are applicable to all pipeline systems.

This Code is specifically designed to provide the operator (as defined in section 13) with the information necessary to develop and implement an effective integrity management program utilizing proven industry practices and processes. The processes and approaches within this Code are applicable to the entire pipeline system.

B31.9 Building Services Piping

This Code Section has rules for the piping in industrial, institutional, commercial, and public buildings, and multi-unit residences, which does not require the range of sizes, pressures, and temperatures covered in B31.1.

(a) Services. This Code applies to the following building services, except as excluded in para. 900.1.3: (1) water and antifreeze solutions for heating and cooling (2) condensing water (3) steam or other condensate (4) other nontoxic liquids (5) steam (6) vacuum (7) compressed air (8) other nontoxic, nonflammable gases (9) combustible liquids including fuel oil

(b) Boiler External Piping. The scope of this Code includes boiler external piping within the following limits: (1) for steam boilers, 15 psig (103 kPag) max; (2) for water heating units, 160 psig (1,103 kPag) max and 250°F (121°C) max. Boiler external piping above these pressure or temperature limits is within the scope of ASME B31.1.

(c) Material and Size Limits. Piping systems of the following materials are within the scope of this Code, through the indicated maximum size (and wall thickness if noted): (1) carbon steel: NPS 48 (DN 1,200) and 0.50 in. (12.7 mm) wall (2) stainless steel: NPS 24 (DN 600) and 0.50 in. (12.7 mm) wall (3) aluminum: NPS 12 (DN 300) (4) brass and copper: NPS 12 (DN 300) and 12.125 in. (308 mm) O.D. for copper tubing (5) thermoplastics: NPS 24 (DN 600) (6) ductile iron: NPS 48 (DN 1,200) (7) reinforced thermosetting resin: 24 in. (600 mm) nominal Other

Attachment ASME - 1 – Code and Regulation Application

materials may be used as noted in Chapter III.

(d) Pressure Limits. Piping systems with working pressures not in excess of the following limits are within the scope of this Code:

(1) steam and condensate: 150 psig (1,034 kPag)

(2) liquids: 350 psig (2,413 kPag)

(3) vacuum: 1 atm external pressure

(4) compressed air and gas: 150 psig (1,034 kPag)

(e) Temperature Limits. Piping systems with working temperatures not in excess of the following limits are within the scope of this Code: (1) steam and condensate: 366°F (186°C); (2) other gases and vapors: 200°F (93°C) ; (3) other nonflammable liquids: 250°F (121°C). The minimum temperature for all services is 0°F (−18°C).

900.1.3 Exclusions. This Code does not apply to economizers, heaters, pumps, tanks, heat exchangers, and equipment covered by the ASME Boiler and Pressure Vessel (BPV) Code.

B31.11 Slurry Transportation Piping Systems

LANL does not apply this code because there are no know systems that are within the scope of the code.

Rules for this Code section have been developed considering the needs for applications, which include piping transporting aqueous slurries between plants and terminals and within terminals, pumping and regulating stations.

This Code does not apply to piping designed for internal pressures at or below 15 psig regardless of temperature or above 15 psig if the temperature is below -20°F (-30°C) or above 250°F (120°C).

B31.12 Hydrogen Piping and Pipelines

IP (industrial piping) Rules for this Part have been developed for hydrogen service included in petroleum refineries, refueling stations, chemical plants, power generation plants, semiconductor plants, cryogenic plants, hydrogen fuel appliances, and related facilities.

PL (pipelines) excludes the following: (a) design and manufacture of pressure vessels covered by the ASME Boiler and Pressure Vessel Code; (b) pipeline systems with temperatures above 450°F or below −80°F; (c) pipeline systems with pressures above 3000 psig; (d) pipeline systems with a moisture content greater than 20 ppm (dew point at 1 atm p −67°F); (e) pipeline systems with a hydrogen content less than 10% by volume.

B31.G Manual for Determining Remaining Strength of Corroded Pipelines

This document is intended solely for the purpose of providing guidance in the evaluation of metal loss in pressurized pipelines and piping systems. It is applicable to all pipelines and piping systems within the scope of the transportation pipeline codes that are part of ASME B31 Code for Pressure Piping, namely: ASME B31.4, Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids; ASME B31.8, Gas Transmission and Distribution Piping Systems; ASME B31.11, Slurry Transportation Piping Systems; and ASME B31.12, Hydrogen Piping and Pipelines, Part PL. Where the term *pipeline* is used, it may also be read to apply to piping or pipe conforming to the acceptable applications and within the technical limitations discussed below.

49 CFR Part 192 Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards

Note: These systems are also be required to B31.8

This part prescribes minimum safety requirements for pipeline facilities and the transportation of gas, including pipeline facilities and the transportation of gas within the limits of the outer continental shelf.

(b) This part does not apply to offshore gathering of gas in State waters; pipelines on the Outer Continental Shelf (OCS); onshore gathering of gas through a pipeline that operates at less than 0 psig, through a pipeline that is not a regulated onshore gathering line, and within inlets of the Gulf of Mexico; any petroleum gas or petroleum gas/air mixtures only pipeline to fewer than 10 customers, if no portion of the system is located in a public place; or a single customer, if the system is located entirely on the customer's premises (no matter if a portion of the system is located in a public place).

NFPA 54 National Fuel Gas Code

Note: NFPA systems are not required to meet ESM Chapter 17 and are presented here only for information to the reader to help clarify which codes apply to the different portions of natural gas systems.

1.1 Scope.

1.1.1 Applicability.

1.1.1.1 This code is a safety code that shall apply to the installation of fuel gas piping systems, appliances, equipment, and related accessories as shown in 1.1.1.1(A) through 1.1.1.1(D).

(A) Coverage of piping systems shall extend from the point of delivery to the appliance connections. For other than undiluted liquefied petroleum gas (LP-Gas) systems, the point of delivery shall be considered to be the outlet of the service meter assembly or the outlet of the service regulator or service shutoff valve where no meter is provided. For undiluted LP-Gas, the point of delivery shall be considered to be the outlet of the final pressure regulator, exclusive of line gas regulators, in the system.

(B) The maximum operating pressure shall be 125 psi (862 kPa).

Exception No. 1: Piping systems for gas–air mixtures within the flammable range are limited to a maximum pressure of 10 psi (69 kPa).

Exception No. 2: LP-Gas piping systems are limited to 20 psi

(140 kPa), except as provided in 5.5.2.

(C) Requirements for piping systems shall include design, materials, components, fabrication, assembly, installation, testing, inspection, operation, and maintenance.

(D) Requirements for appliances, equipment, and related accessories shall include installation, combustion, and ventilation air and venting.

1.1.1.2 This code shall not apply to the following items (reference standards for some of which appear in Annex M):

(1) Portable LP-Gas appliances and equipment of all types that are not connected to a fixed fuel piping system

(2) Installation of farm appliances and equipment such as brooders, dehydrators, dryers, and irrigation equipment

(3) Raw material (feedstock) applications except for piping to special atmosphere generators

(4) Oxygen–fuel gas cutting and welding systems

(5) Industrial gas applications using such gases as acetylene and acetylenic compounds, hydrogen, ammonia, carbon monoxide, oxygen, and nitrogen

(6) Petroleum refineries, pipeline compressor or pumping stations, loading terminals, compounding plants, refinery tank farms, and natural gas processing plants

(7) Large integrated chemical plants or portions of such plants where flammable or combustible liquids or gases are produced by chemical reactions or used in chemical reactions

(8) LP-Gas installations at utility gas plants

(9) Liquefied natural gas (LNG) installations

(10) Fuel gas piping in electric utility power plants

(11) Proprietary items of equipment, apparatus, or instruments such as gas generating sets, compressors, and calorimeters

(12) LP-Gas equipment for vaporization, gas mixing, and gas manufacturing

(13) LP-Gas piping for buildings under construction or renovations that is not to become part of the permanent building piping system -- that is, temporary fixed piping for building heat

(14) Installation of LP-Gas systems for railroad switch heating

(15) Installation of LP-Gas and compressed natural gas (CNG) systems on vehicles

(16) Gas piping, meters, gas pressure regulators, and other appurtenances used by the serving gas supplier in distribution of gas, other than undiluted LP-Gas

(17) Building design and construction, except as

specified herein

(18) Fuel gas systems on recreational vehicles manufactured in accordance with NFPA 1192, *Standard on Recreational Vehicles*

(19) Fuel gas systems using hydrogen as a fuel

(20) Construction of appliances

1.1.2 Other Standards. In applying this code, reference shall also be made to the manufacturers' instructions and the serving gas supplier regulations.

1.2 Purpose. (Reserved)

1.3 Retroactivity. Unless otherwise stated, the provisions of this code shall not be applied retroactively to existing systems that were in compliance with the provisions of the code in effect at the time of installation.

1.4 Equivalency. The provisions of this code are not intended to prevent the use of any material, method of construction, or installation procedure not specifically prescribed by this code, provided any such alternative is acceptable to the authority having jurisdiction *(see 3.2.2)*. The authority having jurisdiction shall require that sufficient evidence be submitted to substantiate any claims made regarding the safety of such alternatives.

1.5 Enforcement. This code shall be administered and enforced by the authority having jurisdiction designated by the governing authority.

RECORD OF REVISIONS

Rev	Date	Description	POC	RM
0	11/09/18	Initial issue.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*

Contact the Standards POC for upkeep, interpretation, and variance issues.

Chapter 17	**Pressure Safety POC and Committee**

This document is online at http://engstandards.lanl.gov

National Board Inspection Code NB-23 Application

This attachment contains paraphrased code scope summaries with discussion of how these mandates shall be applied at LANL. It is based on the 2017 edition; later editions must be evaluated for impact.

Part 1 Installation
This part provides requirements and guidance to ensure all types of pressure-retaining items are installed and function properly. Installation includes meeting specific safety criteria for construction, materials, design, supports, safety devices, operation, testing, and maintenance.
Part 2 Inspection
This part provides information and guidance needed to perform and document inspections for all types of pressure-retaining items. This part includes information on personnel safety, non-destructive examination, tests, failure mechanisms, types of pressure equipment, fitness for service, risk-based assessments, and performance-based standards.

Part 3 Repairs and Alterations
This part provides requirements and guidance to perform, verify, and document acceptable repairs or alterations to pressure retaining items regardless of code of construction. Alternative methods for examination, testing, heat treatment, etc., are provided when the original code of construction requirements cannot be met. Specific acceptable and proven repair methods are also provided.
Part 4 Pressure Relief Devices
This part provides information and guidance to ensure pressure relief devices are installed properly, information and guidance needed to perform and document inspections for pressure relief devices, and information and guidance to perform, verify, and document acceptable repairs to pressure relief devices.

RECORD OF REVISIONS

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This attachment defines fluid services designated as Category M at LANL per ASME B31.3 Process Piping[1]. It also defines lethal substances for LANL per B&PV Code Section VIII[2].

1. No designation in the right-hand column indicates the chemical is considered non-toxic/non-lethal, but no listing cannot be taken to mean that -- only that the chemical requires written evaluation/determination by the PSO and user and (with assistance of Industrial Hygiene if appropriate) with email notification to the CPSO.[3]
2. ID shown is not necessarily the operating system or system ID per ESM Chapter 1 Section 210.
3. Listings are generally alphabetically by media column.

[1] See ASME B31.3 paragraph 300.2 Definitions for “Fluid Service”
[2] See ASME B&PV Code Section VIII UW-2 paragraph (a) and footnote 1
[3] Notification to CPSO allows CPSO to oversee field decisions and/or add new chemicals to this listing over time

ID	Media (generally sorted by this)	Cat M/Lethal? (blank = no, missing = TBD)
AC	acetylene	
AW	acid waste	**Yes** (for concentrated solutions)
AG	argon	
AK	HCFC – 225g (cleaning fluid)	
AM	ammonia	
AAM	anhydrous ammonia	**Yes**
AR	air	
AZ	aerozine 50 fuel	**Yes**
AN	aluminum nitrate	
BA	breathing air	
BH	biological hazard (deadly)	**Yes**
BF	boiler feed water	
BFB	bromofluorobenze	
CF4	carbon tetrafluoride	
CG	calibration gas	Depends on the test gas
ChB	chlorobenzene	
CS	CAM sample air	
CW	caustic waste	
CR	central circulating hot water return	
CS	central circulating hot water supply	
WR	central chilled water return	
WS	central chilled water supply	
CI	chemical injection (water systems)	
CL	chlorine	**Yes**
CL	chlorine gas	**Yes**
CO2	carbon dioxide	
CO	carbon monoxide	
CF4	carbon tetra fluoride	
CW	chilled water	
CA	compressed air	
CD	condensate pump discharge	
DB	diborane (2%), argon bal	**Yes**
DE	diesel	

ID	Media (generally sorted by this)	Cat M/Lethal? (blank = no, missing = TBD)
DI	deionized water (incl. supply and return)	
DW	distilled water	
DR	drain	
DTR	dri-train return	
DTS	dri-train supply	
DU	deuterium	
HDV	house dry vacuum	
PDV	process dry vacuum	
EG	ethylene glycol	
FS	fire suppression	
FSA	fixed head sample air	
F	florine gas	**Yes**
FCB	fluorochlorobenzen	
FE	HFE – 7100 (cleaning fluid)	
FR	Freon (r12) dichlorodifluoromethane	
FU	monomethylhydrazine (MMH) fuel	**Yes**
FX	fire protection water	
GH	gaseous hydrogen	
GN	gaseous nitrogen	
GO	gaseous oxygen	
GS	gasoline	
HA	Halon fire suppression	
H2S	hydrogen sulfide	**Yes**
HAN	hydroxylamine nitrate	**Yes**
HWR	heating water return	
HWS	heating water supply	
HPS	high pressure steam (above 15 psig)	
HIB	hydroxyisobutyric acid	
HCl	hydrochloric acid	**Yes**
HC	hydrocarbon liquid	
HD	hydraulic fluid	Depends on the material reference MSDS
HE	gaseous helium	
HF	hydrogen fluoride	**Yes**

ID	Media (generally sorted by this)	Cat M/Lethal? (blank = no, missing = TBD)
HFa	hydrofluoric acid	**Yes**
HL	liquid helium	
HCL	hydrogen chloride gas	**Yes**
HP	hydrogen peroxide (H_2O_2)	
HR	hydrofluoroether	
HW	hot water	
HY	hydrazine fuel	**Yes**
HZ	hazardous waste	Depends on the makeup of the waste
IP	isopropyl alcohol	
IW	industrial waste	
IW	industrial water	
IA	instrument air	
KE	kerosene	
KR	krypton	
LWR	limited-volume circulating chilled water return	
LWS	limited-volume circulating chilled water supply	
LA	liquid air	
LH	liquid hydrogen	
LN	liquid nitrogen	
LO	liquid oxygen	
LP	propane, butane	
LX	Lexsol heat transfer fluid	
LPC	low-pressure condensate (15 psig or less)	
LPG	low-pressure natural gas (less than 14 in. w.c.)	
LPS	low-pressure steam (15 psig or less)	
HG	mercury	**Yes**
MA	methyl alcohol	
ME	methane	
MF	Freon MF solvent	
NA	sodium hydroxide (NaOH)	**Yes** (for concentrated solutions)
NG	natural gas	
NP	neopentane (2,2-dimethylpropane)	No
NWR	negative-pressure circulating chilled water return	
NWS	negative-pressure circulating chilled water supply	
NE	neon	
NAc	nitric acid	**Yes** (for concentrated solutions)
NO	nitric oxide	
NO2	nitrogen dioxide	**Yes**
N20	nitrous oxide	
N204	dinitrogen tetroxide (N_2O_4)	**Yes**
OL	oil	
P-10	P-10 gas mix	
PH3	phosphine	**Yes**
PWR	positive-pressure circulating chilled water return	
PWS	positive-pressure circulating chilled water supply	
PW	potable water	
PHW	potable hot water return	
KOH	potassium hydroxide	
PCA	process compressed air	
PWR	process cooling water return	
PWS	process cooling water supply	
RLW	radioactive liquid waste	
RL	refrigerant liquid	
RS	refrigerant suction	
RG	regeneration gas	
SC	sodium carbonate	
SC	sodium citrate	
SS	sanitary sewer	
SP	sump pump discharge	
SF	sulfur hexafluoride (SF6)	
SO2	sulfur dioxide	**Yes**
H2SO4	sulfuric acid	**Yes** (for concentrated

ID	Media (generally sorted by this)	Cat M/Lethal? (blank = no, missing = TBD)
		solutions)
ST	steam	
TF	Freon TF solvent	
TG	test gas (special types, mixes, etc.)	**Depends on the test gas**
TMA	trimethylamine 108 ppm	
TWD	tower water drain	
TWR	tower water return	
TWS	tower water supply	
TW	treated water	

ID	Media (generally sorted by this)	Cat M/Lethal? (blank = no, missing = TBD)
T3	tritium	
UD	unsymmetrical dimethyl hydrazine (UDMH) fuel	**Yes**
VA	vacuum	
VH	vent header (to TA-55 zone 1 HVAC)	
WV	wet vacuum	
WA	water	
Z1	zone 1 (TA-55 HVAC)	

Flexhose and Relief Device Restraint

RECORD OF REVISIONS

Rev	Date	Description	POC	RM
0	9/17/2014	Initial issue.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*

Contact the Standards POC for upkeep, interpretation, and variance issues.

Chapter 17	Pressure Safety POC and Committee

This document is online at http://engstandards.lanl.gov

Purpose: This document provides a listing of approved flexhose restraints and one acceptable method/example for designer approval of alternative flex hose restraint by determining thrust load. This same method can be used for thrust load determination of relief devices or their outlet piping to be used as an input to design of their supports.

Approved Flex Hose Restraints

Note: Self-restraining flexhoses like Air Liquide's LifeGuard Safety Hose Anti-Whip Internal Safety System and Global Passive Safety System's LifeGuard meet the requirement for restraint.[1]

Parker Hannifin flex hose restraints provide acceptable protection against whipping in the event of flex hose failure (most commonly shear at the fitting) up to the size/pressure values listed in the table below. For all other hoses, the designer is responsible to evaluate the material of construction and the anchor location to ensure the alternative is a safe design based on a thrust load calculation like the one later in this document.

Per the Parker Hose Whip Restraint Bulletin 4480-148 © 2009 Parker Hannifin Corp: "The Whip Restraint System has been tested to the operating pressures of the hoses listed in HPD Catalog 4400."

The HPD Catalog 4400 © 2011 Parker Hannifin Corporation has multiple types of hoses listed. The highest rating for a given size is shown below in Table ASME-4-1-1.

Table ASME-4-1-1: Highest Hose Ratings listed in Catalog 4400

Hose Size Designation	Hose Size (inch)	Highest Hose Rating	Hose Type
-4	¼	10,500	Hydraulic JK
-5	5/16	5,000	Hydraulic 302
-6	3/8	10,000	Hydraulic JK

[1] VAR-2013-064

-8	½	6,000	Constant Working Pressure 797TC
-10	5/8	6,000	Constant Working Pressure 797TC
-12	¾	6,000	Constant Working Pressure 797TC
-16	1	6,000	Constant Working Pressure 797TC
s-20	1 ¼	6,000	Constant Working Pressure 797TC
-24	2	6,000	Constant Working Pressure 791TC
-32	2 ½	5,000	Constant Working Pressure P35
-40	3 1/4	350	Transportation 201
-48	4	200	Transportation 201

Thus, the Parker Hose Whip Restraint may be used to the maximum value as shown in HPD Catalog 4400.

<u>Designer approval of alternative flex hose restraints and design of relief device and outlet piping supports by calculating the conservative case thrust model</u>

The example below is for a full gas cylinder at 2265 psig.

Estimating the initial surge thrust from an open line based on the assumption that the gas is exiting at sonic velocity, the mass flow rate results from the initial (pre-flow) density and sonic velocity, and that the pressures at the outlet of the tube has decrease to the highest pressure that maintains sonic flow (the critical pressure ratio). This is a worst-case condition and would probably only last a very short time duration until line losses resulted in a decrease in the mass flow and outlet pressure. In addition, the gas temperature will decrease due to isentropic expansion.

Reference: *Introductory Gas Dynamics*, Chapman and Walker, 1971 Ed. Page 273 Equation 7.7

$T = m' V + P_o A$ where:

m' mass flow rate

V' gas outlet velocity

P_o outlet pressure

A Area of the outlet

$m' = rho/g\ v_s A$ mass flow rate based on upstream density (rho), sonic velocity (v_s), and inside diameter

rho = P/RT density based on ideal gas behavior

P absolute pressure

R Gas Constant

T absolute temperature

$V = v_s$ outlet gas velocity is sonic velocity

$V_s = (k\ g\ R\ T)^{1/2}$ sonic velocity for an ideal gas, where:

k ratio of specific heats

g acceleration due to gravity

$P_o = P/PR_c$ outlet pressure based on upstream pressure and critical pressure ratio

critical pressure ratio, reference *Orifice Meters With Supercritical Compressible Flow*, Cunningham, page 635, formula 20, inverse of formula used for upstream to downstream pressure

$PR_c = [(k + 1)/2]^{(k/(k-1))}$

General Thrust Equation: $F = m_e\ w - m_i\ V_o + (P_e - P_o)\ A_e$, where

F = Thrust

m_e = Exit Mass Flow Rate

w = Velocity of exit gas

m_i = Inlet mass flow rate

V_o =Velocity of Free-Stream Air (flight speed)

P_e = Absolute Static Pressure in Exit Section of Exhaust Nozzle

P_o = Absolute Static Pressure of Free-Stream Ambient

A_e = Cross-Sectional Area of Exit Section of Exhaust Nozzle

Solving for thrust:

$T_s = [(P/(RTg))\ ((k\ g\ R\ T)^{1/2})\ A\ ]\ ((k\ g\ R\ T)^{1/2}) + [P/[((k+1)/2)^{(k/(k-1))}]\ A$

Simplifying the equation:

$T_s = PA\ \{k + 1/[((k+1)/2)^{(k/(k-1))}]\}$

Defining the value within the bracket as the Surge Thrust Factor (STF):

$T_s = PA\ STF$

Example: Surge thrust forces for various flex hose sizes with argon with a maximum internal pressure of 2265 psig:

k (argon) = 1.67

Rc (Critical Pressure Ratio) = 2.05

STF (argon) = 2.16 (bounding condition)

Result:

Table ASME 4-1-2 Calculated Surge Thrust (example, argon @ 2265 psig)

Flex Hose ID (fractional inch)	Flex Hose ID (decimal inch)	Area (Pi*D^2/4)	Argon Surge Thrust Factor	Surge Thrust (lbf)
1/8"	0.125	0.0123	2.16	60
1/4"	0.25	0.0491	2.16	240
5/16"	0.3125	0.0767	2.16	375
3/8"	0.375	0.1104	2.16	540
7/16"	0.4375	0.1503	2.16	735
1/2"	0.5	0.1963	2.16	961
9/16"	0.5625	0.2485	2.16	1216
5/8"	0.625	0.3068	2.16	1501
11/16"	0.6875	0.3712	2.16	1816
3/4"	0.75	0.4418	2.16	2161
7/8"	0.875	0.6013	2.16	2942
1"	1	0.7854	2.16	3842
1 1/4"	1.25	1.2272	2.16	6004
1 1/2"	1.5	1.7671	2.16	8646
1 3/4"	1.75	2.4053	2.16	11768
2"	2	3.1416	2.16	15370
2 1/4"	2.25	3.9761	2.16	19453
2 1/2"	2.5	4.9087	2.16	24016
2 3/4"	2.75	5.9396	2.16	29059
3"	3	7.0686	2.16	34582
3 1/4"	3.25	8.2958	2.16	40586
3 1/2"	3.5	9.6211	2.16	47070
3 3/4	3.75	11.0447	2.16	54035
4"	4	12.5664	2.16	61480

Brackets, supports, hose restraints, or whip restraints must be designed to meet or exceed the surge thrust calculated.

RECORD OF REVISIONS

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0	9/17/2014	Initial issue.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*

Contact the Standards POC for upkeep, interpretation, and variance issues.

Chapter 17	**Pressure Safety POC and Committee**

This document is online at http://engstandards.lanl.gov

This document provides a listing of available Swagelok hose and flexible tubing styles and associated data[1] and indicates whether each is acceptable for code construction at LANL when used within its limits.

[1] Swagelok information taken from publication MS-01-180, May 2011 R5. Variance VAR-2010-001.0 evaluated Swagelok (including the old brands of Whitey, Cajon, and Nupro) to meet the ASME B31.3 304.7.2 requirements, and Swagelok components (tubing, fittings, and valves only) are allowed for use in construction of new code compliant systems at LANL.

Swagelok Flex Hose Series	ASME B31.3 Piping Component?	ASME B31.3-2010 Component Standard	Manufacturer Ratings Based on Code	Burst Pressure and Pressure Ratings as a Function of Temperature	Single Burst Test	No Burst Test	LANL-Wide Approval?	Additional Requirements
FM	Yes	BS 6501, Part 1	B31.1	No	NA	NA	Yes	None
FJ	Yes	BS 6501, Part 1	B31.3	No	NA	NA	Yes	None
FL	Yes	BS 6501, Part 1	B31.1	No	NA	NA	Yes	None
CT	Yes	BS 6501, Part 1	None	No	NA	Yes	**No**	See A323.2
T	Yes	ASTM F423	None	Yes	NA	NA	Yes	MAWP based on temperature see A323.2
B	Yes	ASTM F423	None	No	Yes	NA	**No**	See A323.2 and A323.2.4
X	Yes	ASTM F423	None	Yes	NA	NA	Yes	MAWP based on temperature see A323.2
S	Yes	ASTM F423	None	Yes	NA	NA	Yes	MAWP based on temperature see A323.2
C	Yes	ASTM F423	None	Yes	NA	NA	Yes	MAWP based on temperature see A323.2

Swagelok Flex Hose Series	ASME B31.3 Piping Component?	ASME B31.3-2010 Component Standard	Manufacturer Ratings Based on Code	Burst Pressure and Pressure Ratings as a Function of Temperature	Single Burst Test	No Burst Test	LANL-Wide Approval?	Additional Requirements
N	Yes	ASTM F423	None	Yes	NA	NA	Yes	MAWP based on temperature see A323.2
W	Yes	ASTM F423	None	Yes	NA	NA	Yes	MAWP based on temperature see A323.2
F	Yes	ASTM F423	None	Yes	NA	NA	Yes	MAWP based on temperature see A323.2
U	Yes	F781	None	Yes	NA	NA	Yes	MAWP based on temperature see A323.2
PFA	Yes	F781	None	No	NA	Yes	**No**	See A323.2
LT	Yes	Unlisted	None	No	Yes	NA	**No**	See A323.2 and A323.2.4
NG	Yes	Unlisted	None	No	Yes	NA	**No**	See A323.2 and A323.2.4
7R	Yes	Unlisted	None	No	Yes	NA	**No**	See A323.2 and A323.2.4
8R	Yes	Unlisted	None	No	Yes	NA	**No**	See A323.2 and A323.2.4
7N	Yes	Unlisted	None	No	Yes	NA	**No**	See A323.2 and A323.2.4
8N	Yes	Unlisted	None	No	Yes	NA	**No**	See A323.2 and A323.2.4

Swagelok Flex Hose Series	ASME B31.3 Piping Component?	ASME B31.3-2010 Component Standard	Manufacturer Ratings Based on Code	Burst Pressure and Pressure Ratings as a Function of Temperature	Single Burst Test	No Burst Test	LANL-Wide Approval?	Additional Requirements
7P	Yes	ASTM D2737	None	No	Yes	NA	**No**	See A323.2 and A323.2.4
PB	Yes	Unlisted	None	Yes	NA	NA	**No**	See A323.2 and A323.2.4

Some Consensus Standards on Flex Hoses (guidance)

88.	Order	**ASTM F423** Superseded by: NO REPLACEMENT Details | History	Withdrawn	1995.09.10	Standard Specification for Polytetrafluoroethylene (PTFE) Plastic-Lined Ferrous Metal Pipe, Fittings, and Flanges	Favorites (Add) Watch List (Add
27.	Order	**ASTM F781** Superseded by: NO REPLACEMENT **Details | History**	Withdrawn	1995.01.01	Standard Specification for Perfluoro (Alkoxyalkane) Copolymer (PFA) Plastic-Lined Ferrous Metal Pipe and Fittings	Favorites (Add) Watch List (Add)
6.	Order	**BSI BS 6501-1** **Partially superseded by: BSI BS EN ISO 10380** **Details | History**	Active	2004.02.19 (R 2009)	Metal hose assemblies - Part 1: Guidance on the construction and use of corrugated hose assemblies	Favorites (Add) Watch List (Add)

ASME Boiler and Pressure Vessel Code Application

RECORD OF REVISIONS

Rev	Date	Description	POC	RM
0	11/09/18	Initial issue.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*

Contact the Standards POC for upkeep, interpretation, and variance issues.

Chapter 17	Pressure Safety POC and Committee

This document is online at http://engstandards.lanl.gov

This attachment contains paraphrased code and regulation scope summaries with discussion of how these mandates shall be applied at LANL. They are based on the 2015 edition of the code.

Note: The B&PVC is a mandate for new construction only; repairs and alterations are governed by the NBIC (NB-23, which may reference ASME B&PVC); see Section ASME Attachment ASME-2.

Attachment ASME-5 – B&PVC Application

ASME Boiler and Pressure Vessel Code (BPVC) ASME's BPVC document establishes rules of safety relating only to pressure integrity—governing the design, fabrication, and inspection of boilers and pressure vessels, and nuclear power plant components during construction. The objective of the rules is to provide a margin for deterioration in service. The Code Cases clarify the existing requirements or provide, when the need is urgent, rules for materials or constructions not covered by existing BPVC rules.
ASME BPVC.I, Section I—Rules for Construction of Power Boilers This section provides requirements for all methods of construction of power, electric, and miniature boilers; high temperature water boilers, heat recovery steam generators, and certain fired pressure vessels to be used in stationary service; and power boilers used in locomotive, portable, and traction service. Rules pertaining to use of the V, A, M, PP, S and E ASME Product Certification Marks are also included. The rules are applicable to boilers in which steam or other vapor is generated at a pressures exceeding 15 psig, and high temperature water boilers intended for operation at pressures exceeding 160 psig and/or temperatures exceeding 250 degree F. Super heaters, economizers, and other pressure parts connected directly to the boiler without intervening valves are considered as part of the scope of Section I.
ASME BPVC.II.A, Section II—Materials, Part A—Ferrous Material Specifications (beginning to SA–450) This section is a ''service section'' to the other BPVC sections, providing material specifications for ferrous materials adequate for safety in the field of pressure equipment. These specifications contain requirements for chemical and mechanical properties, heat treatment, manufacture, heat and product analyses, and methods of testing. They are designated by SA numbers and are identical with or similar to those of specifications published by ASTM International and other recognized national or international organizations.
ASME BPVC.II.A, Section II—Materials, Part A—Ferrous Material Specifications (SA–451 to end) This section is a ''service section'' to the other BPVC sections providing material specifications for ferrous materials adequate for safety in the field of pressure equipment. These specifications contain requirements for chemical and mechanical properties, heat treatment, manufacture, heat and product analyses, and methods of testing. They are designated by SA numbers and are identical with or similar to those of specifications published by ASTM and other recognized national or international organizations
ASME BPVC.II.B, *Section II—Materials, Part B—Nonferrous Material Specifications* This section is a ''service section'' to the other BPVC sections, providing material specifications for ferrous materials adequate for safety in the field of pressure equipment. These specifications contain requirements for chemical and mechanical properties, heat treatment, manufacture, heat and product analyses, and methods of testing. They are designated by SB numbers and are identical with or similar to those of specifications published by ASTM and other recognized national or international organizations.
ASME BPVC.II.C, *Section II—Materials, Part C—Specification for Welding Rods, Electrodes, and Filler Metals* This section is a ''service section'' to the other BPVC sections providing material specifications for the manufacture, acceptability, chemical composition, mechanical usability, surfacing, testing requirements and procedures, operating characteristics, and intended uses for welding rods, electrodes and filler metals. These specifications are designated by SFA numbers and are derived from AWS specifications.

Attachment ASME-5 – B&PVC Application

ASME BPVC.II.D.C, Section II—Materials, Part D—Properties (Customary)

This section is a ‘‘service section’’ for reference by the BPVC construction sections providing tables of material properties including allowable, design, tensile and yield stress values, physical properties and external pressure charts and tables. Part D facilitates ready identification of materials to specific Sections of the BPVC. Part D contains appendices which contain criteria for establishing allowable stress, the bases for establishing external pressure charts, and information required for approval of new materials.

ASME BPVC.II.D.M, Section II—Materials, Part —Properties (Metric)

Same as “Customary” above, but metric.

ASME BPVC.III.A, Section III— Rules for Construction of Nuclear Facility Components, Appendices.

LANL does not apply this section because there are no known systems that are within the scope of the code.

ASME BPVC.IV, Section IV, Rules for Construction of Heating Boilers

This section provides requirements for design, fabrication, installation and inspection of steam heating, hot water heating, hot water supply boilers, and potable water heaters intended for low pressure service that are directly fired by oil, gas, electricity, coal or other solid or liquid fuels. It contains appendices which cover approval of new material, methods of checking safety valve and safety relief valve capacity, examples of methods of checking safety valve and safety relief valve capacity, examples of methods of calculation and computation, definitions relating to boiler design and welding, and quality control systems. Rules pertaining to use of the H, HV, and HLW ASME Product Certification Marks are also included.

ASME BPVC.V, Section V, Nondestructive Examination

This section contains requirements and methods for nondestructive examination which are referenced and required by other BPVC sections. It also includes manufacturer’s examination responsibilities, duties of authorized inspectors and requirements for qualification of personnel, inspection and examination. Examination methods are intended to detect surface and internal discontinuities in materials, welds, and fabricated parts and components. A glossary of related terms is included.

ASME BPVC.VI, Section VI, Recommended Rules for the Care and Operation of Heating Boilers

This section covers general descriptions, terminology, and operation guidelines applicable to steel and cast iron boilers limited to the operating ranges of Section IV Heating Boilers. It includes guidelines for associated controls and automatic fuel burning equipment. Illustrations show typical examples of available equipment. Also included is a glossary of terms commonly associated with boilers, controls, and fuel-burning equipment.

ASME BPVC.VII, Section VII, Recommended Guidelines for the Care of Power Boilers

The purpose of these recommended guidelines is to promote safety in the use of power boilers. The term ‘‘power boiler’’ in this section includes stationary, portable, and traction type boilers, but does not include locomotive and high temperature water boilers, nuclear power plant boilers, heating boilers, pressure vessels, or marine boilers. This section provides such guidelines to assist those directly responsible for operating, maintaining, and inspecting power boilers. Emphasis has been placed on industrial type boilers because of their extensive use. Guidelines are also provided for operation of auxiliary equipment and appliances that affect the safe and reliable operation of power boilers.

ASME BPVC.VIII.1, Section VIII—Rules for Construction of Pressure Vessels, Division 1

This division provides requirements applicable to the design, fabrication, inspection, testing, and certification of pressure vessels operating at either internal or external pressures exceeding 15 psig. Such pressure vessels may be fired or unfired. Specific requirements apply to several classes of material used in pressure vessel construction, and also to fabrication methods such as welding, forging and brazing. It contains mandatory and non-mandatory appendices detailing supplementary design criteria, nondestructive examination and inspection acceptance standards. Rules pertaining to the use of the U, UM and UV ASME Product Certification Marks are also included.

ASME BPVC.VIII.2, *Section VIII—Rules for Construction of Pressure Vessels, Division 2, Alternative Rules*

This division provides requirements applicable to the design, fabrication, inspection, testing, and certification of pressure vessels operating at either internal or external pressures exceeding 15 psig. Such vessels may be fired or unfired. This pressure may be obtained from an external source or by the application of heat from a direct or indirect source, or any combination thereof. These rules provide an alternative to the minimum requirements for pressure vessels under Division 1 rules. In comparison the Division 1, Division 2 requirements on materials, design, and nondestructive examination are more rigorous; however, higher design stress intensify values are permitted. Division 2 rules cover only vessels to be installed in a fixed location for a specific service where operation and maintenance control is retained during the useful life of the vessel by the user who prepares or causes to be prepared the design specifications. These rules may also apply to human occupancy pressure vessels typically in the diving industry. Rules pertaining to the use of the U2 and UV ASME Product Certification Marks are also included.

ASME BPVC.VIII.3, *Section VIII—Rules for Construction of Pressure Vessels, Division 3, Alternative Rules for Construction of High Pressure Vessels*

This division provides requirements applicable to the design, fabrication, inspection, testing, and certification of pressure vessels operating at either internal or external pressures generally above 10,000 psi. Such vessels may be fired or unfired. This pressure may be obtained from an external source, a process reaction, by the application of heat from a direct or indirect source, or any combination thereof. Division 3 rules cover vessels intended for a specific service and installed in a fixed location or relocated from work site to work site between pressurizations. The operation and maintenance control is retained during the useful life of the vessel by the user who prepares or causes to be prepared the design specifications. Division 3 does not establish maximum pressure limits for either Section VIII, Divisions 1 or 2, nor minimum pressure limits for this Division. Rules pertaining to the use of the UV3 ASME Product Certification Marks are also included.

ASME BPVC.IX, *Section IX— Welding, Brazing and Fusing Qualifications, Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators*

This section contains rules relating to the qualification of welding, brazing, and fusing procedures as required by other BPVC Sections for component manufacture. It also covers rules relating to the qualification and requalification of welders, brazers, and welding, brazing and fusing machine operators in order that they may perform welding, brazing, or plastic fusing as required by other BPVC Sections in the manufacture of components. Welding, brazing, and fusing data cover essential and nonessential variables specific to the joining process used.

ASME BPVC.X, *Section X, Fiber-Reinforced Plastic Pressure Vessels*

This section provides requirements for construction of an FRP pressure vessel in conformance with a manufacturer's design report. It includes production, processing, fabrication, inspection and testing methods required for the vessel. Section X includes three Classes of vessel design; Class I and Class III—qualification through the destructive test of a prototype and Class II—mandatory design rules and acceptance testing by nondestructive methods. These vessels are not permitted to store, handle or process lethal fluids. Vessel fabrication is limited to the following processes: bag molding, centrifugal casting and filament-winding and contact molding. General specifications for the glass and resin materials and minimum physical properties for the composite materials are given.

ASME BPVC.XI, *Section XI, Rules for Inservice Inspection of Nuclear Power Plant Components.* LANL does not apply this code because there are no know systems that are within the scope of the code.

ASME BPVC.XII, *Section XII, Rules for Construction and Continued Service of Transport Tanks*

This section covers requirements for construction and continued service of pressure vessels for the transportation of dangerous goods via highway, rail, air or water at pressures from full vacuum to 3,000 psig and volumes greater than 120 gallons. ‘‘Construction’’ is an all-inclusive term comprising materials, design, fabrication, examination, inspection, testing, certification, and over-pressure protection. ‘‘Continued service’’ is an all-inclusive term referring to inspection, testing, repair, alteration, and recertification of a transport tank that has been in service. This section contains modal appendices containing requirements for vessels used in specific transport modes and service applications. Rules pertaining to the use of the T ASME Product Certification Marks are included.

ASME BPVC.CC.BPV, *Code Cases, Boilers and Pressure Vessels*

This section provides the approved actions by the BPVC Committee on alternatives intended to allow early and urgent implementation of any revised requirements for boilers and pressure vessels.

ASME BPVC.CC.NC, *Code Cases, Nuclear Components.*

LANL does not apply this code because there are no known systems that are within the scope of the code.

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RECORD OF REVISIONS

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0	9/17/2014	Initial issue. Some material an update of Section I, Rev. 3 articles 14, 15, etc.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*

Contact the Standards POC for upkeep, interpretation, and variance issues.

Chapter 17	**Pressure Safety POC and Committee**

This document is online at http://engstandards.lanl.gov

Note: This document is not to be used for new pressure systems that include boilers, pressure vessels, air receivers, or supporting piping (see Chapter 17 Section ASME), nor DOT, OSHA, etc. (see Section GEN).

Note: Piping that does not meet an attached equivalency evaluation must meet all Section ASME requirements (including but not limited to B31.3, B31.9, etc.)

1.0 NEW FABRICATION

A. Piping that is not part of a "supporting piping system" but is within the scope of B31.3 or B31.9 may apply the applicable, approved equivalency evaluations in the Attachments (*e.g., NASME-1, NASME -2*)

B. In order to be eligible for the attached equivalencies, the piping system cannot have a boiler, pressure vessel, or air receiver as part of the pressure system or be part of the supporting piping system.

From ESM Ch 17 Section GEN Attachment GEN-1 Definitions and Acronyms:

"Supporting piping systems" shall be considered any and or all the piping necessary for the function of the process or system for all pressure vessels, boilers, and air receivers. Piping that is attached in excess of that required for the process or system operation is not "supporting piping." For LANL, the system boundaries are defined by ESM Chapter 1, Section 220, and Chapter 1, Section 210, Attachment A. In practical applications to separate "supporting piping" from non-supporting piping, a unique pressure safety system identification number in accordance with ESM Chapter 17 will be used to identify piping that is considered to be non-supporting piping. All pressure systems are required to meet the requirements of ESM Chapter 17.

2.0 DOT, IM, AND UM PORTABLE TANKS

A. Special Instructions for DOT-4L Cylinders[1]

WARNING: A cylinder used for CO_2 service must remain CO_2 service and must not be used for other gas products, especially oxygen or nitrous oxide.

1. Follow the manufacturer's instructions for service and maintenance
2. Excessive loss of product or excessive build-up of pressure is an indication of possible loss of vacuum in the vacuum jacket. Follow the manufacturer's instructions for troubleshooting.
3. If frost spots appear in a non-uniform manner, or are in miscellaneous areas the cylinder may have internal damage and will need to be removed from service until repaired (call cylinder manufacturer for details.)
4. Relief devices must be maintained as defined in this document
5. Where manufacturer recommends checking the set point of relief devices in place, the method must be performed as defined in this document.
6. Solidified contents in cylinders (CO_2) must be re-liquefied per the manufacturer's instructions.

B. Inspection Frequencies

1. Records of DOT, IM, and UM vessel inspection and certification reports must be made available upon request.
2. Owners of DOT, IM, and UM vessels must maintain their DOT vessels certified within the inspection interval frequency.

[1] Chart Industries, Inc., "Liquid Cylinder" Users Manual P/N 10642912 Date:12/00

3. DOT, IM, or UM vessels that are not permanently installed in a pressure system must comply with the retest frequencies in CFR Title 49, 180.209. The following table displays the inspection frequencies and retest pressure for cylinders, but does not contain all the requirements of the CFR. The system owner is advised to carefully review the applicable sections.

Table 14-1 Cylinder Inspection Frequencies and Retest Pressures

Specification under which cylinder was made	Minimum retest pressure (psig)	Retest period (years)
DOT-3	3000 psig	5
DOT-3A, 3AA	5/3 times service pressure, except non-corrosive service *	5, 10, or 12 *
DOT-3AL	5/3 times service pressure	5 or 12 *
DOT-3AX, 3AAX	5/3 times service pressure	5
3B, 3BN	2 times service pressure	5 or 10 *
3C	Retest not required	Retest not required
3D	5/3 times service pressure	5
3E	Retest Not Required	Retest not required
3HT	5/3 times service pressure	3 *
3T	5/3 times service pressure	5
4	700 psig	10
4A	5/3 Times service pressure *	5 or 10 *
4AA480	2 times service pressure	5 or 10 *
4B, 4BA, 4BW, 4B-240ET	2 times service pressure except non-corrosive*	5, 10, or 12 *
4C	Retest not required	Retest not required
4D, 4DA, 4DS	2 times service pressure	5
DOT-4E	2 times service pressure except non-corrosive*	5
4L	Retest not required	Retest not required
8, 8AL	-	10 or 20*
DOT-9	400 psig (maximum 600)	5
25	500 psig	5
26 (for filling over 450 psig)	5/3 times service pressure	5
26 (for filling at 450 psig)	2 times service pressure	5
33	800 psig	5
38	500 psig	5
Special Permit Cylinder	See current special permit.	See current special permit
Foreign Cylinder (see CFR Title 49 section 173.301(j) for restrictions on use).	As marked on the cylinder, but not less than 5/3 of any service or working pressure marking.	5
*See CFR Title 49 Section 173.34(e) for specific instructions for types of vessels.		

4. The following table displays the NBIC inspection frequencies for DOT, IM, and UM portable tanks and vessels. Portable vessels must be maintained within their inspection due dates.[2]

Table 14-2 Portable Tank and Vessel Inspection Frequencies (DOT, IM, and UM)

Specification	Periodic Inspection and Test	Intermediate Periodic Inspection and Test
UM or UN Portable Tanks once placed in service	5 years	2-1/2 years
DOT 51 Portable Tanks	5 years	-
DOT 56 or DOT 57 Portable Tanks (the first periodic inspection and test is required 4 years after being placed into service and each 2-1/2 years thereafter.)	2-1/2 years	-
DOT 60 Portable Tanks (the first periodic inspection and test is required 4 years after being placed into service and the per the schedule to the right)	For the first 12 years of service, every 2 years.	After 12 years of service, yearly.
Retesting is not required on a rubber lined tank, except before relining. For IM and UN Portable Tanks, periodic inspection and test must include at least an internal and external of the portable tank and fittings, taking into account the hazardous material intended to be transported.		

3.0 MOBILE PRESSURE SYSTEMS AND TRANSPORT TANKS

A. Definitions

1. LANL-owned mobile pressure vessels and tanks [Category 406 (4 psi)] are subject to the requirements of this document. These systems and vessels include, but are not limited, to the following:

   a. ASME Section XII vessels

   b. Portable tanks for transporting cryogenic fluids (greater than 120 gallons), not part of a Road-Tank vehicle.

   c. Rail Tanks

   d. Cargo Tanks – Intended primarily for the carriage of liquids or gases and includes appurtenances, reinforcements, fittings, and closures. Is permanently attached to or forms a part of a motor vehicle, or is not permanently attached to a motor vehicle but which by reason of its size, construction, or attachment to a motor vehicle is loaded or unloaded without being removed from the motor vehicle. Is not fabricated under a specification for cylinders, portable tanks, tank cars, or multi-unit tank car tanks.

2. Pressure vessel designs within the scope of Section XII are as follows:

   a. Full vacuum to 3000 psig

[2] NBIC Part-2 Table S6.14, Inspection Intervals

b. Temperature range is between -452°F to 650°F

c. Thickness of shells and heads does not exceed 1.5 inches.

B. Procurement

1. Transport tanks must be procured with the ASME (T) stamp symbol.

2. Mobile pressure systems and transport tanks that do not bear the ASME stamp symbol must be evaluated as equivalent through engineering calculations.

C. Pressure Relief Devices

1. Must comply with the tolerances and capacities as defined by ASME Section VIII, and must be installed as defined in ASME Section XII, paragraph TR-130.

2. Must be code stamped relief devices (UV) or (UD). ASME Section VIII stamped components are authorized to be used on (U) stamped vessels provided the requirements of Section XII are met as defined in ASME Section XII, Article TG-120.2.

3. Must comply with the re-test/replace intervals, as specified in this Chapter.

D. Piping, Valves, and Fittings

1. Each connection must be clearly labeled to indicate its function

2. Piping, valves and fittings must be grouped and protected from damage.

3. Must comply with ASME B31.3 as defined by ASME Section XII.

E. Pressure System Documentation Package Required Initial Contents

1. The manufacturer's data report (T-1A, B, or C) and/or partial data report.

2. Relief valve calculations, recall date, and set pressure.

F. Repairs and Alterations

1. Must be performed by an institution holding the (TR) stamp, in accordance with NBIC/NB-23, and as defined in ASME Section XII Part TP.

2. Must be documented and maintained in the pressure system documentation package.

G. Tests and Inspections

1. Testing and inspection must be performed as defined in ASME Section XII, Articles TP-4 and TP-5.

2. Records of inspections must be maintained in the pressure system documentation package as defined in ASME Section XII, Article TP-6.

4.0 ATTACHMENTS

NASME-1	B31.3 Equivalent Safety Evaluations:
NASME-1-A	Category D Non-Metallic Requirements for Piping Not Associated with Pressure Vessel, Boilers, or Air Receivers
NASME-1-B	Category Normal Non-Metallic Requirements for Piping Not Associated with Pressure Vessel, Boilers, or Air Receivers
NASME-1-C	Normal Fluid Service Requirements for Metallic Piping Not Associated with Pressure Vessel, Boilers, or Air Receivers

NASME-1-D	Category D Requirements for Metallic Piping not Associated with Pressure Vessel, Boilers, or Air Receivers
NASME-2	B31.9 Equivalent Safety Evaluations (future)

Attachment NASME-1-A: Equivalent Safety Evaluation for Category D Non-Metallic Requirements for Piping not Associated with Pressure Vessel, Boilers, or Air Receivers (B31.3-2010, 2012, and 2014)

RECORD OF REVISION

Rev	Date	Description	POC	RM
0	9/17/14	Initial issue.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*
1	6/30/15	A342 changed to use B31.3 paragraph as written. A345 added requirement based on ASME interpretation. Updates for B31.3-2014.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*

Contact the Standards POC for upkeep, interpretation, and variance issues.

Chapter 17	**Pressure Safety POC and Committee**

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This evaluation of risk is per Chapter 17, Section EXIST-1 (Qualitative Risk greater than 3)

1. Applicable for B31.3 piping not including a pressure vessel, boiler, air receiver, or supporting piping.
2. Applicable only for NON - metallic piping systems.
3. This evaluation is for new pressure systems that allow workers to be in close proximity without additional shielding while the system is pressurized.
4. For severely cyclic system see specific code requirements.
5. A list of reputable manufacturers will be maintained by Engineering Services.
6. The “Equivalent Risk Evaluation” in the table below or the original paragraph in B31.3 may be followed. The equivalency is intended to provide an equivalent level of personnel safety to B31.3, not code compliance.
7. Applies to ML-4 only.

Paragraph	**Category D Fluid Service Non Metallic Equivalency Evaluation (Within the allowance of notes above this table)**
Title: Scope and Definitions	
A300 General Statements (b) Responsibilities	System Owner designs system, but must be approved by PSO B for safety check. Training will be developed for System Owners to perform pressure system designs. In the interim until the training is developed and implemented, system owners with PSO assistance and concurrence may serve as designers. PSO Duty Area B may perform the role as Owner's Inspector.
300.1.3 Exclusions	Pressure systems will be inventoried with a system identification tag as defined in Section ADMIN-1. Those pressure systems that are excluded from B31.3 scope shall be declared Section GEN Att GEN-2 as follows: B31.3 excludes pressure systems if less than 15 psig, nonflammable, nontoxic, and not damaging to human tissues with a design temperature from −29°C (−20°F) through 186°C (366°F) B31 series does not apply. LANL pressure systems where the supply pressure is greater than 15 psig but have a relief device proven adequate to protect the system from over pressurization by calculation or flow testing to less than 15 psig, and is nonflammable, nontoxic, and not damaging to human tissues with a design temperature from −29°C (−20°F) through 186°C (366°F) are excluded. In order to maintain the LANL pressure system inventory a system identification tag shall be applied in accordance with ESM Chapter 17, Section 8.0, *System Identification Tag*, with the word Exempt on the tag. The regulator and relief device must be close coupled with no intervening stop valves and identified in accordance with ESM Chapter 17 requirements. A copy of a simplified system sketch and the documentation showing the system is adequately protected against overpressure shall be maintained as records, and must be managed per LANL P 1020, P 1020-1, and P 1020-2. Relief device retest frequency is a 5 year interval.
300.2 Definitions	This table is **not** applicable to for Category M Fluid Service, Elevated Temperature Fluid Service, High Pressure Fluid Service, or High Purity Fluid Service (reference Section II Attachment II-3 for Category M fluids; contact the CPSO for other fluids not listed) Flammability limits are per Compressed Gas Association (CGA) P-23 (NFPA 55) Determination of flammability limit is per American Society for Testing and Materials (ASTM) E681-85, *Standard Test Method for Concentration Limits of Flammability of Chemicals*,

Title: Design	
A301.1 Qualifications of the Designer	See above 300 General Statements (b) Responsibilities
A301.2.2 Required Pressure Containment or Relief	As written for Category D Fluid Service., but using manufacturers' published rating for design pressure. Or protect personnel using other controls; engineering, administrative, and/or PPE as approved by the PSO as per ASME B&PVC Section VIII Div. 1 UG-140 "OVERPRESSURE PROTECTION BY SYSTEM DESIGN "
A301.3 Design Temperature	This paragraph does not apply if the pressure system is in a relatively constant temperature environment (+/- 10 F) and the temperature is less than 120 F (50C) (note this is to ensure there is no effect from thermal linear change).
A301.3.1 Design Minimum Temperature	Lowest allowable minimum design temperature is -20 F (-29 C).
A301.4 Ambient Effects	Does not apply if the pressure system is in a relatively constant temperature environment (+/- 10 F) and ambient temperature is less than 120 degree F.
A301.5 Dynamic Effects	Impact, wind, earthquake, vibration, discharge reactions are required to be evaluated and discounted or applied.
A301.6 Weight Effects	Live and dead loads are required to be evaluated and discounted or applied.
A301.7 Thermal Expansion and Contraction Effects	Normally does not apply to pressure system is in a relatively constant temperature environment (+/- 10 F) and the temperature is less than 120 F (50C) (note this is to ensure there is no effect from thermal linear change) Applies to pressure systems with appreciable thermal expansion or phase change induced volumetric expansion (increases of specific volume).
A301.8 Effects of Support, Anchor, and Terminal Movements	Restraints do not apply for whip hazard.
A301.9 Reduced Ductility Effects	Not applicable
302 Design Criteria	Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.
A302.2.1 Listed Components Having Established Ratings	Listed items are recommended, but manufacturer's published ratings are acceptable.

A302.2.2 Listed Components Not Having Specific Ratings	Use reputable manufacturers' published ratings. A reputable manufacturers' listing will be maintain by Engineering Services. Note: Institutional Evaluated Suppliers List (IESL) is not necessarily a listing of reputable manufacturers.
A302.2.3 Unlisted Components	Use reputable manufacturers' published ratings. A reputable manufacturers' listing will be maintain on the Engineering Services.
A302.3 Allowable Stresses and Other Stress Limits	Per design may consider other protective measures in order of precedence as follows: engineering controls (barriers, interlocks or controls), procedural controls (access control), and/or PPE.
A302.3.3 Limits of Calculated Stresses Due to Sustained Loads	Use B31.3 paragraph as written if applicable Note: It is recommended that external loads be supported independent from the piping system.
A302.3.4 Limits of Calculated Stresses Due to Occasional Loads	Use B31.3 paragraph as written if applicable
A302.4 Allowances	Fluid will be evaluated and determined to be compatible for the service life of the system with the materials of construction and manufacturer's recommendations.
A304 PRESSURE DESIGN OF COMPONENTS A304.1 Straight Pipe	If LANL is designing or having a design made for a pressure component, the design shall comply with paragraph A304.1. The material shall meet A323.1 and must have a 3:1 factor of safety for materials not listed Table B1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.
A304.2 Curved and Mitered Segments of Pipe	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph A304.2 The material shall meet A323.1 and must have a 3:1 factor of safety for materials not listed Table B1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.
A304.3 Branch Connections	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph A304.3 The material shall meet A323.1 and must have a 3:1 factor of safety for materials not listed Table B1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.

A304.4 Closures	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph A304.4 The material shall meet A323.1 and must have a 3:1 factor of safety for materials not listed Table B1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.
304.5 Pressure Design of Nonmetallic Flanges and Blanks	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph 304.5 The material shall meet 323.1 and must have a 3:1 factor of safety for materials not lised Table A1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.
A304.6 Reducers	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph A304.6 The material shall meet A323.1 and must have a 3:1 factor of safety for materials not listed Table B1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.
A304.7 Pressure Design of Other Components	Initial design consistent with the design criteria of ASME B31.3 shall be a hoop stress evaluation at the minimum wall thickness at the maximum part diameter (worst case hoop stress) showing the design meets or exceed the stress. Note use B31.3 allowable stress values with B31.3 equations. Substantiation of the above may be done by one of the 4 items below: Note: System design pressure may be used to evaluate the component as the design pressure 1) For a simple part that has no stress intensification factors (notches, threads, pits, cracks, etc..) the minimum calculated hoop stress shall be 4x the design pressure (MAWP) 2) Determine if the piping component was previously used in accordance with paragraph A304.7.2 (a) 3) Pressure test to 4x the design pressure (at maximum design temperature). 4) Perform Engineering Finite Analysis (FEA) in accordance with paragraph 304.7.2 (d).
A305 Pipe	Paragraph is required to be evaluated and discounted or applied

A306 FITTINGS, BENDS, MITERS, LAPS, AND BRANCH CONNECTIONS	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph A306. The material shall meet A323.1 and must have a 3:1 factor of safety for materials not listed Table A1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.
A307 VALVES AND SPECIALTY COMPONENTS	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph A307. The material shall meet A323.1 and must have a 3:1 factor of safety for materials not lised Table A1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.
A308 FLANGES, BLANKS, FLANGE FACINGS, AND GASKETS	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph A308. The material shall meet A323.1 and must have a 3:1 factor of safety for materials not listed Table A1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.
A309 BOLTING	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph A309. The material shall meet A323.1 and must have a 3:1 factor of safety for materials not listed Table A1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.
A310 GENERAL	Use B31.3 paragraph as written.
A311 Bonded Joints in Plastic	Welding or Brazing shall be done in accordance with ESM Chapter 13 *Welding, Joining, and NDE* [Non-destructive examinations (NDE)]. Note: Qualitative Risk evaluated per ESM Chapter 17 Att GEN-4 shall be controlled to QR number of 4 or higher per Table GEN-4-4, Qualitative Risk (QR) Determination Follow manufacturers' instructions for assembly of PVC solvent welded joints.
A311.2 Specific Requirements	Welding or Brazing shall be done in accordance with ESM Chapter 13 *Welding, Joining, and NDE*.

A312 Flanged Joints	Use B31.3 paragraph as written for Category D Fluid Service: “The designer should consult the manufacturer for ratings of flanged joints in nonmetallic piping and in piping lined with nonmetals.”
A313 Expanded Joints	Use B31.3 paragraph as written for Category D Fluid Service
A314 Threaded Joints	Use B31.3 paragraph as written for Category D Fluid Service
A315 Tubing Joint	Use B31.3 paragraph as written for Category D Fluid Service
A316 CAULKED JOINTS	Use B31.3 paragraph as written for Category D Fluid Service.
A318 Special Joints	As written for Category D Fluid Service, and evaluate in accordance with A304.7.2 in this table. NOTE: Gland here does not mean Swagelok gland fitting.
A319 Piping Flexibility	The design temperature is from −29°C (−20°F) through 186°C (366°F) Paragraph is required to be evaluated and discounted or applied When pressure systems are fabricated and used at relatively constant temperature conditions (+/- 10 F), and fluid temperature is also held within the same range this paragraph is satisfied.
A320 Analysis of Sustained Loads	Piping is not to be used to support equipment (not a piping component). Paragraph is required to be evaluated and discounted or applied. Piping supports may be in accordance with LANL Master Specification 22 0529 for all Category D Fluid Service pressures. If additional support is required see 321.
A321 Piping Supports	Use B31.3 paragraph as written in 321.1.2 “simple calculations and engineering judgment”
A322 SPECIFIC PIPING SYSTEMS	Use B31.3 paragraph as written.
A322 SPECIFIC PIPING SYSTEMS	Use B31.3 paragraph as written Pressure systems with vessels, air receivers or boilers require an ASME Stamped and approved relief device protecting the vessel, air receiver, or boiler. Existing piping relief devices may be used if they are stamped and the vessel cannot be pressurized through any other path or means. Piping relief is not required to be V stamped if no code stamped item (pressure vessel, boiler, or air receiver) is present.

<table>
<tr><th colspan="2">Title: Materials</th></tr>
<tr><td>A323 GENERAL REQUIREMENTS</td><td>Use listed materials for example:
<table>
<tr><td>Acrylonitrile-butadiene-styrene plastics</td><td>ABS</td></tr>
<tr><td>Chlorinated poly(vinyl chloride)</td><td>CPVC</td></tr>
<tr><td>Perfluoro (alkoxyalkane)</td><td>PFA</td></tr>
<tr><td>Polypropylene PP, Poly(vinyl chloride)</td><td>PVC</td></tr>
<tr><td>Poly (vinylidene chloride)</td><td>PVDC</td></tr>
<tr><td>Poly (vinylidene fluoride)</td><td>PVDF</td></tr>
<tr><td>Polytetrafluoroethylene</td><td>PTFE</td></tr>
</table>
Additional listed materials are in B31.3 Appendix B.
This evaluation does not apply to Test Articles.</td></tr>
<tr><td>A323.1.1 Listed Materials.</td><td>Use B31.3 paragraph as written.</td></tr>
<tr><td>A323.1.2 Unlisted Materials</td><td>Prior to using an unlisted material the chemistry, physical and mechanical properties, method and process of manufacture, heat treatment, and quality control must be known as required by A323.1.
Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer’s published ratings this paragraph does not apply. The Designer is cautioned that materials must be suitable for the application and must be evaluated in accordance with A323.1 if necessary to determine the suitability of the material.</td></tr>
<tr><td>A323.1.3 Unknown Materials</td><td>Don’t use unknown materials.</td></tr>
<tr><td>A323.1.4 Reclaimed Materials.</td><td>Use B31.3 paragraph as written.</td></tr>
<tr><td>A323.2 Temperature Limitations</td><td>Note: The minimum [−29°C (−20°F)] and maximum temperature as shown in the definition of Category D Fluid Service does not necessarily apply, and must be verified as required by A323.2</td></tr>
<tr><td>A323.2.1 Upper Temperature Limits, Listed Materials</td><td>Materials shall have test results or manufacturers supplied data at or above the highest expected service temperature.</td></tr>
</table>

A323.2.2 Lower Temperature Limits, Listed Materials	Materials shall have test results or manufacturers supplied data at or below the lowest expected service temperature.
A323.2.3 Temperature Limits, Unlisted Materials	Use B31.3 paragraph as written. To verify the temperature limits of the unlisted material meet the requirements of the design temperature. Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply. The Designer is cautioned that materials must be suitable for the temperature and must be evaluated in accordance with 323.2.3 if necessary to determine the suitability of the material.
A323.2.4 Verification of Serviceability	Use B31.3 paragraph as written.
A323.4 Fluid Service Requirements for Non-Metallic Materials	Use B31.3 paragraph as written.
A323.5 Deterioration of Materials in Service	Designer is required to design the pressure system for the service life of the system and consider material compatibility.
A325 MATERIALS — MISCELLANEOUS	Use B31.3 paragraph as written.
326 DIMENSIONS AND RATINGS OF COMPONENTS	Use components as defined in the code or use reputable manufacturers' published ratings. A reputable manufacturers' listing will be maintained on the Engineer Services website. Note: Institutional Evaluated Suppliers List (IESL) is not necessarily a listing of reputable manufacturers.
A326.1 Dimensional Requirements	Apply B31.3 paragraph as written (see A301.2.2)
A326.4 Abbreviations in Table A326.1 and Appendix B	Apply B31.3 paragraph as written
A327 GENERAL	Use B31.3 paragraph as written.
A328 BONDING OF PLASTICS	Not required for a low risk pressure system (ESM Chapter 17 Pressure Safety, Table E-3 Qualitative Risk (greater than 3))

A329 FABRICATION OF PIPING LINED WITH NONMETALS	Apply B31.3 paragraph as written (see A301.2.2), or as per the variance VAR-2013-060 B31.3 – 2010 & 2012 Category D Requirements
A332 BENDING AND FORMING	Apply B31.3 paragraph as written (see A301.2.2), or as per the variance VAR-2013-060 B31.3 – 2010 & 2012 Category D Requirements
A334 JOINING NONPLASTIC PIPING	Use B31.3 paragraph as written.
A335 ASSEMBLY AND ERECTION	Assemble in accordance with the manufacturer's requirements
A340 INSPECTION 340.1 General	Paragraph 340 applies in its entirety. PSO Duty Area B will be the Owner's Inspector Owner's Inspector will be knowledgeable with the pressure system of interest.
340.2 Responsibility for Inspection	Use B31.3 paragraph as written.
340.3 Rights of the Owner's Inspector	Use B31.3 paragraph as written.
340.4 Qualifications of the Owner's Inspector	See paragraph 300; PSO Duty Area B will act as the Owner's Inspector or equivalent.
A341 EXAMINATION	Use B31.3 paragraph as written.
A342 Examination Personnel	Use B31.3 paragraph as written.
A343 Examination Procedures	Use B31.3 paragraph as written.
A344 Types of Examination	Use B31.3 paragraph as written.

A345 TESTING	Precautions in Appendix F, para. FA323.4 Material Considerations — Nonmetals should be considered. Owner has elected to use Initial Service Leak Test for Category D Fluid Service (additional testing may be required by the Designer). Pneumatic leak testing is approved for all systems less than 2 cubic feet in volume. Additional volume must be approved by the CPSO. [1] See Exist – Legacy System Requirements (*3.B.1*) for vacuum rate of rise and inert gas referee test gas. See A345 for other requirements for example test pressures (A345.4.2), test limitations (A345.2.1), and other requirements for pneumatic testing (A345.5.2) Note: Be aware of the ramifications of using high molecular weight gases to test system for lower molecular weight gas. The engineering best practice is to use a lower or equal weight molecular weight gas as the referee test gas except for hydrogen where helium is accepted.
A346 RECORDS	Required information is as follows: • Sketch, • Component list (manufacturer, model number, pressure rating, FM07 information) • Calculation • Relief device/flow calc. • Examinations • Inspections Electronic copy loaded into a master site repository.

[1] EMRef-73 ASME Interpretation of Para. 345.5.5 Pneumatic Leak Test Procedure

NASME-1-B: Equivalent Safety Evaluation for Category Normal Non-Metallic Requirements for Piping not Associated with Pressure Vessel, Boilers, or Air Receivers

(B31.3-2010, 2012, and 2014)

RECORD OF REVISIONS

Rev	Date	Description	POC	RM
0	9/17/14	Initial issue.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*
1	6/30/15	A342 changed to use B31.3 paragraph as written. A345 added requirement based on ASME interpretation. Updates for B31.3-2014.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*

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Chapter 17	**Pressure Safety POC and Committee**

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This evaluation of risk is per Chapter 17 Section EXIST-1 (Qualitative Risk greater than 3).

1. Applicable for B31.3 piping not including a pressure vessel, boiler, air receiver, or supporting piping.
2. This evaluation is for new pressure systems that allow workers to be in close proximity without additional shielding while the system is pressurized.
3. For severely cyclic system see specific code requirements.
4. Applicable only for NON - metallic piping systems.
5. A list of reputable manufacturers will be maintained by Engineering Services.
6. The “Equivalent Risk Evaluation” in the table below or the original paragraph in B31.3 may be followed. The equivalency is intended to provide an equivalent level of personnel safety to B31.3 not code compliance.
7. Applies to ML-4 only.

Paragraph	Normal Fluid Service Non Metallic Equivalency Evaluation (within the allowance of notes above this table)
Title: Scope and Definitions	
A300 GENERAL STATEMENTS (b) Responsibilities	System Owner designs system, but must be approved by PSO B for safety check. Training will be developed for System Owners to perform pressure system designs. In the interim until the training is developed and implemented, system owners with PSO assistance and concurrence may serve as designers. PSO Duty Area B may perform the role of Owner's Inspector.
300.1.3 Exclusions (referenced from A300 General Statements (f))	Pressure systems will be inventoried with a system identification tag as defined in ESM Chapter 17. Those pressure systems that are excluded from B31.3 scope shall be declared exempt as defined Section GEN-2 as follows: B31.3 excludes pressure systems if less than 15 psig, nonflammable, nontoxic, and not damaging to human tissues with a design temperature from −29°C (−20°F) through 186°C (366°F) B31 series does not apply. LANL pressure systems where the supply pressure is greater than 15 psig but have a relief device proven adequate to protect the system from over pressurization by calculation or flow testing to less than 15 psig, and is nonflammable, nontoxic, and not damaging to human tissues with a design temperature from −29°C (−20°F) through 186°C (366°F) are excluded. In order to maintain the LANL pressure system inventory a system identification tag shall be applied in accordance with ESM Chapter 17, Section ADMIN, *System Identification Tag*, with the word Exempt on the tag. The regulator and relief device must be close coupled with no intervening stop valves and identified in accordance with ESM Chapter 17 requirements. A copy of a simplified system sketch and the documentation showing the system is adequately protected against overpressure shall be maintained as records, and must be managed per LANL P 1020, P 1020-1, and P 1020-2. Relief device retest frequency is a 5-year interval.
300.2 Definitions (referenced from A300 General Statements (f))	This table is **not** applicable to for Category M Fluid Service, Elevated Temperature Fluid Service, High Pressure Fluid Service, or High Purity Fluid Service (reference Section II Attachment II-3 for Category M fluids , contact the CPSO for other fluids not listed)

	Flammability limits are per Compressed Gas Association (CGA) P-23 (NFPA 55) Determination of flammability limit is per American Society for Testing and Materials (ASTM) E681-85, *Standard Test Method for Concentration Limits of Flammability of Chemicals*,
Title: Design	
301.1 Qualifications of the Designer (referenced from A301)	See above 300 General Statements (b) Responsibilities
301.2.2 Required Pressure Containment or Relief (referenced from A302)	As written for Normal Fluid Service, but using manufacturers' published rating for design pressure. Or protect personnel using other controls; engineering, administrative, and/or PPE as approved by the PSO as per ASME B&PVC Section VIII Div. 1 UG-140 "OVERPRESSURE PROTECTION BY SYSTEM DESIGN"
A301.3 Design Temperature	This paragraph does not apply if the pressure system is in a relatively constant temperature environment (+/- 10 F) and the temperature is less than 120 F (50C) (note this is to ensure there is no effect from thermal linear change).
A301.3.1 Design Minimum Temperature	Minimum design temperature is a function of the material and the lower allowable temperatures in Table B-1. Note: Non-metallic materials exhibit a "glass transition temperature" where the material becomes hard and may be susceptible to brittle fracture.
301.4 Ambient Effects (referenced from A301)	Does not apply if the pressure system is in a relatively constant temperature environment (+/- 10 F) and ambient temperature is less than 120 degree F.
301.5 Dynamic Effects (referenced from A301)	Impact, wind, earthquake, vibration, discharge reactions are required to be evaluated and discounted or applied.
301.6 Weight Effects (referenced from A301)	Live and dead loads are required to be evaluated and discounted or applied.
301.7 Thermal Expansion and Contraction Effects (referenced from A301)	This paragraph normally does not apply to if the pressure system is in a relatively constant temperature environment (+/- 10 F) and the temperature is less than 120 F (50C) (note this is to ensure there is no effect from thermal linear change) Applies to pressure systems with appreciable thermal expansion or phase change induced volumetric expansion (increases of specific volume).
301.8 Effects of Support, Anchor, and Terminal Movements (referenced from A301)	This paragraph does not apply to restraints for whip hazard.

301.9 Reduced Ductility Effects (referenced from A301)	Not applicable
301.10 Cyclic Effects (referenced from A301)	Not applicable
301.11 Air Condensation Effects (referenced from A301)	Required to be evaluated and discounted or applied
A302 Design Criteria	Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.
A302.1 General	Required to be evaluated and discounted or applied
A302.2.1 Listed Components Having Established Ratings	Use listed component if available, but if none are available manufacturer's ratings are acceptable for the service conditions temperature, pressure, compatibility, etc….
A302.2.2 Listed Components Not Having Specific Ratings	First use reputable manufacturer's ratings for the service conditions (IESL, or add listing of example suppliers as attachment to web page.) If none are available establish a rating for the service conditions temperature, pressure, compatibility, etc… as approved by the PSO. NOTE: Institutional Evaluated Suppliers List (IESL) is not necessarily a listing of reputable manufacturers
A302.2.3 Unlisted Components	First use reputable manufacturers ratings for the service conditions (IESL, or add listing of example suppliers as attachment to web page.) If none are available establish a rating for the service conditions temperature, pressure, compatibility, etc… as approved by the PSO.
A302.2.4	Required to be evaluated and discounted or applied
A302.2.5	Apply paragraph as written
A302.3 Allowable Stresses and Other Design Limits	Per design may consider other protective measures in order of precedence as follows: engineering controls (barriers, interlocks or controls), procedural controls (access control), and/or PPE.
A302.3.3 Limits of Calculated Stresses Due to Sustained Loads	Use B31.3 paragraph as written if applicable Note: It is recommended that external loads be supported independent from the piping system.
A302.3.4 Limits of Calculated Stresses Due to Occasional Loads	Use B31.3 paragraph as written if applicable
302.4 Allowances (referenced from A302.4)	Fluid will be evaluated and determined to be compatible for the service life of the system with the materials of construction and

	manufacturer's recommendations or allowances must be added in accordance with the paragraph.
Pressure Design of Piping Components A303 GENERAL	Use B31.3 paragraph as written
A304 PRESSURE DESIGN OF COMPONENTS A304.1 Straight Pipe	All LANL designs or designs for LANL shall comply with para A304. The material shall meet A323.1 and must have a 3:1 factor of safety for materials not listed Table B1 (unlisted material). (if using reputable manufacturer's published ratings this Part 2 does not apply) Or protect personnel using other controls; engineering, administrative, and/or PPE as approved by the PSO.
A304.2 Curved and Mitered Segments of Pipe	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph A304.2 The material shall meet A323.1 and must have a 3:1 factor of safety for materials not listed Table B1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.
A304.3 Branch Connections	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph A304.3 The material shall meet A323.1 and must have a 3:1 factor of safety for materials not listed Table B1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.
A304.3.1 General	Required to be evaluated and discounted or applied
A304.3.2 Branch Connections Using Fittings	Required to be evaluated and discounted or applied
A304.3.3 Additional Design Considerations	Required to be evaluated and discounted or applied
A304.4 Closures	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph A304.4 The material shall meet A323.1 and must have a 3:1 factor of safety for materials not listed Table B1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.
304.5 Pressure Design of Nonmetallic Flanges	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph 304.5 The material shall meet 323.1 and must have a 3:1 factor of safety for materials not listed Table A1 (unlisted material).

	Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.
A304.6 Reducers	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph A304.6 The material shall meet A323.1 and must have a 3:1 factor of safety for materials not listed Table B1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.
A304.7 Pressure Design of Other Components	Initial design consistent with the design criteria of ASME B31.3 shall be a hoop stress evaluation at the minimum wall thickness at the maximum part diameter (worst case hoop stress) showing the design meets or exceed the stress. Note use B31.3 allowable stress values with B31.3 equations. Substantiation of the above may be done by one of the 4 items below: Note: System design pressure may be used to evaluate the component as the design pressure 1) For a simple part that has no stress intensification factors (notches, threads, pits, cracks, etc..) the minimum calculated hoop stress shall be 4x the design pressure (MAWP) 2) Determine if the piping component was previously used in accordance with paragraph A304.7.2 (a) 3) Pressure test to 4x the design pressure (at maximum design temperature). 4) Perform Engineering Finite Analysis (FEA) in accordance with paragraph 304.7.2 (d).
A305 Pipe	Paragraph is required to be evaluated and discounted or applied
A306 FITTINGS, BENDS, MITERS, LAPS, AND BRANCH CONNECTIONS	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph A306. The material shall meet A323.1 and must have a 3:1 factor of safety for materials not listed Table A1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.
A307 VALVES AND SPECIALTY COMPONENTS	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph A307. The material shall meet A323.1 and must have a 3:1 factor of safety for materials not listed Table A1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.
A308 FLANGES, BLANKS, FLANGE FACINGS, AND	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph A308. The material shall

GASKETS	meet A323.1 and must have a 3:1 factor of safety for materials not listed Table A1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.
A309 BOLTING	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph A309. The material shall meet A323.1 and must have a 3:1 factor of safety for materials not listed Table A1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.
A310 GENERAL	Use B31.3 paragraph as written.
311 BONDED JOINTS IN PLASTICS	Welding shall be done in accordance with ESM Chapter 13 *Welding, Joining, and NDE* [Non-destructive examinations (NDE)]. Use B31.3 paragraph as written.
A312 FLANGED JOINTS	Use B31.3 paragraph as written for Normal Fluid Service: "The designer should consult the manufacturer for ratings of flanged joints in nonmetallic piping and in piping lined with nonmetals."
A313 EXPANDED JOINTS	Use B31.3 paragraph as written for Normal Fluid Service
A314 THREADED JOINTS	Use B31.3 paragraph as written for Normal Fluid Service
A315 TUBING JOINT	Use B31.3 paragraph as written for Normal Fluid Service.
A316 CAULKED JOINTS	Use B31.3 paragraph as written for Normal Fluid Service.
A318 SPECIAL JOINTS	As written for Normal Fluid Service, and evaluate in accordance with A304.7.2 in this table. NOTE: Gland here does not mean Swagelok gland fitting.
A319 FLEXIBILITY AND NONMETALLIC PIPING	Paragraph is required to be evaluated and discounted or applied When pressure systems are fabricated and used at relatively constant temperature conditions (+/- 10 F), and fluid temperature is also held within the same range this paragraph is satisfied.
A321 PIPING SUPPORTS	Use B31.3 paragraph as written and reference 321.1.2 "simple calculations and engineering judgment"
A322 SPECIFIC PIPING SYSTEMS	Use B31.3 paragraph as written Pressure systems with vessels, air receivers or boilers require an ASME Stamped and approved relief device protecting the vessel, air receiver, or boiler. Existing piping relief devices may be used if they are stamped and

	the vessel cannot be pressurized through any other path or means. Piping relief is not required to be V stamped if no code stamped item (pressure vessel, boiler, or air receiver) is present.

Title: Materials	
A323 GENERAL REQUIREMENTS	Use listed materials for example: Acrylonitrile-butadiene-styrene plastics — ABS Chlorinated poly(vinyl chloride) — CPVC Perfluoro (alkoxyalkane) — PFA Polypropylene PP, Poly(vinyl chloride) — PVC Poly(vinylidene chloride) — PVDC Poly(vinylidene fluoride) — PVDF Polytetrafluoroethylene — PTFE Additional listed materials are in B31.3 Appendix B. This evaluation does not apply to Test Articles.
323.1. Listed Materials.(referenced from A323.1 Materials and Specifications)	Use B31.3 paragraph as written.
323.1.2 Unlisted Materials (referenced from A323.1 Materials and Specifications)	Prior to using an unlisted material the chemistry, physical and mechanical properties, method and process of manufacture, heat treatment, and quality control must be known as required by 323.1.2 (referenced from A323.1). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply. The Designer is cautioned that materials must be suitable for the application and must be evaluated in accordance with A323.1 if necessary to determine the suitability of the material.
A323.1.3 Unknown Materials.(referenced from A323.1 Materials and Specifications)	Don't use unknown materials.
A323.1.4 Reclaimed Materials.	Use B31.3 paragraph as written.

A323.2 Temperature Limitations	Use B31.3 paragraph as written.
A323.2.1 Upper Temperature Limits, Listed Materials	Materials shall have test results or manufacturers supplied data at or above the highest expected design temperature.
A323.2.2 Lower Temperature Limits, Listed Materials	Materials shall have test results or manufacturers supplied data at or below the lowest expected design temperature. Note: Non-metallic materials exhibit a "glass transition temperature" where the material becomes hard and may be susceptible to brittle fracture.
A323.2.3 Temperature Limits, Unlisted Materials.	Use B31.3 paragraph as written. To verify the temperature limits of the unlisted material meet the requirements of the design temperature. Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply. The Designer is cautioned that materials must be suitable for the temperature and must be evaluated in accordance with 323.2.3 (referenced by A323.2.3) 3 if necessary to determine the suitability of the material.
A323.2.4 Verification of Serviceability	Use B31.3 paragraph as written.
A323.4 Fluid Service Requirements for Non-Metallic Materials 323.4.1 General	Use B31.3 paragraph as written.
A323.4.2 Specific Requirements	Use B31.3 paragraph as written.
A323.4.3 Piping Lined With Nonmetals	Use B31.3 paragraph as written.
A323.5 Deterioration of Materials in Service	Designer is required to design the pressure system for the service life of the system and consider material compatibility.
A325 MATERIALS MISCELLANEOUS	Use B31.3 paragraph as written.

Title: Standards for Piping Components	
326 DIMENSIONS AND RATINGS OF COMPONENTS	Use components as defined in the code or use reputable manufacturers' published ratings. A reputable manufacturers' listing will be maintained on the Engineer Services website. Note: Institutional Evaluated Suppliers List (IESL) is not necessarily a listing of reputable manufacturers.

A326.1 Dimensional Requirements	Apply B31.3 paragraph as written (see A301.2.2)
A326.4 Abbreviations in Table A326.1 and Appendix B	Apply B31.3 paragraph as written

Title: Fabrication, Assembly, and Erection	
A327 GENERAL	Use B31.3 paragraph as written.
A328 BONDING OF PLASTICS	Not required for a low risk pressure system (ESM Chapter 17, GEN-4, Qualitative Risk (greater than 3))
A329 FABRICATION OF PIPING LINED WITH NONMETALS	Apply B31.3 paragraph as written (see A301.2.2), or as per the variance VAR-2013-060 B31.3 – 2010 & 2012 Normal Requirements
A332 BENDING AND FORMING	Apply B31.3 paragraph as written (see A301.2.2), or as per the variance VAR-2013-060 B31.3 – 2010 & 2012 Normal Requirements
A334 JOINING NONPLASTIC PIPING	Use B31.3 paragraph as written.
A335 ASSEMBLY AND ERECTION	Assemble in accordance with the manufacturer's requirements

Title: Inspection, Examination, and Testing	
A340 INSPECTION	Paragraph A340 applies in its entirety. PSO Duty Area B will be the Owner's Inspector Owner's Inspector will be knowledgeable with the pressure system of interest.
340.2 Responsibility for Inspection (referenced by A340)	Use B31.3 paragraph as written.
340.3 Rights of the Owner's Inspector (referenced by A340)	Use B31.3 paragraph as written.
340.4 Qualifications of the Owner's Inspector (referenced by A340)	See paragraph 300; PSO Duty Area B will act as the Owner's Inspector or equivalent.
A341 EXAMINATION	Use B31.3 paragraph as written.
A342 EXAMINATION PERSONNEL	Use B31.3 paragraph as written.
A343 EXAMINATION PROCEDURES	Use B31.3 paragraph as written.

A344 TYPES OF EXAMINATION	Use B31.3 paragraph as written.
A345 TESTING	Precautions in Appendix F, para. FA323.4 Material Considerations — Nonmetals should be considered. The Owner accepts pneumatic or hydro-pneumatic leak testing with inert gas or air (additional testing may be required by the Designer). See Exist – Legacy System Requirements (*3.B.1*) for vacuum rate of rise and inert gas referee test gas. Pneumatic leak testing is approved for all systems less than 2 cubic feet in volume. Additional volume must be approved by the CPSO. [1] See A345 for other requirements for example test pressures (A345.4.2), test limitations (A345.2.1), and other requirements for pneumatic testing (A345.5.2) Note: Be aware of the ramifications of using high molecular weight gases to test system for lower molecular weight gas. The engineering best practice is to use a lower or equal weight molecular weight gas as the referee test gas except for hydrogen where helium is accepted.
A346 RECORDS	Required information is as follows: • Sketch, • Component list (manufacturer, model number, pressure rating, FM07 information) • Calculation • Relief device/flow calc. • Examinations • Inspections Electronic copy loaded into a master site repository.

[1] EMRef-73 ASME Interpretation of Para. 345.5.5 Pneumatic Leak Test Procedure.

NASME-1-C: Equivalency Evaluation to Normal Fluid Service for Metallic Piping Not Associated with Pressure Vessel, Boilers, or Air Receivers

(B31.3-2010, 2012, and 2014)

RECORD OF REVISION

Rev	Date	Description	POC	RM
0	9/17/14	Initial issue.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*
1	6/30/15	A342 changed to Use B31.3 paragraph as written. A345 change based on ASME interpretation. Updates for B31.3-2014.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*
2	8/24/15	Admin change to add missing "for ML-4 only."	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*

Contact the Standards POC for upkeep, interpretation, and variance issues.

Chapter 17	**Pressure Safety POC and Committee**

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This evaluation of risk is per Chapter 17, Section EXIST-1 (Qualitative Risk greater than 3).

1. Applicable for B31.3 piping not including a pressure vessel, boiler, air receiver, or supporting piping.
2. This evaluation is for new pressure systems that allow workers to be in close proximity without additional shielding while the system is pressurized.
3. For severely cyclic system see specific code requirements.
4. Applicable only for metallic piping systems.
5. For Elevated Temperature Fluid Service (temperature in creep range) see specific code requirements.
6. A list of reputable manufacturers will be maintained by Engineering Services
7. The "Equivalency Evaluation" in the table below or the original paragraph in B31.3 may be followed. The equivalency is intended to provide an equivalent level of personnel safety to B31.3, not code compliance.
8. Applies to ML-4 only.

B31.3 Paragraph	**Equivalency Evaluation (within the allowance of notes above this table)**
Title: Scope and Definitions	
300 GENERAL STATEMENTS (B) RESPONSIBILITIES	System Owner designs system, but must be approved by PSO B for safety check. Training will be developed for System Owners to perform pressure system designs. In the interim until the training is developed and implemented, system owners with PSO assistance and concurrence may serve as designers.) PSO Duty Area B may perform the role of Owner's Inspector.
300.1.3 Exclusions	Pressure systems will be inventoried with a system identification tag as defined in ESM Chapter 17. Those pressure systems that are excluded from B31.3 scope shall be declared exempt as defined in Section GEN as follows: B31.3 excludes pressure systems if less than 15 psig, nonflammable, nontoxic, and not damaging to human tissues with a design temperature from −29°C (−20°F) through 186°C (366°F) B31 series does not apply. LANL pressure systems where the supply pressure is greater than 15 psig but have a relief device proven adequate to protect the system from over pressurization by calculation or flow testing to less than 15 psig, and is non-flammable, nontoxic, and not damaging to human tissues with a design temperature from −29°C (−20°F) through 186°C (366°F) are excluded. In order to maintain the LANL pressure system inventory a system identification tag shall be applied in accordance with ESM Chapter 17, Section ADMIN, *System Identification Tag*, with the word Exempt on the tag. The regulator and relief device must be close coupled with no intervening stop valves and identified in accordance with ESM Chapter 17 requirements. A copy of a simplified system sketch and the documentation showing the system is adequately protected against overpressure shall be maintained as records, and must be managed per LANL PD 1020, P 1020-1, and P 1020-2. Relief device retest frequency is a 5 year interval.
300.2 Definitions	This table is **not** applicable to for Category D Fluid Service, Category M Fluid Service, Elevated Temperature Fluid Service, High Pressure Fluid Service, or High Purity Fluid Service (reference Chapter 17 Section II Attachment II-3 for Category M fluids; contact the CPSO for fluids not listed) Flammability limits are per Compressed Gas Association (CGA) P-23 (NFPA 55) Determination of flammability limit is per ASTM E681-85, *Standard Test Method for Concentration Limits of Flammability of Chemicals*.

Title: **Design**	
301.1 Qualifications of the Designer	See above 300 General Statements (b) Responsibilities
301.2.2 Required Pressure Containment or Relief	As written for Normal Fluid Service, but using manufacturers' published rating for design pressure. Or protect personnel using other controls; engineering, administrative, and/or PPE as approved by the PSO as per ASME B&PVC Section VIII Div. 1 UG-140 "OVERPRESSURE PROTECTION BY SYSTEM DESIGN "
301.3 Design Temperature	This paragraph does not apply if the pressure system is in a relatively constant temperature environment (+/- 10 F) and the temperature is less than 120 F (50C) (note: this is to ensure there is no effect from thermal linear change).
301.3.1 Design Minimum Temperature	Minimum design temperature is a function of the material and the lower allowable temperatures in Table A.
301.4 Ambient Effects	Does not apply if the pressure system is in a relatively constant temperature environment (+/- 10 F) and the temperature is less than 120 F (50C) (note this is to ensure there is no effect from thermal linear change).
301.5 Dynamic Effects	Impact, wind, earthquake, vibration, discharge reactions are required to be evaluated and discounted or applied.
301.6 Weight Effects	Live and dead loads are required to be evaluated and discounted or applied.
301.7 Thermal Expansion and Contraction Effects	Paragraph normally does not apply to pressure system is in a relatively constant temperature environment (+/- 10 F) and the temperature is less than 120 F (50C) (note this is to ensure there is no effect from thermal linear change) This paragraph applies to pressure systems with appreciable thermal expansion or phase change induced volumetric expansion (increases of specific volume).
301.8 Effects of Support, Anchor, and Terminal Movements	This paragraph does not apply to pressure system is in a relatively constant temperature environment (+/- 10 F) and the temperature is less than 120 F (50C) (note this is to ensure there is no effect from thermal linear change) This paragraph applies to pressure systems with appreciable thermal expansion or phase change induced volumetric expansion (increases of specific volume). Note: This paragraph does not apply for flex hoses restraints to reduce whip hazard
301.9 Reduced Ductility Effects	Paragraph is required to be evaluated and discounted or applied
302.2.1 Listed Components	Use listed component if available, but if none are available manufacturer's

Having Established Ratings	ratings are acceptable for the service conditions temperature, pressure, compatibility, etc…
302.2.2 Listed Components Not Having Specific Ratings	Use reputable manufacturers' published ratings. A reputable manufacturers' listing will be maintain by Engineering Services. Note: Institutional Evaluated Suppliers List (IESL) is not necessarily a listing of reputable manufacturers.
302.2.3 Unlisted Components	Use reputable manufacturers' published ratings. A reputable manufacturers' listing will be maintain on the Engineering Services.
302.3 Allowable Stresses and Other Stress Limits	Per design may consider other protective measures in order of precedence as follows: engineering controls (barriers, interlocks or controls), procedural controls (access control), and/or PPE.
302.3.3 Casting Quality Factor, Ec	Use B31.3 paragraph as written if applicable
302.3.4 Weld Joint Quality Factor, Ej	Use B31.3 paragraph as written if applicable
302.3.5 Limits of Calculated Stresses Due to Sustained Loads and Displacement Strains	Paragraph is required to be evaluated and discounted or applied If unlisted, use manufacturer's allowable stress ratings for the material. Note: If piping and piping elements (unions, couplings, etc...) are rated above the maximum design pressure for the Normal Service and is sufficiently supported (see paragraph 321 "Piping Supports"), and the other piping components that are in the pressure system are adequately supported this paragraph does not apply.
302.3.6 Limits of Calculated Stresses Due to Occasional Loads	Do not apply paragraph if application of ESM Chapter 17 Att GEN-4 Table GEN-4-4, *Qualitative Risk (QR) Determination*, bounding conditions shows low risk (less than 3) approved by the PSO or apply paragraph.
302.4 Allowances	Fluid will be evaluated and determined to be compatible for the service life of the system with the materials of construction and manufacturer's recommendations or allowances must be added in accordance with the paragraph.
304 PRESSURE DESIGN OF COMPONENTS 304.1 Straight Pipe	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph 304.1. The material shall meet 323.1 and must have a 3:1 factor of safety for materials not listed Table A1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.
304.2 Curved and Mitered Segments of Pipe	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph 304.2 The material shall meet 323.1 and must have a 3:1 factor of safety for materials not listed Table A1 (unlisted material).

	Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply. When the wall thickness is 1.5 times the minimum required by equation 3a no additional evaluation of Intrados or Extrados is required. or Use approved vendor tubing or pipe bender with their required pipe/tube to their published standard.
304.3 Branch Connections	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph 304.3 The material shall meet 323.1 and must have a 3:1 factor of safety for materials not listed Table A1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.
304.4 Closures	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph 304.4 The material shall meet 323.1 and must have a 3:1 factor of safety for materials not listed Table A1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.
304.5 Pressure Design of Flanges and Blanks	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph 304.5 The material shall meet 323.1 and must have a 3:1 factor of safety for materials not listed Table A1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.
304.6 Reducers	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph 304.6 The material shall meet 323.1 and must have a 3:1 factor of safety for materials not listed Table A1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.
304.7 Pressure Design of Other Components	Initial design consistent with the design criteria of ASME B31.3 shall be a hoop stress evaluation at the minimum wall thickness at the maximum part diameter (worst case hoop stress) showing the design meets or exceed the stress. Note: Use 31.3 material allowable stress values with B31.3 equations. Substantiation of the above may be done by one of the 4 items below: 1) For a simple part that has no stress intensification factors (notches, threads, pits, cracks, etc...) the minimum calculated

	hoop stress shall be 4x the design pressure (MAWP) 2) Determine if the piping component was previously used in accordance with paragraph 304.7.2 (a) 3) Pressure test to 4x the design pressure. 4) Perform Engineering Finite Analysis (FEA) in accordance with paragraph 304.7.2 (d)
305 PIPE	Paragraph is required to be evaluated and discounted or applied.
306 FITTINGS, BENDS, MITERS, LAPS, AND BRANCH CONNECTIONS	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph 306. The material shall meet 323.1 and must have a 3:1 factor of safety for materials not listed Table A1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.
307 VALVES AND SPECIALTY COMPONENTS	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph 307. The material shall meet 323.1 and must have a 3:1 factor of safety for materials not listed Table A1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.
308 FLANGES, BLANKS, FLANGE FACINGS, AND GASKETS	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph 308. The material shall meet 323.1 and must have a 3:1 factor of safety for materials not listed Table A1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.
309 BOLTING	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph 309. The material shall meet 323.1 and must have a 3:1 factor of safety for materials not listed Table A1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.
310 GENERAL	Use B31.3 paragraph as written.
311 WELDED JOINTS	Welding and brazing shall be done in accordance with ESM Chapter 13 *Welding, Joining, and NDE* [Non-destructive examination].
311.2 Specific Requirement	See above
311.2.7 Seal Welds	See above

312 FLANGED JOINTS	Conflat and KF flanges are not pressure joints unless qualified in accordance with the requirement in this table.
313 EXPANDED JOINTS	Use B31.3 paragraph as written for Normal Fluid Service
314 THREADED JOINTS	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph 314. The material shall meet 323.1 and must have a 3:1 factor of safety for materials not listed Table A1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.
315 TUBING JOINT	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph 314. The material shall meet 323.1 and must have a 3:1 factor of safety for materials not listed Table A1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply. Evaluate inter-mixed fittings using paragraph 304.7 above. May consider de-rating the fitting based on the application to define or establish the MAWP.
316 CAULKED JOINTS	Not allowed for Normal Fluid Service.
317 SOLDERED AND BRAZED JOINTS	Brazed joints shall be done in accordance with ESM Chapter 13 Welding, Joining, and NDE. Soldering shall meet B31.3 requirements.
318 SPECIAL JOINTS	Use B31.3 paragraph as written for Normal Fluid Service and evaluate in accordance with 304.7.2 in this table. NOTE: Gland here does not mean Swagelok gland fitting.
319 PIPING FLEXIBILITY	Paragraph is required to be evaluated and discounted or applied Does not apply to pressure systems where thermal expansion is not an issue. When pressure systems are used at relatively constant temperature conditions (+/- 10 F), normally within buildings and labs, and ambient temperature is less than 120 degree F this paragraph is not applicable.
320 ANALYSIS OF SUSTAINED LOADS	Piping is not to be used to support equipment (not a piping component). Paragraph is required to be evaluated and discounted or applied. Piping supports may be in accordance with LANL Master Spec Section 22 0529 for all Normal Fluid Service including pressures above 150 psig. If additional support is required see 321.
321 PIPING SUPPORTS	Use B31.3 paragraph as written in 321.1.2 "simple calculations and engineering judgment"

322 SPECIFIC PIPING SYSTEMS	Use B31.3 paragraph as written
322 SPECIFIC PIPING SYSTEMS	Use B31.3 paragraph as written. Pressure systems with vessels, air receivers or boilers require an ASME Stamped and approved relief device protecting the vessel, air receiver, or boiler. Existing piping relief devices may be used if they are stamped and the vessel cannot be pressurized through any other path or means. Piping relief is not required to be V-stamped if no code stamped item (pressure vessel, boiler, or air receiver) is present.

Title: **Materials**	
323 GENERAL REQUIREMENTS	Use listed materials for example: 304, 316, B88, and A108; additional listed materials are in B31.3 Appendix A. This evaluation does not apply to Test Articles.
323.1.1 Listed Materials	Use B31.3 paragraph as written.
323.1.2 Unlisted Materials	Prior to using an unlisted material the chemistry, physical and mechanical properties, method and process of manufacture, heat treatment, and quality control must be known as required by 323.1.2. Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply. The Designer is cautioned that materials must be suitable for the application and must be evaluated in accordance with 323.1.2 if necessary to determine the suitability of the material.
323.1.3 Unknown Materials	Don't use unknown materials.
323.1.4 Reclaimed Materials	Use B31.3 paragraph as written.
323.2 Temperature Limitations	Use B31.3 paragraph as written.
323.2.1 Upper Temperature Limits, Listed Materials	Know the temperature limits of the materials.
323.2.2 Lower Temperature Limits, Listed Materials	Use B31.3 paragraph as written.
323.2.3 Temperature Limits, Unlisted Materials	Verify the temperature limits of the unlisted material meet the requirements of the design temperature.

	Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply. The Designer is cautioned that materials must be suitable for the temperature and must be evaluated in accordance with 323.2.3 if necessary to determine the suitability of the material.
323.2.4 Verification of Serviceability	Use B31.3 paragraph as written.
323.3 Impact Testing Methods and Acceptance Criteria (entire)	Use B31.3 paragraph as written.
323.4 Fluid Service Requirements for Materials (entire)	Use B31.3 paragraph as written.
323.5 Deterioration of Materials in Service	Designer is required to design the pressure system for the service life of the system and consider material compatibility.
325 MATERIALS — MISCELLANEOUS	Use B31.3 paragraph as written.

Title: Standards for Piping Components	
326 DIMENSIONS AND RATINGS OF COMPONENTS	Use components as defined in the code or use reputable manufacturers' published ratings. A reputable manufacturers' listing will be maintain on the Engineer Services website. Note: Institutional Evaluated Suppliers List (IESL) is not necessarily a listing of reputable manufacturers.
326.1 Dimensional Requirements	Apply B31.3 paragraph as written. (see 301.2.2)
326.2 Ratings of Components	Apply B31.3 paragraph as written (see 301.2.2)
326.3 Reference Documents	Apply B31.3 paragraph as written (see 301.2.2)

Title: Fabrication, Assembly, and Erection	
327 GENERAL	Use B31.3 paragraph as written.
328 WELDING (entire)	Welding and brazing shall be done in accordance with ESM Chapter 13 Welding.

330 PREHEATING	See above.
331 HEAT TREATMENT	See above.
331.2 Specific Requirements	See above.
332 BENDING AND FORMING	Bend or form in accordance with the manufactures' specification or requirements
333 BRAZING AND SOLDERING	Welding and brazing shall be done in accordance with ESM Chapter 13. Note: 317.1 Soldered Joints: "Soldered joints shall be made in accordance with the provisions of paragraph 333 and may be used only in Category D fluid service." -- i.e., soldered joints are not allowed for Normal Fluid Service.
335 ASSEMBLY AND ERECTION	Assemble in accordance with the manufacturer's requirements

Title: Inspection, Examination, and Testing	
340 INSPECTION 340.1 General	PSO Duty Area B will be the Owner's Inspector. Owner's Inspector will be knowledgeable with the pressure system of interest.
340.2 Responsibility for Inspection	Use B31.3 paragraph as written.
340.3 Rights of the Owner's Inspector	Use B31.3 paragraph as written.
340.4 Qualifications of the Owner's Inspector	See paragraph 300. PSO Duty Area B will act as the Owner's Inspector or equivalent.
341 EXAMINATION	Use B31.3 paragraph as written.
342 EXAMINATION PERSONNEL	Use B31.3 paragraph as written.
343 EXAMINATION PROCEDURES	Use B31.3 paragraph as written.
344 TYPES OF EXAMINATION	Use B31.3 paragraph as written.
345 TESTING	The Owner accepts pneumatic or hydro-pneumatic leak testing with inert gas or air (additional testing may be required by the Designer). See Exist – Legacy System Requirements (*3.B.1*) for vacuum rate of rise and inert gas referee test gas Pneumatic leak testing is approved for all systems less than 2 cubic feet in

	volume. Additional volume must be approved by the CPSO. [1] See A345 for other requirements for example test pressures (A345.4.2), test limitations (A345.2.1), and other requirements for pneumatic testing (A345.5.2) Note: Be aware of the ramifications of using high molecular weight gases to test system for lower molecular weight gas. The engineering best practice is to use a lower or equal weight molecular weight gas as the referee test gas except for hydrogen where helium is accepted.
346 RECORDS	Required information is as follows: • Sketch, • Component list (manufacturer, model number, pressure rating, FM 07 information) • Calculation • Relief device/flow calc. • Examinations • Inspections Electronic copy loaded into a master site repository.

[1] EMRef-73 ASME Interpretation of Para. 345.5.5 Pneumatic Leak Test Procedure.

Attachment NASME-1-D: Equivalency Evaluation of Category D Requirements for Metallic Piping not Associated with Pressure Vessel, Boilers, or Air Receivers (B31.3-2010, 2012, and 2014[1])

RECORD OF REVISION

Rev	Date	Description	POC	RM
0	9/17/14	Initial issue.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*
1	6/30/15	A342 changed to use B31.3 paragraph as written. A345 added requirement based on ASME interpretation. Updates for B31.3-2014.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*
2	11/09/18	A342 changed to use B31.3 paragraph as written; other minor clarifications and corrections.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*

Contact the Standards POC for upkeep, interpretation, and variance issues.

Chapter 17	**Pressure Safety POC and Committee**

This document is online at http://engstandards.lanl.gov

This evaluation of risk is per Chapter 17, Section EXIST-1 (Qualitative Risk greater than 3).

1. Applicable for B31.3 piping not including a pressure vessel, boiler, air receiver, or supporting piping.
2. Applicable only for metallic piping systems.
3. This evaluation is for new pressure systems that allow workers to be in close proximity without additional shielding while the system is pressurized.
4. For severely cyclic system see specific code requirements.
5. A list of reputable manufacturers will be maintained by Engineering Services.
6. The “Equivalent Risk Evaluation” in the table below or the original paragraph in B31.3 may be followed. The equivalency is intended to provide an equivalent level of personnel safety to B31.3, not code compliance.
7. Applies to ML-4 only.

[1] Requires CPSO review prior to use with 2016, 2018

Paragraph	Category D Fluid Service Equivalency Evaluation (within the allowance of notes above this table)
Title: Scope and Definitions	
300 GENERAL STATEMENTS (b) Responsibilities	System Owner designs system, but must be approved by PSO Duty Area B for safety check. Training will be developed for System Owners to perform pressure system designs. In the interim until the training is developed and implemented, system owners with PSO assistance and concurrence may serve as designers. PSO Duty Area B may perform the role as Owner's Inspector.
300.1.3 Exclusions	Pressure systems will be inventoried with a system identification tag as defined in ESM Chapter 17. Those pressure systems that are excluded from B31.3 scope shall be declared exempt as defined in Section GEN Att GEN-2 as follows: B31.3 excludes pressure systems if less than 15 psig, nonflammable, nontoxic, and not damaging to human tissues with a design temperature from −29°C (−20°F) through 186°C (366°F) B31 series does not apply. LANL pressure systems where the supply pressure is greater than 15 psig but have a relief device proven adequate to protect the system from over pressurization by calculation or flow testing to less than 15 psig, and is nonflammable, nontoxic, and not damaging to human tissues with a design temperature from −29°C (−20°F) through 186°C (366°F) are excluded. In order to maintain the LANL pressure system inventory a system identification tag shall be applied in accordance with ESM Chapter 17, ADMIN-1, (9. *System Identification Tag)*, with the word Exempt on the tag. The regulator and relief device must be close coupled with no intervening stop valves and identified in accordance with ESM Chapter 17 requirements. A copy of a simplified system sketch and the documentation showing the system is adequately protected against overpressure shall be maintained as records, and must be managed per LANL PD1020, P 1020-1, and P 1020-2; also, as applicable, AP-341-608, *Engineering Drawings and Sketches*, and AP-341-402, *Engineering Document Management In Operating Facilities*. *Also see ESDO-AP-001, Engineering Document Control Desktop Instruction.* Relief device retest frequency is a 5 year interval.
300.2 Definitions	This table is **not** applicable to for Category M Fluid Service, Elevated Temperature Fluid Service, High Pressure Fluid Service, or High Purity Fluid Service (reference ESM Chapter 17 Section ASME Att ASME-4, contact the CPSO for other fluids not listed) Flammability limits are per Compressed Gas Association (CGA) P-23 (NFPA 55) Determination of flammability limit is per American Society for Testing and Materials (ASTM) E681-85, *Standard Test Method for Concentration Limits of Flammability of Chemicals*,

Title: Design	
301.1 Qualifications of the Designer	See above 300 General Statements (b) Responsibilities

Paragraph	Category D Fluid Service Equivalency Evaluation (within the allowance of notes above this table)
Title: Scope and Definitions	
301.2.2 Required Pressure Containment or Relief	As written for Category D Fluid Service., but using manufacturers' published rating for design pressure. Or protect personnel using other controls; engineering, administrative, and/or PPE as approved by the PSO as per ASME B&PVC Section VIII Div. 1 UG-140 "OVERPRESSURE PROTECTION BY SYSTEM DESIGN"
301.3 Design Temperature	This paragraph does not apply if the pressure system is in a relatively constant temperature environment (+/- 10 F) and the temperature is less than 120 F (50C) (note this is to ensure there is no effect from thermal linear change).
301.3.1 Design Minimum Temperature	Lowest allowable minimum design temperature is -20 F (-29 C).
301.4 Ambient Effects	Does not apply if the pressure system is in a relatively constant temperature environment (+/- 10 F) and ambient temperature is less than 120 degree F.
301.5 Dynamic Effects	Impact, wind, earthquake, vibration, discharge reactions are required to be evaluated and discounted or applied.
301.6 Weight Effects	Live and dead loads are required to be evaluated and discounted or applied.
301.7 Thermal Expansion and Contraction Effects	Normally does not apply to pressure system is in a relatively constant temperature environment (+/- 10 deg F) and the temperature is less than 120 F (50C) (note this is to ensure there is no effect from thermal linear change) Applies to pressure systems with appreciable thermal expansion or phase change induced volumetric expansion (increases of specific volume).
301.8 Effects of Support, Anchor, and Terminal Movements	Restraints do not apply for whip hazard.
301.9 Reduced Ductility Effects	Not applicable
302.2.1 Listed Components Having Established Ratings	Listed items are recommended, but manufacturer's published ratings are acceptable.
302.2.2 Listed Components Not Having Specific Ratings	Use reputable manufacturers' published ratings. A reputable manufacturers' listing will be maintain by Engineering Services. Note: Institutional Evaluated Suppliers List (IESL) is not necessarily a listing of reputable manufacturers.

Paragraph	Category D Fluid Service Equivalency Evaluation (within the allowance of notes above this table)
Title: Scope and Definitions	
302.2.3 Unlisted Components	Use reputable manufacturers' published ratings. A reputable manufacturers' listing will be maintain on the Engineering Services.
302.3 Allowable Stresses and Other Stress Limits	Per design may consider other protective measures in order of precedence as follows: engineering controls (barriers, interlocks or controls), procedural controls (access control), and/or PPE.
302.3.3 Casting Quality Factor, Ec	Use B31.3 paragraph as written if applicable
302.3.4 Weld Joint Quality Factor, Ej	Use B31.3 paragraph as written if applicable
302.3.5 Limits of Calculated Stresses Due to Sustained Loads and Displacement Strains	Paragraph is required to be evaluated and discounted or applied If unlisted, use manufacturer's allowable stress ratings for the material. Note: If piping and piping elements (unions, couplings, etc...) are rated above the maximum design pressure of 150 psig for Category D Fluid Service and is sufficiently supported (see Paragraph 321 "Piping Supports"), and the other piping components that are in the pressure system are adequately supported this paragraph does not apply.
302.3.6 Limits of Calculated Stresses Due to Occasional Loads	Do not apply paragraph because application of ESM Chapter 17, EXIST-1, Risk-Based Engineering Evaluation Process, Table EXIST-1-4 Qualitative Risk (QR) Determination, bounding conditions show low risk.
302.4 Allowances	Fluid will be evaluated and determined to be compatible for the service life of the system with the materials of construction and manufacturer's recommendations.
304 PRESSURE DESIGN OF COMPONENTS 304.1 Straight Pipe	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph 304.1. The material shall meet 323.1 and must have a 3:1 factor of safety for materials not listed Table A1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.

Paragraph	Category D Fluid Service Equivalency Evaluation (within the allowance of notes above this table)
Title: Scope and Definitions	
304.2 Curved and Mitered Segments of Pipe	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph 304.2 The material shall meet 323.1 and must have a 3:1 factor of safety for materials not listed Table A1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply. When the wall thickness is 1.5 times the minimum required by equation 3a no additional evaluation of Intrados or Extrados is required. or Use approved vendor tubing or pipe bender with their required tubing to their published standard.
304.3 Branch Connections	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph 304.3 The material shall meet 323.1 and must have a 3:1 factor of safety for materials not listed Table A1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.
304.4 Closures	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph 304.4 The material shall meet 323.1 and must have a 3:1 factor of safety for materials not listed Table A1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.
304.5 Pressure Design of Flanges and Blanks	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph 304.5 The material shall meet 323.1 and must have a 3:1 factor of safety for materials not listed Table A1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.
304.6 Reducers	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph 304.6 The material shall meet 323.1 and must have a 3:1 factor of safety for materials not listed Table A1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.

Paragraph	Category D Fluid Service Equivalency Evaluation (within the allowance of notes above this table)
	Title: Scope and Definitions
304.7 Pressure Design of Other Components	Initial design consistent with the design criteria of ASME B31.3 shall be a hoop stress evaluation at the minimum wall thickness at the maximum part diameter (worst case hoop stress) showing the design meets or exceed the stress. Note use B31.3 allowable stress values with B31.3 equations. Substantiation of the above may be done by one of the 4 items below: 1) For a simple part that has no stress intensification factors (notches, threads, pits, cracks, etc..) the minimum calculated hoop stress shall be 4x the design pressure (MAWP) 2) Determine if the piping component was previously used in accordance with paragraph 304.7.2 (a) 3) Pressure test to 4x the design pressure. 4) Perform Engineering Finite Analysis (FEA) in accordance with paragraph 304.7.2 (d).
305 PIPE	Paragraph is required to be evaluated and discounted or applied
306 FITTINGS, BENDS, MITERS, LAPS, AND BRANCH CONNECTIONS	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph 306. The material shall meet 323.1 and must have a 3:1 factor of safety for materials not listed Table A1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.
307 VALVES AND SPECIALTY COMPONENTS	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph 307. The material shall meet 323.1 and must have a 3:1 factor of safety for materials not listed Table A1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.
308 FLANGES, BLANKS, FLANGE FACINGS, AND GASKETS	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph 308. The material shall meet 323.1 and must have a 3:1 factor of safety for materials not listed Table A1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.
309 BOLTING	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph 309. The material shall meet 323.1 and must have a 3:1 factor of safety for materials not listed Table A1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply.
310 GENERAL	Use B31.3 paragraph as written.
311 WELDED JOINTS	Welding or Brazing shall be done in accordance with ESM Chapter 13 *Welding, Joining, and* Non-destructive examinations (NDE).

Paragraph	Category D Fluid Service Equivalency Evaluation (within the allowance of notes above this table)
Title: Scope and Definitions	
311.2 Specific Requirements	Welding or Brazing shall be done in accordance with ESM Chapter 13 *Welding, Joining, and NDE*.
311.2.1 Welds for Category D Fluid Service	Welding or Brazing shall be done in accordance with ESM Chapter 13 *Welding, Joining, and NDE.*
311.2.7 Seal Welds	Welding or Brazing shall be done in accordance with ESM Chapter 13 *Welding, Joining, and NDE*.
312 FLANGED JOINTS	“Conflat” and KF flanges are not pressure joints unless qualified in accordance with the requirement in this table.
313 EXPANDED JOINTS	Use B31.3 paragraph as written for Category D Fluid Service
314 THREADED JOINTS	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph 314. The material shall meet 323.1 and must have a 3:1 factor of safety for materials not listed Table A1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer’s published ratings this paragraph does not apply.
315 TUBING JOINT	If LANL is designing or having a design for a pressure component, the design shall comply with paragraph 314. The material shall meet 323.1 and must have a 3:1 factor of safety for materials not listed Table A1 (unlisted material). Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer’s published ratings this paragraph does not apply. Evaluate inter-mixed fittings using paragraph 304.7 above. May consider de-rating the fitting based on the application to define or establish the MAWP.
316 CAULKED JOINTS	Use B31.3 paragraph as written for Category D Fluid Service.
317 SOLDERED AND BRAZED JOINTS	Brazed joints shall be done in accordance with ESM Chapter 13 Welding, Joining, and NDE. Soldering shall meet B31.3 requirements.
318 SPECIAL JOINTS	As written for Category D Fluid Service and evaluate in accordance with 304.7.2 in this table. NOTE: Gland here does not mean Swagelok gland fitting.

Paragraph	Category D Fluid Service Equivalency Evaluation (within the allowance of notes above this table)
Title: Scope and Definitions	
319 PIPING FLEXIBILITY	The design temperature is from −29°C (−20°F) through 186°C (366°F) Paragraph is required to be evaluated and discounted or applied Does not apply to pressure systems where thermal expansion is not an issue. When pressure systems are used at relatively constant temperature conditions (+/- 10 F), normally within buildings and labs, and ambient temperature is less than 120 degree F this paragraph is not applicable.
320 ANALYSIS OF SUSTAINED LOADS	Piping is not to be used to support equipment (not a piping component). Paragraph is required to be evaluated and discounted or applied. Piping supports may be in accordance with LANL Master Spec 22 0529 for all Category D Fluid Service pressures. If additional support is required see 321.
321 PIPING SUPPORTS	Use B31.3 paragraph as written in 321.1.2 "simple calculations and engineering judgment"
322 SPECIFIC PIPING SYSTEMS	Use B31.3 paragraph as written.
322 SPECIFIC PIPING SYSTEMS	Use B31.3 paragraph as written Pressure systems with vessels, air receivers or boilers require an ASME Stamped and approved relief device protecting the vessel, air receiver, or boiler. Existing piping relief devices may be used if they are stamped and the vessel cannot be pressurized through any other path or means. Piping relief is not required to be V stamped if no code stamped item (pressure vessel, boiler, or air receiver) is present.

Title: Materials	
323 GENERAL REQUIREMENTS	Use listed materials for example: 304, 316, B88, and A108; additional listed materials are in B31.3 Appendix A. This evaluation does not apply to Test Articles.
323.1.1 Listed Materials	Use B31.3 paragraph as written.

323.1.2 Unlisted Materials	Prior to using an unlisted material the chemistry, physical and mechanical properties, method and process of manufacture, heat treatment, and quality control must be known as required by 323.1.2. Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply. The Designer is cautioned that materials must be suitable for the application and must be evaluated in accordance with 323.1.2 if necessary to determine the suitability of the material.
323.1.3 Unknown Materials	Don't use unknown materials.
323.1.4 Reclaimed Materials	Use B31.3 paragraph as written.
323.2 Temperature Limitations	Any carbon steel material may be used to a minimum temperature of −29°C (−20°F) for Category D Fluid Service.
323.2.1 Upper Temperature Limits, Listed Materials	Know the temperature limits of the materials.
323.2.2 Lower Temperature Limits, Listed Materials	Select materials that are ductile (including welds/braze/solder) at -20 F. Normally these materials include 304, 316 (austenitic SS), brass, etc…; additional listed materials are in B31.3 Appendix A.
323.2.3 Temperature Limits, Unlisted Materials	Verify the temperature limits of the unlisted material meet the requirements of the design temperature. Note: This paragraph is for designing pipe and components, not for procurement of items offered for sale. If using reputable manufacturer's published ratings this paragraph does not apply. The Designer is cautioned that materials must be suitable for the temperature and must be evaluated in accordance with 323.2.3 if necessary to determine the suitability of the material.
323.2.4 Verification of Serviceability	Use B31.3 paragraph as written.
323.3 Impact Testing Methods and Acceptance Criteria (entire)	Not required for Category D Fluid Service
323.4 Fluid Service Requirements for Materials (entire)	Not required for Category D Fluid Service
323.5 Deterioration of Materials in Service	Designer is required to design the pressure system for the service life of the system and consider material compatibility.

325 MATERIALS — MISCELLANEOUS 325.1 Joining and Auxiliary Materials	Use B31.3 paragraph as written.

Title: Standards for Piping Components	
326 DIMENSIONS AND RATINGS OF COMPONENTS	Use components as defined in the code or use reputable manufacturers' published ratings. A reputable manufacturers' listing will be maintain on the Engineer Services website. Note: Institutional Evaluated Suppliers List (IESL) is not necessarily a listing of reputable manufacturers.
326.1 Dimensional Requirements	Apply B31.3 paragraph as written (see 301.2.2)
326.2 Ratings of Components	Apply B31.3 paragraph as written (see 301.2.2)
326.3 Reference Documents	Apply B31.3 paragraph as written (see 301.2.2)

Title: Fabrication, Assembly, and Erection	
327 GENERAL	Use B31.3 paragraph as written.
328 WELDING (entire)	Welding or Brazing shall be done in accordance with ESM Chapter 13 Welding
330 PREHEATING	Welding or Brazing shall be done in accordance with ESM Chapter 13 Welding
331 HEAT TREATMENT	Welding or Brazing shall be done in accordance with ESM Chapter 13 Welding
331.2 Specific Requirements	Welding or Brazing shall be done in accordance with ESM Chapter 13 Welding
332 BENDING AND FORMING	Bend or form in accordance with the manufactures requirements
333 BRAZING AND SOLDERING	Welding or Brazing shall be done in accordance with ESM Chapter 13 Welding, Joining, and NDE. Soldering shall meet B31.3 requirements.
335 ASSEMBLY AND ERECTION	Assemble in accordance with the manufacturer's requirements

Title: Inspection, Examination, and Testing	
A340 INSPECTION 340.1 General	PSO Duty Area B will be the Owner's Inspector. Owner's Inspector will be knowledgeable with the pressure system of interest.
340.2 Responsibility for Inspection	Use B31.3 paragraph as written.
340.3 Rights of the Owner's Inspector	Use B31.3 paragraph as written.
340.4 Qualifications of the Owner's Inspector	See paragraph 300; PSO Duty Area B will act as the Owner's Inspector or equivalent.
341 EXAMINATION 341.1 General	Use B31.3 paragraph as written. Use B31.3 paragraph as written if applicable.
342 Examination Personnel	Use B31.3 paragraph as written.
343 EXAMINATION PROCEDURES	Use B31.3 paragraph as written.
344 TYPES OF EXAMINATION	Use B31.3 paragraph as written.
345 TESTING	Owner has elected to use Initial Service Leak Test for Category D Fluid Service (additional testing may be required by the Designer). See Exist – Legacy System Requirements (*3.B.1*) for vacuum rate of rise and inert gas referee test gas Pneumatic leak testing is approved for all systems less than 2 cubic feet in volume. Additional volume must be approved by the CPSO. [2] See A345 for other requirements for example test pressures (A345.4.2), test limitations (A345.2.1), and other requirements for pneumatic testing (A345.5.2) Note: Be aware of the ramifications of using high molecular weight gases to test system for lower molecular weight gas. The engineering best practice is to use a lower or equal weight molecular weight gas as the referee test gas except for hydrogen where helium is accepted.

[2] EMRef-73 ASME Interpretation of Para. 345.5.5 Pneumatic Leak Test Procedure.

346 RECORDS	Required information is as follows: • Sketch, • Component list (manufacturer, model number, pressure rating, FM07 information) • Calculation • Relief device/flow calc. • Examinations • Inspections Electronic copy loaded into a master site repository.

Equivalent Safety Evaluation for ASME B31.9 for Piping Not Associated with Pressure Vessel, Boilers, or Air Receivers

(B31.9-2014)

This evaluation of risk is per Chapter 17, Section EXIST-1 (Qualitative Risk greater than 3)

1. Applicable for B31.9 piping not including a pressure vessel, boiler, air receiver, or supporting piping.
2. This evaluation is for **new** pressure systems that allow workers to be in close proximity without additional shielding while the system is pressurized.
3. A list of reputable manufacturers will be maintained by Engineering Services.
4. The "Equivalent Safety Evaluation" in the table below or the original paragraph in B31.9 may be followed. The equivalency is intended to provide an equivalent level of personnel safety to B31.9, not code compliance.
5. Does not apply to safety class or safety significant pressure systems (see DOE O 420.1C).

B31.9 Paragraph	**Equivalency Safety Evaluation** **(within the allowance of notes above this table)**
Chapter I Scope and Definitions	
900 GENERAL	Use as written.
900.1 Scope	This equivalency may be used for all fluids within the scope of B31.9 except steam, steam condensate, and boiler external piping.
900.2 Terms and Definitions	In addition to 900.2 the following definitions also apply: Fully engaged: a bolt or stud shall at least be flush with exit of the nut or fastener. Listed: for the purposes of this equivalency, describes a material or component that conforms to a specification in at least one of the following: Table 926.1, Table I-1, Table I-2, Table I-3, Table I-4, or Table II-1.

Chapter II Design	
PART 1 CONDITIONS AND CRITERIA	
901 DESIGN CONDITIONS	
901.1 901.2 901.3 901.4	Use as written.
901.5	Seismic supports shall accommodate thermal expansion and contraction.
901.6	Supports that are not fixed anchors (hangers) shall be used to accommodate thermal expansion or contraction.
902 DESIGN CRITERIA	
902.1	Use as written.
902.2.1	Listed components shall be the first component selected for the application. Listed: for the purposes of this equivalency, describes a material or component that conforms to a specification in at least one of the following: Table 926.1, Table I-1, Table I-2, Table I-3, Table I-4, or Table II-1. Items listed in ASME B31.1 may also be used. Additional approved components are located in the file “Allowed Unlisted Components Listing per ADMIN-2, Article Z -- Unlisted, Specialty, or Unique Components, para 2 (xls)” on http://engstandards.lanl.gov/unlisted_components.shtml Unlisted components may be used as long as they are listed on the reputable manufacturer’s list. A reputable manufacturers’ listing will be maintained on the Engineering Services website. NOTE: Institutional Evaluation Suppliers List (IESL) is not necessarily a listing of reputable manufacturers. The Commercial Grade Designation (CGD) qualifies ML-3 & 4 equipment from non-IESL suppliers for use in ML-1 & 2 service, but does not qualify equipment for ASME B31.9 code equivalency to code concerns. Listing on a reputable manufacturer’s list requires ratings that are acceptable for the service conditions of temperature, pressure, compatibility, for service and ratings. or Engineering calculations showing a factor of safety of 4:1 (this item would then be entered onto the reputable manufacturer’s list as well).

	Items being placed on this list need final approval by the CPSO or Designee.
902.2.2	Use as written.
902.2.3	Use as written.
902.2.4	Use as written.
902.3	Per design may consider other protective measures in order of precedence as follows: engineering controls (barriers, interlocks or controls), procedural controls (access control), and/or PPE with PSO review and approval.
902.4	Use as written.
PART 2 PRESSURE DESIGN OF PIPING COMPONENTS	
903 CRITERIA FOR PRESSURE DESIGN OF PIPING COMPONENTS	Use as written.
904 PRESSURE DESIGN OF COMPONENTS	
904.1 Straight Pipe	Use as written: Note: For $t \geq D/6$ or for $P/SE > 0.385$, calculation of pressure design thickness for straight pipe requires special consideration of factors such as theory of failure, effects of fatigue, and thermal stress. Alternative equations maybe required for heavy walls.
904.2 Curved and Mitered Segments of Pipe	Use as written.
904.3 Branch Connections	Use as written.
904.4 Closures	Use as written.
904.5 Pressure Design of Flanges and Blanks	Use as written.
904.6 Reducers	Use as written.
904.7 Pressure Design of Other Pressure Containing Components	
904.7.1	Use as written.
904.7.2	See 902.2.1.
PART 3 SELECTION AND LIMITATION OF COMPONENTS	
905 PIPE	Use as written.
906 FITTINGS, BENDS, AND INTERSECTIONS	Use as written, see 902.2.1 for additional information.
907 VALVES	

907.1 General 907.1.1 Listed Valves.	Use as written.
907.1.2 Unlisted Valves.	See 902.2.1.
907.2 Marking	Use as written, for reputable manufactured item the manufacturer's identification is acceptable.
908 FLANGES, BLANKS, GASKETS, AND BOLTING	Use as written; note: for gaskets 902.2.1 may also be used (also applies to all 908 items).
PART 4 SELECTION AND LIMITATION OF JOINTS	
910 PIPING JOINTS	Use as written.
911 WELDED JOINTS	Use as written.
912 FLANGED JOINTS	Use as written; Vacuum style flanges for example "ConFlat" CF or KF (QF) flanges may be used after qualification in accordance with this document.
913 MECHANICAL AND PROPRIETARY JOINTS	See 902.2.1. Note to 913.1: Do not use friction fittings with flammable liquids or flammable gases inside buildings.
914 THREADED JOINTS	Use as written.
915 FLARED, FLARELESS, AND COMPRESSION JOINTS	Use as written with the exception that items meeting 902.2.1 are allowed.
916 BELL AND SPIGOT JOINTS	Use as written.
917 BRAZED AND SOLDERED JOINTS	Solder use as written. Brazing shall be in accordance with ESM Chapter 13.
PART 5 EXPANSION, FLEXIBILITY, AND SUPPORT	
919 EXPANSION AND FLEXIBILITY	Paragraph is required to be evaluated and discounted or applied. Does not apply to pressure systems where thermal expansion is not an issue. When pressure systems are used at relatively constant temperature conditions (+/- 10 F), normally within buildings and labs, and ambient temperature is less than 120 degrees F this paragraph is not applicable.
920 LOADS ON PIPE-SUPPORTING ELEMENTS	Piping is not to be used to support equipment (not a piping component). Paragraph is required to be evaluated and discounted or applied. Piping supports may be in accordance with edited LANL Master Spec

	Section 22 0529 for all Normal Fluid Service including pressures above 150 psig. Hangers used at elbows are to be of the supporting guide style not fixed rigid style; the piping supports must allow expansion and contraction of the piping system when required by 919 above. If additional support is required see 921.
921 DESIGN OF PIPE-SUPPORTING ELEMENTS	Use paragraph and subparagraphs as written except add the allowance from ASME B31.3 paragraph 321.1.2, "In general, the location and design of pipe supporting elements may be based on simple calculations and engineering judgment."
PART 6 SYSTEMS	
922 DESIGN REQUIREMENTS PERTAINING TO SPECIFIC PIPING SYSTEMS	
922.1 Pressure Reducing Systems 922.1.1	NOTE: Unlike ASME B31.3 there is no allowed accumulation over pressure of 10% above design pressure. Where pressure reducing valves are used, a relief device or safety valve shall be provided on the low-pressure side of the system. The relief or safety devices shall be located adjoining or as close as practicable to the reducing valve. The combined relieving capacity provided shall be such that the design pressure of the low-pressure system will not be exceeded if the reducing valve fails in the open position. The set point of the relief device shall be set a minimum of 10% less than the low pressure system design pressure so the relief device may function properly. Use as is.
922.1.2 Alternative Systems	Do not apply paragraph 922.1.2.
922.1.3 Bypass Valves	Use as is.
922.1.4 Design of Valves and Relief Devices	Use as is.
922.2 Steam Trap Piping	Use as is.
922.3 Fuel Oil Piping	Use most applicable NFPA code for combustible or flammable liquids.
Chapter III Materials	
923 MATERIALS — GENERAL REQUIREMENTS	
923.1.1 Listed or Published Specifications	Use as is.
923.1.2 Materials Not Listed	Use as is and reference table 902.3.
923.1.3 Used Materials	Use as is.

923.1.4 Limitations on Unknown Materials	Use as is.
923.2 Limitations on Specific Metals	Use as is.
923.3 Limitations on Specific Nonmetals	Use as is.
923.4 Coatings and Linings	Use as is.
923.5 Deterioration in Service	Use as is.
Chapter IV Component Requirements and Standard Practices	
926 DIMENSIONS AND RATINGS OF COMPONENTS	
926.1 Standard Piping Components	Use Table 926.1 in accordance with 902.2.1 in this equivalency evaluation. Items listed in ASME B31.1 may also be used.
926.1.1 Boiler External Piping.	Use as is.
926.2 Standard Practices	Use as is. Other installation practices of approved unlisted components shall follow the manufacturer's instructions, for example Swagelok® or LOKRING™.
926.3 Nonstandard Piping Components	Use as is.
926.4 Abbreviations	Use as is.
Chapter V Fabrication, Assembly, and Erection	
927 WELDED FABRICATION OF METALS	
927.1 General	Welding shall be performed in accordance with the qualification requirements of ESM Chapter 13. Limitations on imperfections and acceptance standards are as stated in B31.9 Chapter VI or in the engineering design.
927.2 Materials	Materials shall be in accordance with ESM Chapter 13.
927.3 Preparation	Preparations shall be in accordance with ESM Chapter 13.
927.4 Rules for Welding	Use ASME B31.8 as written. Welding and Brazing shall be in accordance with ESM Chapter 13.
927.5 Qualification	Qualification shall be in accordance with ESM Chapter 13.

927.6 Qualification Requirements	Qualification Requirements shall be in accordance with ESM Chapter 13.
928 BRAZING AND SOLDERING OF METALS	
928.1 Brazing	Brazing shall be in accordance with ESM Chapter 13.
928.2 Soldering	Use as is.
929 BENDING	
929.1 General	Pipe may be bent to any radius by any hot or cold method that results in a crack free bend surface free of cracks and free of buckles. **Cracks and creases in bends are not allowed.** Such bends shall meet the design requirements of para. 904.2.1. This shall not prohibit the use of corrugated bends if specified in the engineering design.
930 FORMING	
931 HEAT TREATMENT	Use as is.
934 FABRICATION OF NONMETALS	Use as is.
935 ASSEMBLY	Use as is.
Chapter VI Inspection, Examination, and Testing	
936 INSPECTION AND EXAMINATION	Use as is.
937 LEAK TESTING	Use as is.

Table of Contents

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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 evaluation 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*
2	5/25/2017	Clarified when piping flexibility analysis is required. Updated initial service leak test for low pressure systems and acceptance criterial of initial service leak test. Added requirement for variance/alternative methods to place non-compliance issues into PFITS for tracking.	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.

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

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.

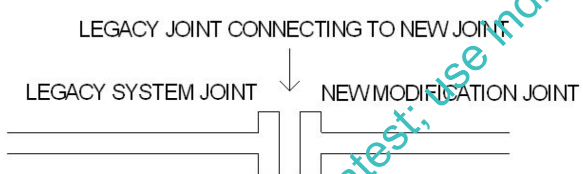
1. Engineering calculations for flexibility, piping supports, and thrust when evaluating systems with small pipe size, indoor location, adequate supports, low changes in system temperature, and low relief discharge energies are not required.

3.0 Modification or Maintenance of an Existing System

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

B. Testing of <u>Modifications to Existing Systems</u>

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 except for systems under 25 psig and with a volume of 2 cubic foot or less, pressure can be brought up in one step.

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.

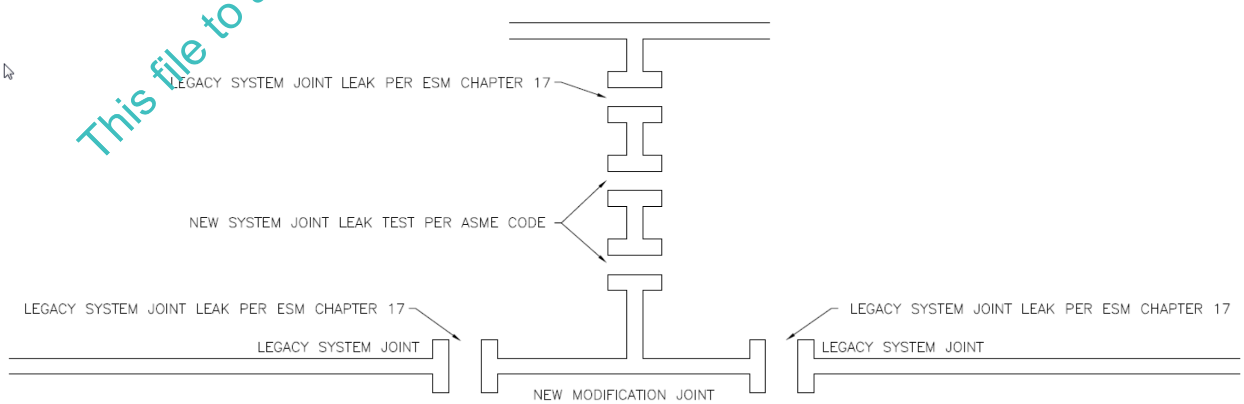
d. For leak testing pressure system modifications that only consist of ASME B31.3 or LANL CPSO-approved components with mechanical connections and/or code tested sub-assemblies, where mechanical connections are assembled in accordance with manufacturer's instruction or the applicable code or standard:

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 is stopped and the system pressure (absolute) monitored 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.

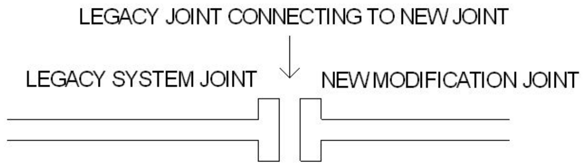
   ii. Trial run of substitute referee inert gas(s) at same operating conditions as will exist with process gas(s): Conduct a trial run at the same pressure, temperature, and other salient operating conditions as process gas(s) with substitute inert gas(s) prior to introduction of the process gas(s). The pressure system will be examined for evidence of leakage at the joint(s) during the referee inert gas test. 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. PSO approval is required for specified acceptance criteria greater than 10^{-3} standard cc/sec.

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
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. When a variance/alternative method is used to extend the grace periods, a PFITS will be assigned to each nonconformance and tracked until closed.

[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 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.

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.

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)[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		

[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 at intervals not to exceed the required maximum thereafter, but PMs beyond the grace period will require an approved variance/alternative method to continue operation. Use PFITS to track PMs granted an extension period.

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)
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 may be revised beyond the maximum period stated above, provided the owner-user has submitted technical justification for revising the

[5] Once any required PM has been performed on a component, that PM must be performed at intervals not to exceed the required maximum thereafter, and PMs beyond the grace period will require an approved variance/alternative method to continue operation. Use PFITS to track PMs granted an extension period.

[6] NBIC-2013 Part 2 Sect. 4.4 is basis for D.1 and D.2

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]
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

[7] Once any required PM has been performed on a component, that PM must be performed at intervals not to exceed the required maximum thereafter, and missed PMs will require an approved variance/alternative method to continue operation. Use PFITS to track PM that exceeds the maximum interval. These percentages were created to allow a reasonable period to eliminate the sizeable maintenance and inspection backlog with a risk-based graded approach; they will be deleted from the program once that backlog is eliminated. See footnote for Table EXIST-2D.2.

[8] Revision of NMAC 08-01-2003 supersedes this snapshot.

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 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	

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

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
ASME B31.1			
	All others	Temperatures between 350ºF and 750ºF and pressures above 1025 psig	Temperatures over 750ºF 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 may 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.

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 or variance must be based on establishing a level of worker safety consistent with the requirements of 10CFR851.

e. Use PFITS to track items granted an extension period.

f. 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. The deactivation and disassembly requirements are described in ESM Chapter 17 ADMIN-1 C.8 (“Deactivating a Pressure System”), and must meet P315, *Conduct of Operations*. 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.

g. 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 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 stringent, applicable code or Code of Federal Regulations, if more than one apply; for example, ASME B31.8 and 49CFR192.

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.

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

[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.

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.

i. 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

RECORD OF REVISIONS

Rev	Date	Description	POC	RM
0	9/17/2014	Initial issue. Previously was Chapter 17, Section I, rev. 3, App E.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*

Contact the Standards POC for upkeep, interpretation, and variance issues.

Chapter 17	**Pressure Safety POC and Committee**

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This Risk-Based Evaluation process is used in Chapter 17 Section EXIST and may be used in other situations (e.g., ASME, NASME) where allowed by those sections or with a variance (Form 2137).[1]

Guidance: The risk-based engineering evaluation evaluates the systems and determines if there is a risk to the worker (and equipment). A risk-based engineering evaluation is normally applied to non-hardware issues. A system that has known hardware issues will not likely benefit from this type of analysis.

A. Definitions

1. **Engineering Evaluation** – The Risk-Based Engineering Evaluation is the process of reviewing a pressure system for adequate pressure system integrity and determining necessary corrective actions to mitigate risk to acceptable level based on best engineering practices.
2. **Consequence** – The potential outcome from an event. There may be more than one consequence from an event.
3. **Probability** – The relative frequency with which an event is likely to occur within the time frame under consideration.
4. **Acceptable Risk** – A Qualitative Risk (QR) number of 4 or higher as shown on Table EXIST-1-4, Qualitative Risk, below. Qualitative Risk shall be controlled to QR number of 4 or higher.

B. Baseline Criteria

1. The Risk-Based Engineering Evaluation applies only to systems that have correctly sized relief protection.

C. Engineering Evaluation

1. The Risk-Based Engineering Evaluation is a three step process. This process applies to evaluation of Risk Level 2 and 3 deficiencies, as defined above; Risk Level 1 deficiencies must be corrected in accordance with the requirements stipulated above.

[1] Process is based on API RP 580-2009 Risk-Based Inspection methodology

a. Using system information generated from the walk down team efforts and other sources, and ESM Chapter 17 requirements, the engineer generates a Qualitative Risk of each deficiency.

b. The Qualitative Risk is then compared to the Acceptable Risk (i.e., risk number of 4 or higher).

c. If the Qualitative Risk is greater than the Acceptable Risk (i.e., a risk number lower than 4), then either the consequence or probability must be adjusted to achieve a risk number of 4 or higher.

2. An engineering evaluation of the pressure system shall be performed by personnel meeting the qualification requirements for a pressure system designer and approved by a qualified PSO (*see Section GEN)* with Risk Evaluation training.

3. The engineering evaluation shall be an analysis and examination of the pressure system to determine the system integrity.

4. The Risk-Based Engineering Evaluation analysis shall be included with the pressure system documentation.

5. The Risk-Based Engineering Evaluation shall ensure that hazards and dominant contributors to risk are controlled according to the following:

a. Eliminate accident scenarios (e.g., eliminate hazards or initiating events by design).

b. Reduce the likelihood of accident scenarios through design and operational changes (hazard control).

c. Reduce the severity of accident consequences (hazard mitigation).

d. Improve the state-of-knowledge regarding key uncertainties that drive the risk associated with a hazard (uncertainty reduction to support implementation of the above strategies).

6. The control(s) shall be based on the level of risk associated with that hazard. Some risks may require a combination of several different approaches to prevent, mitigate, and/or control the risk.

7. Controls shall be in applied the following order of precedence:

a. Engineered controls,

b. Administrative controls,

c. Personal protective equipment.

D. Qualitative Risk (QR)

1. The Risk-Based Engineering Evaluation shall, as a first step, use a Qualitative Risk based approach to evaluate adequacy of pressure system integrity.

2. The qualitative risk evaluation shall identify:

a. the system(s),

b. the hazard(s) (deficiency,

c. the probability assessment,

d. the consequence of failure evaluation, and

e. the subsequent QR number (see Table EXIST-1-3).

3. The Qualitative Risk based evaluation shall be based on probability and consequence of a single-point system failure for each deficiency observed.

Table EXIST-1-1 Probability factors to be considered

a. corrosion potential (crevice corrosion, general, galvanic, etc…)
b. materials of construction (composite, plastic, steel, brass, etc...)
c. material compatibility (lubricants, seals, and general materials)
d. oxygen systems
e. erosion potential
f. fatigue cycles (cycle life)
  1) low-cycle fatigue (where significant plastic straining occurs).
  2) high-cycle fatigue (where stresses and strains are largely confined to the elastic region)
g. size (contained energy)
h. human error
i. operating history
j. damage mechanisms
k. operation in creep range
l. stress intensification factors; for example, cracks or acute angles in pressure boundaries
m. available documentation
  1) welding
  2) code pressure test
n. documentation of ASME code fabrication
o. MAWP and design pressure as used in code calculations
p. design temperature
q. corrosion allowance determination
r. code required calculations (as applicable)
s. minimum wall thickness
t. nozzle reinforcement
u. thermal load calculations
v. seismic calculations
w. support structure
x. wind loading
y. piping flexibility analysis
z. cyclic loading calculations
aa. other static loadings (static fluid head)
bb. other dynamic loadings
cc. historical operational documentation
  1) corrosion rate (mils/year) (used to determine inspection interval)
  2) locations and dates of thickness measurements
  3) year of construction
  4) date of original installation
  5) date of first use
  6) out of service periods (used to determine inspection interval)
  7) discrepancy conditions
  8) a comprehensive chronological record of maintenance history
  9) history of repair – objective evidence required for ASME code stamped items.
  10) history of alterations – objective evidence required for ASME code-stamped items.
  11) historical inspections records of NDE
  12) applicable variances/waivers
  13) fabrication documentation
  14) leak test records
  15) maintenance sheet
  16) daily logs
  17) boiler records – water treatment, maintenance, and boiler appurtenances
  18) engineering evaluations as required by this chapter

4. Consequences of failure to be considered include the following safety and health issues:
   a. Chemical toxicity
   b. Physical hazards (e.g., projectiles)
   c. Flammability
   d. Radioactivity
   e. Asphyxiation hazards
   f. Volume
   g. Failure Mode
      1) Brittle fracture failure mode
      2) Leak before burst failure mode
   h. Inhabited areas
   i. Shielding (glove box, fume hood, test cell)
5. Other issues to consider include:
   a. Mission criticality
   b. Economic impact
   c. Schedule
   d. Environmental impact

E. Hazard Mitigation

1. Based on the results of the probability evaluation, a probability bin is selected as defined in Table EXIST-1-2, Failure Probability.

2. Based on the results of the consequence evaluation, a consequence bin is selected as defined in Table EXIST-1-3, Consequence of Failure.

3. Enter Table EXIST-1-4, Qualitative Risk Evaluation, and locate the QR number that corresponds to the intersection of the probability bin (A through E) and consequence bin (I through V).

4. If the QR number rating is less than 4 (i.e., 1, 2, or 3), then the Risk-Based Engineering Evaluation shall provide a methodology to reduce risk through correction of deficiencies or introduction of additional controls. Refer to Table EXIST-1-5, "Action Matrix for Existing (Legacy) Pressure System Deficiencies" *QR Action Matrix*, to determine the approved actions to correct the issues.

Table EXIST-1-2 Failure Probability

Level	Description	Qualitative
A (Frequent)	Frequent	Likely to occur immediately
B (Probable)	Probable	Probably will occur in time
C (Occasional)	Occasional	May occur in time
D (Remote)	Remote	Unlikely to occur
E (Improbable)	Improbable	Improbable to occur

Table EXIST-1-3 Consequence of Failure

Category	Description	Examples
I	Major	Fatalities, and/or major long-term environmental impact
II	Serious	Serious injuries, and/or significant environmental impact
III	Significant	Minor injuries, and/or short-term environmental impact
IV	Minor	First aid injuries only, and/or minimal environmental impact
V	Insignificant	No significant consequence

Table EXIST-1-4 Qualitative Risk (QR) Determination

			Probability				
			A	**B**	**C**	**D**	**E**
			Frequent	**Probable**	**Occasional**	**Remote**	**Improbable**
Consequence	**I**	**Major**	1	1	1	2	3
	II	**Serious**	1	1	2	3	4
	III	**Significant**	1	2	3	4	5
	IV	**Minor**	2	3	4	5	6
	V	**Insignificant**	3	4	5	6	7

5. The following risk-based engineering evaluation Table EXIST-1-5 applies only to legacy systems (built prior to March 10, 2009). All other systems are required to meet ESM Chapter 17 requirements for new in construction in ASME or NASME.

Table EXIST-1-5

Action Matrix for Existing (Legacy) Pressure System Deficiencies

Item	Deficiency	QR 1	QR 2	QR 3
1.	Vessel rating; rating unknown (unknown design pressure or MAWP)	1) Replace item with rated item, or 2) Perform code-compliant calculations to establish MAWP	1) Replace item with rated item, or 2) Perform code-compliant calculations to establish MAWP	1) Replace item with rated item, or 2) Perform code-compliant calculations to establish MAWP, or 3) Perform minimum wall calculation, perform field verification of minimum wall, and perform code-compliant pressure test
2.	Piping component rating; rating unknown (unknown design pressure or MAWP)	1) Replace item with rated item, or 2) Perform code-compliant calculations to establish MAWP	1) Replace item with rated item, or 2) Perform code-compliant calculations to establish MAWP	1) Replace item with rated item, or 2) Perform code-compliant calculations to establish MAWP, or 3) In cases where published manufacturer's literature provides a maximum operating pressure: determine appropriate system design pressure, confirm that manufacturer's maximum pressure condition is greater than system design pressure, and perform code-compliant pressure test
3.	Missing or out of date system schematic	Create or update sketch or drawing in accordance with Section V of this Chapter	Create or update sketch or drawing in accordance with Section V of this Chapter	Create or update sketch or drawing in accordance with Section V of this Chapter
4.	Materials of construction not suitable for service	Replace item with correct material	Replace item with correct material	1) Replace item with correct material, or 2) Provide shielding, or 3) Control personnel exposure to hazard

Item	Deficiency	QR 1	QR 2	QR 3
5.	Code stamped vessel code data report not available (U1, U1A, P1, etc.)	1) Obtain manufacturer's shop drawing and verify that vessel has not been modified 2) If manufacturer's shop drawing is not available, obtain written statement from system owner that vessel has not been modified 3) If vessel has been modified, perform code calculations to confirm that the vessel is still code compliant 4) Replace vessel	1) Obtain manufacturer's shop drawing and verify that vessel has not been modified 2) If manufacturer's shop drawing is not available, obtain written statement from system owner that vessel has not been modified 3) If vessel has been modified, perform code calculations to confirm that the vessel is still code compliant 4) Replace vessel	1) Obtain manufacturer's shop drawing and verify that vessel has not been modified 2) If manufacturer's shop drawing is not available, obtain written statement from system owner that vessel has not been modified 3) If vessel has been modified, perform code calculations to confirm that the vessel is still code compliant 4) Replace vessel
6.	Non-ASME code stamped vessel design and fabrication documentation not in compliance with ASME Section VIII			
6.1.	Code compliant design calculations, including: minimum wall thickness, corrosion allowance, weld efficiency rating, support structure loading, nozzle calculations	1) Perform code-compliant calculations (require review by Professional Engineer), or 2) Replace with code-stamped vessel	1) Perform code-compliant calculations (require review by Professional Engineer), or 2) Replace with code-stamped vessel	1) Perform code-compliant calculations (require review by Professional Engineer), or 2) Replace with code-stamped vessel , or 3) Provide shielding or control personnel exposure to vessel when pressurized
6.2.	Pressure Test Report	1) Perform code pressure test	1) Perform code pressure test	1) Perform in-service leak test, or 2) Provide shielding or control personnel exposure when pressurized

Item	Deficiency	QR 1	QR 2	QR 3
6.3.	Modification or alteration calculations	1) Perform code compliant calculations to verify proper modification or alteration, or 2) Replace with code-stamped vessel	1) Perform code compliant calculations to verify proper modification or alteration, or 2) Replace with code-stamped vessel	1) Perform code compliant calculations to verify proper modification or alteration, or 2) Replace with code-stamped vessel, or 3) Provide shielding or control personnel exposure when pressurized
6.4.	Non-Destructive Evaluation (NDE) data reports	1) Perform NDE as required by code	1) Perform NDE as required by code, or 2) Perform code pressure test	1) Perform NDE as required by code, or 2) Perform in-service leak test, or 3) Provide shielding or control personnel exposure to system when pressurized
7.	Piping System design and fabrication documentation not in compliance with applicable B31 piping code			
7.1.	Piping System Code required calculations; for example, in B31.3: 301.10 cyclic effects, 304 pressure design, 304.3.5 external forces, thermal expansion and contraction, dead and live loads, 319 flexibility analysis, 319.2.1(c) wind loading, and seismic loading; see specific code for additional detail.	1) Perform code-compliant calculations	1) Perform code-compliant calculations	1) Perform code-compliant calculations 2) Provide shielding or control personnel exposure to system when pressurized
7.2.	Pressure Test Report	1) Perform code pressure test	1) Perform code pressure test	1) Perform in-service leak test 2) Provide shielding or control personnel exposure to system when pressurized
7.3.	Piping System Non-Destructive Evaluation (NDE) data reports	1) Perform NDE as required by code	1) Perform NDE as required by code, or 2) Perform code pressure test	1) Perform NDE as required by code, or 2) Perform in-service leak test, or 3) Provide shielding or control personnel exposure to system when pressurized
8.	Other	Action reviewed and approved by CPSO	Action reviewed and approved by CPSO	Action reviewed and approved by CPSO

6. Approved Qualitative Risk Evaluation (QRs)
   a. Attached to this document are approved, general qualitative risk evaluations that can be applied to existing systems meeting the LANL definition of legacy. At time of writing, these were:

      EXIST-1a, QR for Inert Gas Cylinders
      EXIST-1b, QR for Low Pressure Steam and Steam Condensate
      EXIST-1c, QR for Compressed Air Systems

General Qualitative Risk Evaluation for Inert Gas Cylinders Existing Systems Only

RECORD OF REVISIONS

Rev	Date	Description	POC	RM
0	9/17/2014	Initial issue. Administrative update to ES-DO-QR-2010-002.0, 5/18/2010.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*

Contact the Standards POC for upkeep, interpretation, and variance issues.

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Assumptions:

Fluid Service

1. The system fluid service is not an FS1 as defined by ESM Chapter 17
   1.1. The pressure system fluid service is not high pressure as define by ASME B31.3 2008 Chapter IX.
   1.2. The pressure system fluid service is not a Category M fluid ASME B31.3 2008.
   1.3. The pressure system fluid service is not steam.
2. The system fluid service is not flammable (hydrogen, deuterium, and tritium).
3. The system fluid service will not support combustions (oxidizer for example oxygen or fluorine).

System Operation

4. The pressure system is not subject to low-cycle fatigue (where significant plastic straining occurs).
5. High-cycle fatigue (where stresses and strains are largely confined to the elastic region) is controlled to less than 100,000 cycles for the life of the pressure system.
6. The pressure system does not operate in the creep range.
7. There are no stress intensification factors for example cracks or acute angles of pressure boundaries.
8. The pressure system is not an ASME Section I or VIII stamped item or unstamped item performing the same task (e.g. unstamped pressure vessel).

System Hardware

9. The system components have exhibited extensive, successful service experience under comparable conditions with similarly proportioned components of the same or like material.
10. Corrosion is not a significant factor.
11. Materials of construction are compatible with the system fluid service.
12. The system is equipped with a properly sized, set, and functional pressure relief device(s).
13. Flexible elements are restrained to prevent whipping.

Failure Mode

14. A ductile failure mode is assumed (not brittle fracture).

Consequence of Failure

15. The result of the failure will not result in personnel injury

Safety Class

16. Applicable to ML4 only.

Allowance: ESM Chapter 17 Section EXIST

RL2-A. Vessel pressure rating indeterminate, or non-ASME stamped vessel without design documentation (unknown MAWP)
Risk-based engineering evaluations may be applied for FS3 deficiencies

RL2-B. Piping component pressure rating indeterminate, or unlisted piping component (unknown MAWP)
Risk-based engineering evaluations may be applied for FS2 and FS3 deficiencies

RL3-A-inside. Missing weld examination documentation (within a glove box)
Risk-based engineering evaluations should be applied for FS1 and FS2 system deficiencies to determine if further action is required

RL3-A-outside. Missing weld examination documentation (outside a glove box)
Risk-based engineering evaluations should be applied for FS1 and FS2 system deficiencies to determine if weld examination is required

RL3-B. Missing pressure test documentation
Risk-based engineering evaluations may be applied for FS2 and FS3 system deficiencies

Applicable Systems
Nitrogen, helium, argon, and other inert gases fabricated from

A system with a relief device set equal to less than 150 shall be rated as FS3.

These systems shall be exempt from the requirements of having pressure test documentation, weld documentation (inside or outside the glovebox), may continue to use unlisted components, or components with an indeterminate pressure rating, or ASME non-stamped vessels.

This equipment will be considered grandfathered and will not be replaced with like items.

Qualitative Risk Assessment

Probability: Remote

Consequence: Significant

QR Factor: 4

Table 3 Qualitative Risk (QR) Determination

			Probability				
			A	B	C	D	E
			Frequent	Probable	Occasional	Remote	Improbable
Consequence	I	Major	1	1	1	2	3
	II	Serious	1	1	2	3	4
	III	Significant	1	2	3	**4**	5
	IV	Minor	2	3	4	5	6
	V	Insignificant	3	4	5	6	7

General Qualitative Risk Evaluation for Low Pressure Steam and Steam Condensate

RECORD OF REVISIONS

Rev	Date	Description	POC	RM
0	9/17/2014	Initial issue. Administrative update to ES-DO-QR-2010-001.0, 5/18/2010.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*

Contact the Standards POC for upkeep, interpretation, and variance issues.

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Legacy Systems Only

Assumptions:

Fluid Service

1. Steam or steam condensate.

System Operation

2. No superheated steam.
3. System pressure less than 14.7 psia (212 deg. F saturated steam)
4. Piping systems only.
5. The pressure item is not an ASME Section I, ASME Section IV, or VIII stamped item or unstamped item performing the same task (e.g. unstamped pressure vessel).
6. The pressure system is not subject to low-cycle fatigue (where significant plastic straining occurs).
7. High-cycle fatigue (where stresses and strains are largely confined to the elastic region) is controlled to less than 100,000 cycles for the life of the pressure system.
8. The pressure system does not operate in the creep range.
9. There are no stress intensification factors for example cracks or acute angles of pressure boundaries.

System Hardware

10. The system components have exhibited extensive, successful service experience under comparable conditions with similarly proportioned components of the same or like material.
11. Corrosion is not a significant factor.
12. Materials of construction are compatible with the system fluid service.

13. The system is equipped with a properly sized, set, and functional pressure relief device(s).
14. Flexible elements are restrained to prevent whipping.

Failure Mode

15. A ductile failure mode is assumed (not brittle fracture).

Consequence of Failure

16. The result of the failure will not result in personnel injury

Safety Class

17. Applicable to ML4 only.

Allowance: ESM Chapter 17 Section IV

RL2-A. Vessel pressure rating indeterminate, or non-ASME stamped vessel without design documentation (unknown MAWP)
Risk-based engineering evaluations may be applied for FS3 deficiencies

RL2-B. Piping component pressure rating indeterminate, or unlisted piping component (unknown MAWP)
Risk-based engineering evaluations may be applied for FS2 and FS3 deficiencies

RL3-A-inside. Missing weld examination documentation (within a glove box)
Risk-based engineering evaluations should be applied for FS1 and FS2 system deficiencies to determine if further action is required

RL3-A-outside. Missing weld examination documentation (outside a glove box)
Risk-based engineering evaluations should be applied for FS1 and FS2 system deficiencies to determine if weld examination is required

RL3-B. Missing pressure test documentation
Risk-based engineering evaluations may be applied for FS2 and FS3 system deficiencies

Applicable Systems
Steam and steam condensate, for example building heating and condensate return piping.

A system with a relief device set equal to less than 150 shall be rated as FS2.

These systems shall be exempt from the requirements of having pressure test documentation, weld documentation (inside or outside the glovebox), may continue to use unlisted components, or components with an indeterminate pressure rating, or ASME non-stamped vessels.

This equipment will be considered grandfathered and will not be replaced with like items. System shall be upgraded to ASME compliance as items age out of service by attrition.

Qualitative Risk Assessment

Probability: Remote (note: evaluation is remote for probability to cause significant consequence)

Consequence: Significant

QR Factor: 4

Table 3 Qualitative Risk (QR) Determination

			Probability				
			A	B	C	D	E
			Frequent	Probable	Occasional	Remote	Improbable
Consequence	I	Major	1	1	1	2	3
	II	Serious	1	1	2	3	4
	III	Significant	1	2	3	4	5
	IV	Minor	2	3	4	5	6
	V	Insignificant	3	4	5	6	7

General Qualitative Risk Evaluation for Compressed Air Systems

Existing Systems Only

RECORD OF REVISIONS

Rev	Date	Description	POC	RM
0	9/17/2014	Initial issue. Administrative update to ES-DO-QR-2010-003.0, 5/18/2010.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*

Contact the Standards POC for upkeep, interpretation, and variance issues.

Chapter 17	**Pressure Safety POC and Committee**

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Assumptions:

Fluid Service

1. The system fluid service is not an ES1 as defined by ESM Chapter 17
   1.1. The pressure system fluid service is not high pressure as define by ASME B31.3 2008 Chapter IX.
2. The system fluid service is not interconnected to a flammable (hydrogen, deuterium, and tritium).
3. The system fluid service is not interconnected with a fluid that supports combustion (oxidizer for example oxygen or fluorine).

System Operation

4. The pressure system is not subject to low-cycle fatigue (where significant plastic straining occurs).
5. High-cycle fatigue (where stresses and strains are largely confined to the elastic region) is controlled to less than 100,000 cycles for the life of the pressure system.
6. The pressure system does not operate in the creep range.
7. There are no stress intensification factors for example cracks or acute angles of pressure boundaries.
8. The pressure system is not an ASME Section I or VIII stamped item or unstamped item performing the same task (e.g. unstamped pressure vessel).

System Hardware

9. The system components have exhibited extensive, successful service experience under comparable conditions with similarly proportioned components of the same or like material.

10. Corrosion is not a significant factor.
11. Materials of construction are compatible with the system fluid service.
12. The system is equipped with a properly sized, set, and functional pressure relief device(s).
13. Flexible elements are restrained to prevent whipping.

Failure Mode

14. A ductile failure mode is assumed (not brittle fracture).

Consequence of Failure

15. The result of the failure will not result in personnel injury

Safety Class

16. Applicable to ML4 only.

Allowance: ESM Chapter 17 Section IV

RL2-A. Vessel pressure rating indeterminate, or non-ASME stamped vessel without design documentation (unknown MAWP)
Risk-based engineering evaluations may be applied for FS3 deficiencies

RL2-B. Piping component pressure rating indeterminate, or unlisted piping component (unknown MAWP)
Risk-based engineering evaluations may be applied for FS2 and FS3 deficiencies

RL3-A-inside. Missing weld examination documentation (within a glove box)
Risk-based engineering evaluations should be applied for FS1 and FS2 system deficiencies to determine if further action is required

RL3-A-outside. Missing weld examination documentation (outside a glove box)
Risk-based engineering evaluations should be applied for FS1 and FS2 system deficiencies to determine if weld examination is required

RL3-B. Missing pressure test documentation
Risk-based engineering evaluations may be applied for FS2 and FS3 system deficiencies

Applicable Systems

Compressed air systems, for example oil less or non-oil less air compressors used for shop air systems, calibration gas, actuation pressures, etc…

A system with a relief device set equal to less than 150 shall be rated as FS3.

These systems shall be exempt from the requirements of having pressure test documentation, weld documentation (inside or outside the glovebox), may continue to use unlisted components, or components with an indeterminate pressure rating, or ASME non-stamped vessels.

This equipment will be considered grandfathered and will not be replaced with like items. System shall be upgraded to ASME compliance as items age out of service by attrition.

Qualitative Risk Assessment

Probability: Occasional

Consequence: Insignificant

QR Factor: 5

Table 3 Qualitative Risk (QR) Determination

			Probability				
			A	**B**	**C**	**D**	**E**
Consequence			**Frequent**	**Probable**	**Occasional**	**Remote**	**Improbable**
	I	**Major**	1	1	1	2	3
	II	**Serious**	1	1	2	3	4
	III	**Significant**	1	2	3	4	5
	IV	**Minor**	2	3	4	5	6
	V	**Insignificant**	3	4	5	6	7

LANL Review Processes

RECORD OF REVISIONS

Rev	Date	Description	POC	RM
0	9/17/2014	Initial issue. Rev of material formerly in Section I Rev. 3 Article 9; implementation plan is new.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*
1	3/15/2016	Removed reference to ML1 and ML2 when discussing NCRs	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*

Contact the Standards POC for upkeep, interpretation, and variance issues.

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A. PRID

1. If the CSPO determines that his/her early involvement in projects is necessary to ensure that they are aware of and properly execute this chapter's requirements, then CPSO shall be identified as an SME by the Permits Requirements Identification (PRID) tool at appropriate stages(s).[1]

2. *Guidance: The PRID process is a project planning tool used by project leaders to identify required permits, requirements, and facilitate SME reviews in the early planning stages of a project.*

3. *More information is located at this LANL web site.*

B. Project Pressure Safety Implementation Plan (PSIP) [2]

1. Each project must assess and plan for compliance with ESM Chapter 17 Pressure Safety. The project-specific PSIP shall be submitted to the CPSO or designee for review and approval in the early stages of project design (e.g., 30% complete) and resubmitted at later review phases (e.g., 60%, 90%) if/as it matures. The PSIP shall address all areas of pressure safety compliance including the following items:

   a. Design pressure and temperature ranges to the extent known

   b. Identification of the code(s) of record

   c. Design output expectations (designer qualifications, specifications, drawings, calculations)

   d. Fabrication expectations (methods and qualification of fabrication personnel)

   e. ASME quality (procurement, inspection, examination, and testing requirements)

   f. Required records (manufacturers data reports, examiner procedures and qualifications, welder/brazing/soldering qualifications and procedures, and ADMIN-1-1 Forms 1 through 10)

C. Pressure System Certification Process

1. General

[1] Lessons learned, RLUOB and other projects.
[2] The PSIP's submittals purpose is allow LANL to confirmation that the design agency understands the requirements of this chapter at an early stage.

a. The pressure system certification process is a formal review of pressure systems by the PSO. The program also includes recertification of a pressure system if a major modification is performed to ensure continued compliance with the program (e.g., configuration control, documentation accuracy, and compliance with the codes). It is not an ASME certification.

b. Pressure System Certification is the end of a review process that provides documentation that the pressure system has demonstrated compliance to this chapter.

c. For a new pressure system or a new modification of existing pressure system Pressure System Certification means the following:

1) New pressure systems (and new modification of existing pressure systems) must be must be fabricated as required by this chapter:

a) Code construction

b) Approved Equivalency Construction

2) System documentation meeting ADMIN 1-4

3) Maintenance of relief devices, vessels, and flex hoses have been added to an automated maintenance tracking system

d. For an existing pressure system, Pressure System Certification means:

1) Fabrication meets the minimums established by this chapter

2) System documentation meeting Attachment ADMIN-1-3

3) Maintenance of relief devices, vessels, and flex hoses have been added to an automated maintenance tracking system

2. Review Process (see Process Flow Chart below)

a. The system owner is responsible for creating the required documentation and submitting it for review to the PSO.

b. The PSO is responsible for reviewing the information and identifying any non-compliance (code or non-code) if any.

c. The system owner is responsible for addressing the issues in three ways:

1) Correct the deficiency in accordance with ESM Chapter 17 requirements

2) Deactivate the pressure system

3) Request a Variance or Alternative Method per ESM Chapter 1 Sect. Z10.

d. A Variance or Alternative Method may be requested for two cases:

1) Temporary allowance for a deviation from the requirements for a finite duration to allow for correction of the deficiency while the system continues to operate.

2) Permanent allowance for a deviation from the requirements.

e. Prior to working any issue, the Management Level Determination of the pressure system must be made in accordance with AP-341-502, Management Level Determination. This determination is required information as part of Form 1 (FM01).

f. Whenever code non-compliance deficiencies are found, the PSO or system owner must initiate a Nonconformance Report (NCR) when required by LANL Procedure P330-6.

g. After any non-compliances (code or non-code), if any, are resolved the PSO reviews the systems and the documentation and the CPSO or designee approves the system.

h. The PSO or designee inputs the data into the data repository for maintenance; the maintenance process is now instituted that will notify personnel when the pressure safety maintenance items are due (relief devices retest/replacement, vessel inspections, flex-hose inspection)

i. The CPSO or designee issues the Active sticker to the system owner or PSO who places it on the system identification tag.

Note: This system is now certified

3. Authorization to Operate Pending Certification for New Low Risk Systems

a. Authorization to Operate Pending Certification may be applied to low risk programmatic systems that meet all of the following criteria:

1) ASME B31.3 Fluid Category Normal or D (does not include steam, Category M, or high pressure).

2) The system pressure is not greater than 150 psig, based on the relief device set point.

3) Operation is within the temperature and pressure ratings of the manufactures.

4) Pressure cycles are less than 100,000 for all system components.

5) Corrosion is not a significant factor.

6) Mechanical assembly using listed components, ASME VIII stamped equipment, and/or CPSO approved components.

7) The system components have exhibited successful service experience under comparable conditions with similarly proportioned components of the same or like materials.

b. For Authorization to Operate Pending Certification, an Owner's Inspector or a Duty Area B qualified PSO must perform the following:

1) Inspect the low risk pressure system and be sure the system is adequate for the pressure or has appropriate sized relief protection.

2) Observe the code leak test, and fill out the appropriate Owner's Inspector check list.

3) Verify any necessary examination is performed.

4) Call the CPSO for a pressure system identification tag for the system.

c. The CPSO office will:

1) Issue the non-repeating pressure system number to the PSO.

2) Log the pressure system into the database.

3) Approve a 6-month operational period for the pressure system.

4) Attach an Active sticker to the system indicating the "Due Date" of the pressure system certification.

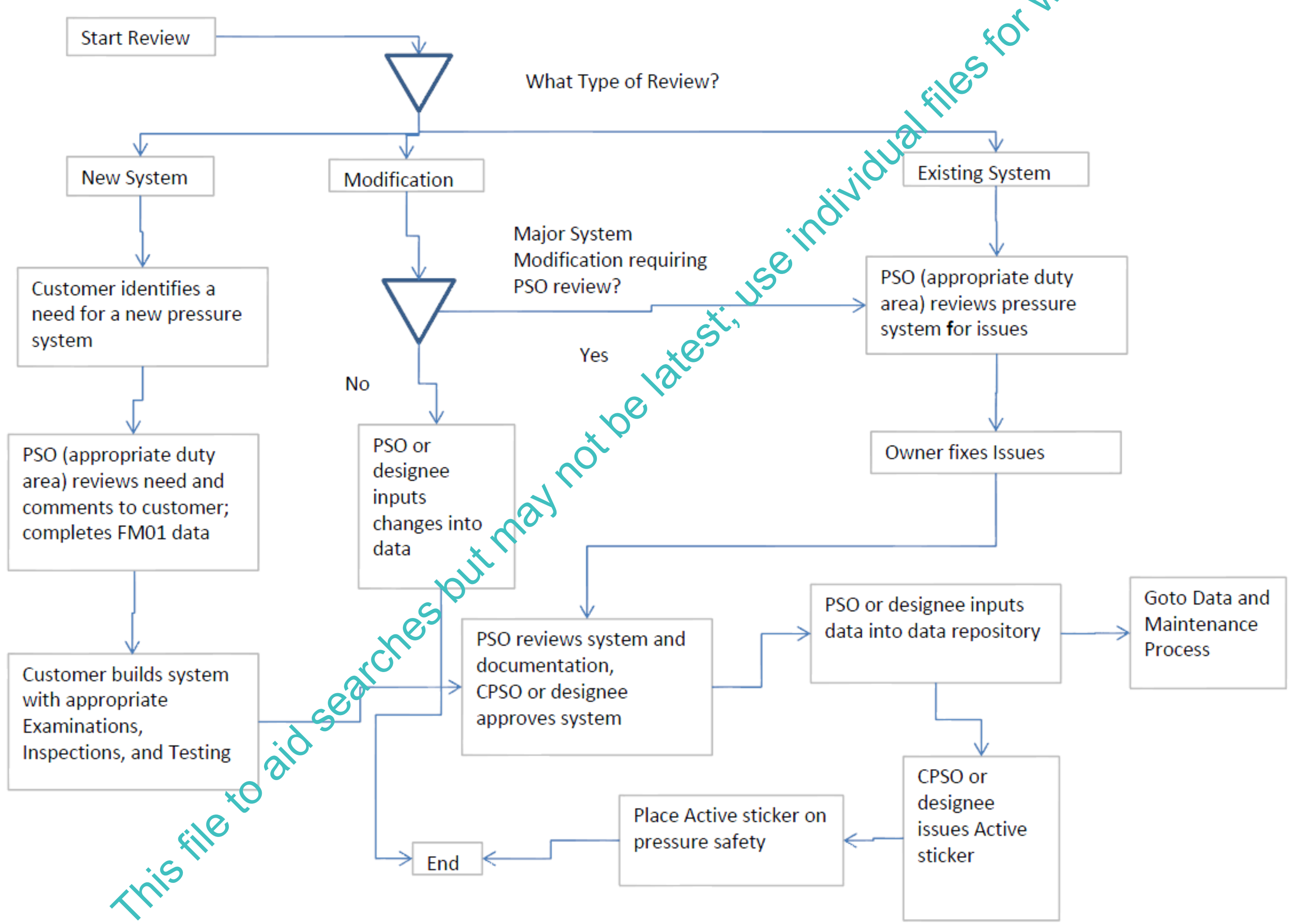
d. After six months the system is required to be certified using the normal process or the pressure system must be disconnected and disassembled.

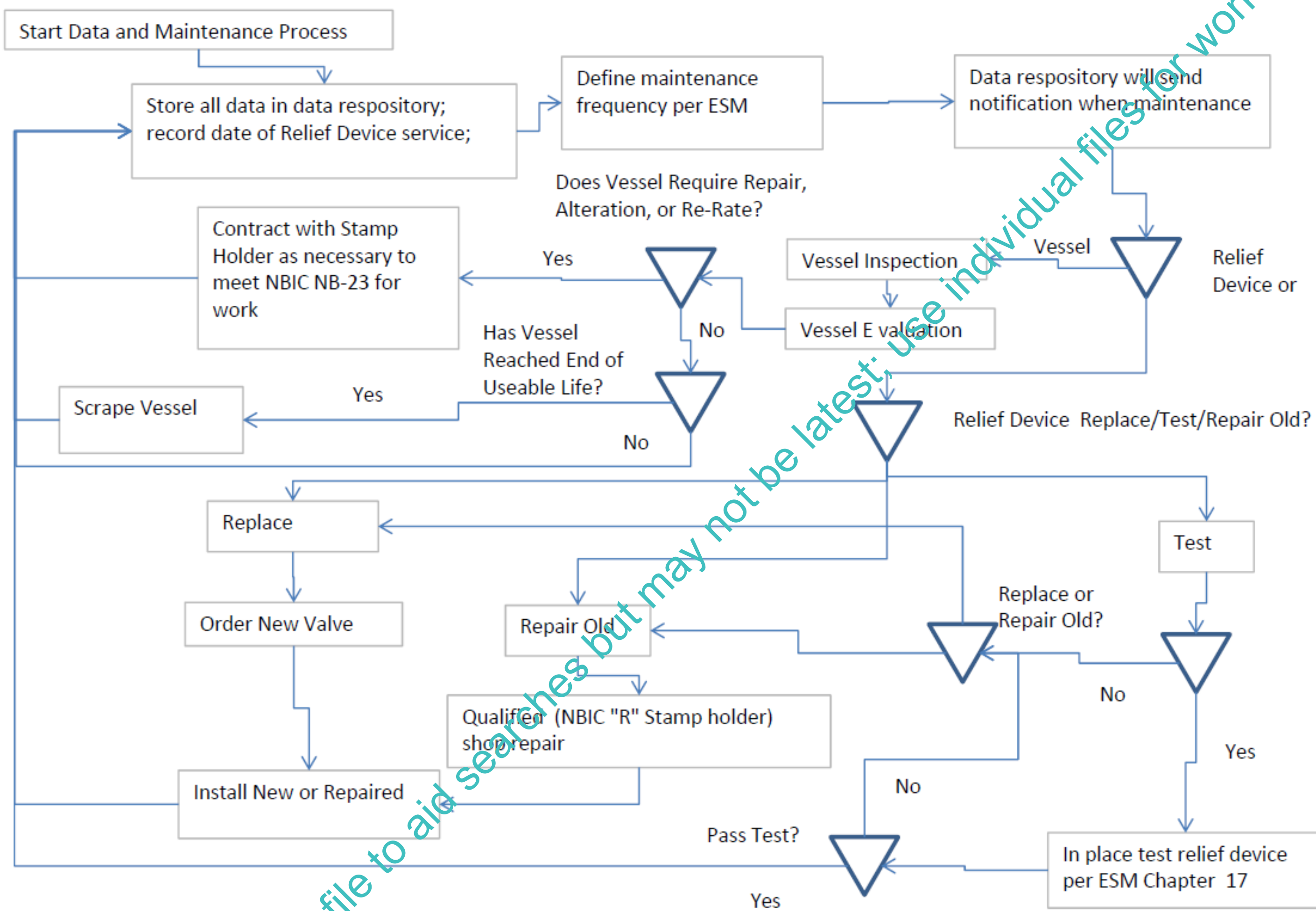
4. Other Issue Resolution

a. Inactive, deactivated, or other non-active pressure systems may be operated in order to achieve active status (e.g., perform leak checks) after the PSO has reviewed the system design, configuration, and documentation package to verify there are not safety issues.

b. Any system found to be unsafe in the opinion of the System Owner, PSO, or CPSO must be reported to the system owner and the appropriate FOD and/or RAD. Appropriate action must be taken to insure the safety of personnel.

5. Certification Process Flow Chart




Start Data and Maintenance Process
Store all data in data respository; record date of Relief Device service;
Define maintenance frequency per ESM
Data respository will send notification when maintenance
Does Vessel Require Repair, Alteration, or Re-Rate?
Contract with Stamp Holder as necessary to meet NBIC NB-23 for work
Yes
Vessel Inspection
Vessel
Relief Device or
Vessel E valuation
No
Has Vessel Reached End of Useable Life?
Scrape Vessel
Yes
No
Relief Device Replace/Test/Repair Old?
Replace
Test
Order New Valve
Repair Old
Replace or Repair Old?
No
Qualified (NBIC "R" Stamp holder) shop repair
Yes
Install New or Repaired
No
Pass Test?
In place test relief device per ESM Chapter 17
Yes

6. Conflict of Interest

   a. If a PSO owns or uses pressure systems, they may not review or approve their own systems. They must be reviewed by an uninvolved PSO.

   b. When the CPSO has designated certification approval the CPSO and the PSO cannot be the same person to prevent conflict of interest.

7. Documenting Non-conformances

   a. Forms FM03 and FM04 or equal must be completed for all deficiencies.

   b. A completed copy an applicable NCR (Form 2082) shall be maintained in the system documentation package.

8. Deactivating a Pressure System

   a. The responsible System Owner deactivates the particular pressure system as follows:

      1) Remove hazardous materials from the system.
      2) Reducing system pressure to ambient
      3) Physically disconnect the system from all pressure sources.

   b. The PSO reviews the system and if the deactivation is acceptable updates the certification tracking database with date of deactivation.

   c. The PSO submits note into pressure system documentation package that system is not active, and maintains package in IRM document control repository.

   d. The PSO annotates the Pressure System Certification Status Form with the date the system became inactive and places the "Inactive" sticker on the system identification tag.

   e. PSO informs the CPSO that the pressure has been deactivated, and inactivates the related components in CMMS.

   f. CPSO or delegate updates certification tracking database showing the system as inactive.

   g. If system is to be disassembled perform the following:

      1) Notify IRM that documentation may be archived.
      2) The database tracking system entries must be archived.
      3) The identification tag must be returned to the CPSO.

9. Pressure System Identification Tag

a. Pressure systems must be marked with a system identification tag (see below), which will be supplied by the CPSO.

b. The purpose of this tag is to provide a means of identification and inventory of the system. The identification number on this tag must match the pressure system documentation package identification number. This system identification number is unique to each individual system.
Guidance: The tag should be attached using stainless lock-wire or zip-ties anywhere on the system in open view, where the most visible portion of the pressure system is located. To be attached by the PSO or designee.

c. Tags must not be placed on removable components such as gas cylinders. Further, tags may not be removed from the system without notifying the CPSO.

10. Status Stickers

a. Status indication "stickers" may only be generated by CPSO-approved method (i.e., system owner may not print their own "stickers"). System certification dates will be tracked through the Pressure Safety Certification System (PSCS) database.

b. "Inactive" stickers must be issued for those pressure systems that have been removed from the pressure source, are not designated to be disassembled, and are considered to become operational in the future. Inactive systems must be physically disconnected from the pressure source.

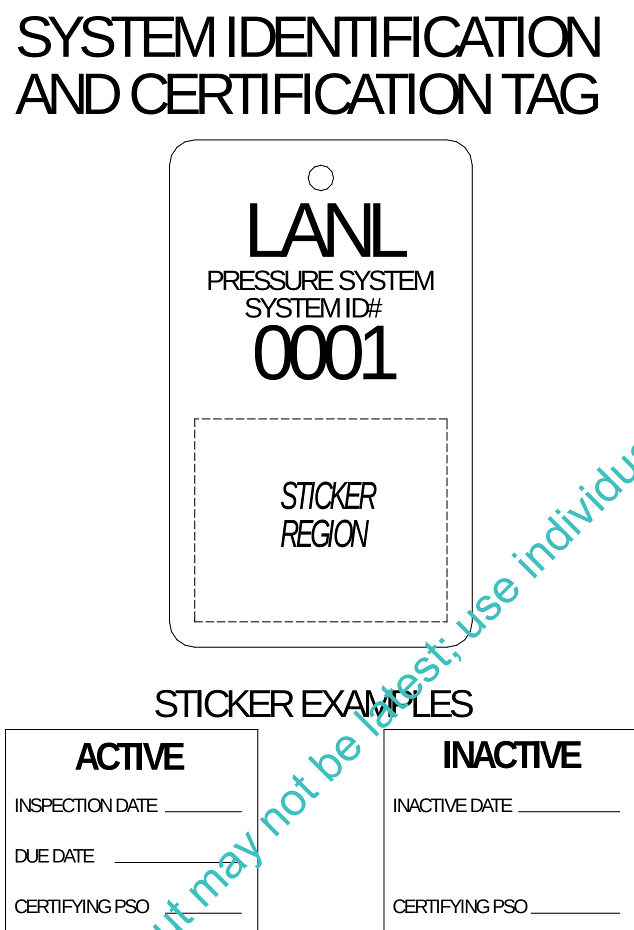
c. "Active" stickers must be issued for those pressure systems that have been certified and approved to operate as per the requirements of this document.

d. *Guidance: "Stickers" should be covered with UV-resistant tape such as Kapton® or other similar transparent, UV-resistant tape, after being applied to the identification tag.*

e. Damaged or lost stickers can be replaced through request to the CPSO, who will verify certification status in the pressure systems database prior to issuing a new sticker.

f. LANL does not issue "Excluded" stickers instead the word "Excluded" is written on the inventory tag, and the data repository is marked as "Excluded".

g. LANL does not issue "Exempt" stickers instead the word "Exempt" is written on the inventory tag, and the data repository is marked as "Exempt".



11. System Relocation/Disassembly Notification Process

   a. If a pressure system is to be relocated on laboratory property, have the PCSC updated with the new location.

   b. If a pressure system is to be relocated off LANL property, updated the PSCS to indicate the system has been removed from LANL

   c. When a system is to be disassembled and removed from service, have the PSCS updated to indicate that the system has been removed from service.

ATTACHMENTS

Attachment ADMIN-1-1, Pressure Safety Forms (FM01 - FM10)

Attachment ADMIN-1-2, Form Directions (FM01 - FM10)

Attachment ADMIN 1-3, Existing Pressure System Documentation

Attachment ADMIN 1-4, New Pressure System Documentation

Attachment ADMIN 1-5, Pressure System Owner Checklist (Guidance)

Attachment ADMIN-1-6, Risk-Based Certification Processing and Maintenance (Guidance)

RECORD OF REVISIONS

Rev	Date	Description	POC	RM
0	9/17/2014	Initial issue. Supersedes forms associated with Section I Rev 3.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*
1	4/15/2015	Removed signatures from forms and incorrect citations from FM10	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*
2	3/15/2016	Removed footnote 3 referencing ML1 and ML2 on FM04. Fixed footnoting errors	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*

Contact the Standards POC for upkeep, interpretation, and variance issues.

Chapter 17	**Pressure Safety POC and Committee**

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Pressure Safety Forms FM01 - FM10

1. The appended forms are samples provided to illustrate the minimum information required[1].
2. The information shall be managed as a record and must comply with LANL P1020-1 *Laboratory Records Management*, and P1020-2, *Laboratory Document Control*. Normally this information will be placed in the PSCS database and then EDMS.
3. Any spreadsheet-based or individual Word forms posted online with this chapter may be used in lieu of these samples.

[1] As such may be revised for format or to reduce required information with POC and Standards Manager approval as an admin change.

FM01	Pressure System Certification Status Form
FM02	PRV Recall Summary Sheet
FM03	Code Non-Compliance Log
FM04	Minor Non-Compliance Log
FM05	Flexible Pressure Element Visual External Examination
FM06	Tubing and Piping Data Sheet
FM07	Pressure System Component List
FM08	Relief Device Placement Verification Record
FM09	Thrust Consideration Data Sheet
FM10	System Schematic

Additional direction on how the forms are used, and what is specifically required to document a pressure system, is provided in the following attachments to ADMIN-1:

ADMIN-1-2	Form Directions
ADMIN-1-3	Existing (Legacy) Pressure System Documentation Requirements
ADMIN-1-4	New Pressure System Documentation Requirements

FM01

Pressure System Certification Status Form

(Place this form in pressure system documentation package when completed)

System ID No.:	Excluded System: Yes ☐ No ☐
Other System Identification Name (or Number):	
System Location (TA-BLDG-Room): - - (Not applicable if mobile)	
Mobile System "T" Number: (Not applicable if mobile)	
System Contents (N_2, AR, etc.): (Do not list if Classified)	
System Fluid Category (FS1, FS2, FS3):	
System Design Pressure:	
System Design Temperature Minimum	
System Design Temperature Maximum	
PRD Set Pressure(s)	
Applicable ASME B&PVC Section for System:	Applicable B31 Code for system:
System Owner:	Phone/Pager:
Last Re-certification (MM/DD/YY):	
Next Re-certification (MM/DD/YY):	
Reviewer Name:	

Notes:

Approval Signature List:	**Printed Name & Z #**	**Signature**	**Date**
FOD PSO Certification			
CPSO Certification			

FM02

PRV Recall Summary Sheet

System Name and ID No.:								
Pressure Relief Device Component Number	**Manufacturer**	**Model Number**	**MAWP (PSIG)**	**Set Pressure (PSIG)**	**Test date**	**Due Date**	**PRV Test Lab Report #**	**Flow check procedure or Calculation Number**

FM03

Code Non-Compliance Log*

System ID No.:	
System Description	
Page _____ of _____	

Description	Code Requirements (Section, Chapter & Paragraph)	Closure & Rationale	Closure date & LANL PSO Signature & Z #

* Examples are: Undersized relief device, wrong set pressure on relief device, weld repairs without “R” stamp, component MAWP less than design system pressure, un-supported piping, unknown materials used in construction, unknown design pressure, failure to perform and document code required inspections and testing, etc.

FM04

Minor Non-Compliance Log[1]

System ID No.:	
System Description	
Page _____ of _____	

Description	Requirement (LANL Document, Section & Paragraph)	Closure & Rationale	Closure date & Initials	
			Owner	FOD PSO

[1] Examples of minor non-compliances are: Relief device past recall due date, in-service inspections past due date, chipped paint, lack of flex-hose restraints, leaking fittings, surface anomalies, identification tags, schematics do not match physical layout, mud dauber nests in relief valve discharge ports.

FM05

Flexible Pressure Element Visual External Examination

System ID No.:		
Date of Inspection	FOD PSO Signature & Z #	

Component Number	MAWP	Integrity		Are Flex Hose Restraints used Yes or No	Flex Hose Restraint	
		ACCEPTABLE (good condition, no visible flaws)	**UNACCEPTABLE (Describe)** (kinks, frayed, crushed, etc.)		**ACC**	**UNACC**
					☐	☐
					☐	☐
					☐	☐
					☐	☐
					☐	☐
					☐	☐

FM06

Tubing and Piping Data Sheet[1]

System ID No.:	Drawing #		Date	

Components that tubing/Piping section is located between. **(eg. MV-4 & PI-3)** *This is N/A if all piping/tubing is the same size and type throughout entire system*	**Tubing Material** **(SS, CU, CS, etc.)**	**Tubing Spec./Grade** **(316-A26, 304L-A358, etc.)**	**OD (in.)**	**ID (in.)**	**Seamless**		**Max Operating Temp °F**
					☐ **Yes**	☐ **No**	
					☐ **Yes**	☐ **No**	
					☐ **Yes**	☐ **No**	
					☐ **Yes**	☐ **No**	
					☐ **Yes**	☐ **No**	
					☐ **Yes**	☐ **No**	
					☐ **Yes**	☐ **No**	

[1] This data sheet accomplishes the requirements found in ASME B31.3, Paragraph 323.1.3

FM07

Pressure System Component List *
Pressure system documentation package I.D. Number:
System Location (TA-BLDG-Room): - -

Component I.D.	Manufacturer	Model Number	Material (316S.S., Brass, etc.)	MAWP	Soft Goods Material(s)[1]	Code Stamp (U, UV,etc.)[2]	Listed Item (Y/N)	Code of Item

[*] This form accomplishes configuration control requirements, allows for quick viewing of system piping component characteristics and to ensure adequate pressure relief has been provided. Components found on this form must be found on the system drawing, and visa-versa.
[1] Unknown is an acceptable answer for inert systems, where material compatibility is not an issue.
[2] N/A (Not applicable) is an acceptable answer if component is not code stamped

FM08

Relief Device Placement Verification Record[1]

This form is to be maintained in the pressure system documentation package.

1) Perform system review. Identify placement of all components in the pressure system in relationship to a pressure relief device. Can any components be isolated from a pressure relief device? (i.e., can a valve be closed which blocks flow path to a relief device?)

Yes ☐ No ☐

List below all the components that can be isolated from a pressure relief device. (attach sheets as necessary)

a) ____________ b) ____________ c) ____________ d) ____________

e) ____________ f) ____________ g) ____________ h) ____________

2) Is the MAWP, of any of the identified components, less than the system source supply pressure?

Yes ☐ No ☐

If yes, list components below, and re-design system to provide over pressure protection for the listed components.

Component I.D.	Manufacturer	Model	MAWP (psig)

[1] This data sheet accomplishes the requirements of ASME B31.3, Paras. 301.2.1 & 301.2.2

FM09

Thrust Consideration Data Sheet [1]

Use for all manual valves, nozzles, relief devices, solenoid valves, (etc.) in a system that discharge to the ambient surroundings.

Component Identification String	Fluid	I.D. of nozzle/tubing at discharge (inches)	Maximum source pressure (psig)	Maximum surge or sustained thrust (lbf)	Type of restraint Mechanism (if any installed)	Maximum loading restraint can withstand [2] (lbs)

[1] This data sheet accomplishes the requirements of ASME B31.3, Paragraph 301.5.5, 322.6.2 & Appendix G
[2] As determined by manufacturers' documentation, finite element analysis, calculations, catalog description, etc.

FM10

System Schematic (Sample)

Sketch the pressure system

System I.D. Number	Relief Device Component I.D.	Sketcher/Evaluator Name	Date

Minimum Acceptable Documentation Necessary to Meet the Requirements of ESM Chapter 17

RECORD OF REVISIONS

Rev	Date	Description	POC	RM
0	9/17/2014	Initial issue.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*

Contact the Standards POC for upkeep, interpretation, and variance issues.

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Use the tables in this document as a checklist. Some items listed may not be required if there is not an item that fits the description in the pressure system. Some examples are:

> If the pressure system does not contain a vessel (as defined in ASME Boiler and Pressure Vessel Code Section VIII, Div 1, paragraph U-1(c)(2)), then Table ADMIN-1-1 items #4 "Code Stamped Vessel Fabrication Documentation" and item #5 "Non-ASME code Fabricated Vessel Information (code-equivalent Documentation)" are not required.
>
> If a system is located inside a temperature controlled environment and will not experience relatively large thermal cycles than a calculation evaluating thermal growth is not required.

As stated in elsewhere in this chapter, "Information required on system drawings and schematics may be documented in alternative documents or captured in controlled databases, such as the MEL or the CMMS, but must be referenced and readily available for review. The evaluation shall be considered a record and must be managed per LANL P1020, P1020-1, and P1020-2"

How to determine which forms are required is as follows:

Form Number	Description of Form	Notes
FM01	This form (or equivalent) is required for all packages. This form has been modified to state "Signature of the PSO indicates that all deficiencies have been resolved, including deficiencies tracked in PFITS", and "Signature of the PSO indicates that the Maximum Allowable Working Pressures (MAWPs) of the system components have been reviewed and that the set point of the pressure relief valve is equal to lower than, the lowest component MAWP".	
FM02	This form (or equivalent) is required for all packages. This form is required to be loaded into the Pressure Safety Certification System database with the minimum information required for CMMS entry (see the Attachment 2: Minimum Required Data Entry into CMMS).	As an alternative to directly loading this information into the database, a direct entry into the CMMS maybe performed and documentation of the update submitted with the pressure system package for certification.
FM03	In accordance with the note on FM01, all FM03 entries will have been closed prior to submission for certification.	The PSO or CPSO may elect to use FM03 or DRR forms to comment on the pressure safety package submission.
FM04	In accordance with the note on FM01, all FM04 entries will have been closed prior to submission for certification.	The PSO or CPSO may elect to use FM04 or DRR forms to comment on the pressure safety package submission.
FM05	If flexible elements (not non-metallic pipe/tube) are system components, an inspection of the hoses will be performed to ensure they are still adequate for the application.	Evaluation of hoses may be performed to manufacturer guidelines or Designer specified requirements.
FM06	Specifies actual pipe or tube material, thickness, and size used in the construction.	This form is not required if the information is included as part of the system schematic sketch, an Excel spreadsheet, or Master Equipment List
FM07	A listing of system components is required.	This form is not required if the information is included as part of the system schematic sketch, an Excel spreadsheet, or Master Equipment List
FM08	If the system is designed for the system pressure or protected by a relief device this form is not required.	

Form Number	Description of Form	Notes
FM09	A reference to a bounding calculation (see Notes) is sufficient to show that thrust considerations have been considered.	Bounding calculations could be, for example: System 4980 PSV set at 225 psig reaction loads showed 52 lbf; System 4375 PSV set at 200 psig showed 80 lbf on a ¼ inch elbow. All forces were absorbed by the tubing systems and normal tubing supports.
FM10	System schematic sketch	
FM11	Not required	This was used by the walkdown team to document the configuration of the relief protection.

Additional Information Required for Pressure System Packages

Relief Protection

A formal pressure relief device calculation is required for all systems. This calculation may be a comparison using the LANL approved calculations, CALC-10-00-786-PSS-GEN-00001 Rev.0 and CALC-10-00-786-PSS-GEN-00001 Rev.0, (or successors) assuming the conditions of the calculations are met.

Component MAWP or Rating

Supporting documentation must be presented that contains manufacturer's rating of items that are not ASME B31.3 piping components.

> ASME B31.3-2010 paragraph 300.2 **Definitions**:
> *piping components:* mechanical elements suitable for joining or assembly into pressure-tight fluid-containing piping systems. Components include pipe, tubing, fittings, flanges, gaskets, bolting, valves, and devices such as expansion joints, flexible joints, pressure hoses, traps, strainers, inline portions of instruments, and separators.

Examiners and Examinations

An Examiner with the necessary training and experience must be appointed by the Responsible Line Manager in accordance with LANL Policy P330-8, paragraph 3.6.

3.6 Inspection and Test (I/T) Personnel Qualification/Certification

The RLM will appoint appropriate personnel and identify the qualification requirements for qualifications/certifications not identified in this section.

Qualification records of I/T workers must be maintained as a record in accordance with P1020-1, *Laboratory Records Management*.

3.6.7 Test Personnel

Test personnel must have the knowledge, skills, and abilities to adequately and safely perform the required test process. In some cases, specific qualification and certification requirements will apply.

These requirements must be specific in the test plan or procedures. Organization-specific qualification and certification procedures may be necessary (e.g., boiler and pressure vessel test, leak testing).
Note: For guidance on content and approval of test personnel qualification and certification contact the QA Division at 665-5437 or Engineering Services Division at 606-0600.

The following is required by ASME Code B31.3-2010:

342.1 Personnel Qualification and Certification
Examiners shall have training and experience commensurate with the needs of the specified examinations. The employer shall certify records of the examiners employed, showing dates and results of personnel qualifications, and shall maintain them and make them available to the Inspector.

346.3 Retention of Records
Unless otherwise specified by the engineering design, the following records shall be retained for at least 5 years after the record is generated for the project:

(a) Examination procedures

(b) Examination personnel qualifications

Examiner certificates must be supplied indicating that the necessary examinations were performed and acceptable. This is required by the ASME Code B31.3-2010:

341.4.1 Examination — Normal Fluid Service.

(c) Certifications and Records. The examiner shall be assured, by examination of certifications, records, and other evidence, that the materials and components are of the specified grades and that they have received required heat treatment, examination, and testing. The examiner shall provide the Inspector with a certification that all the quality control requirements of the Code and of the engineering design have been carried out.

Owner's Inspector Report

A LANL Owner's Inspector, qualified and accepted by the LANL Construction Management, shall perform an evaluation of the system in accordance with their standard procedures. A LANL qualified Duty Area B PSO may serve as an Owner's Inspector for piping systems which fall under the scope of ASME B31.3.
A copy of the Owner's Inspector checklist and report is required to be included in the pressure safety package.

Leak Testing

Leak Test is a code term for a pressure test conducted on the pressure system before it is ready for operation. A Leak Test report is required to be included in the pressure safety package.

Calculations

For existing FS-2 and FS-3 systems it is appropriate to apply engineering judgment for existing pressure systems with successful service history, and not perform strict engineering evaluations when evaluating small pipe size, indoor locations, with adequate supports, and low relief energies. The evaluation must not conflict with safety basis.

Existing (including Legacy) System Documentation Requirements[1]

RECORD OF REVISIONS

Rev	Date	Description	POC	RM
0	9/17/2014	Initial issue. Modification of Table 16.1 of Chapter 17, Section I, rev. 3.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*
0.1	5/04/2016	Reference correction in Table ADMIN-1-3-1, Documentation Requirements for Existing (including Legacy) Systems, 9. Piping System Documentation.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*

Contact the Standards POC for upkeep, interpretation, and variance issues.

Chapter 17	**Pressure Safety POC and Committee**

This document is online at http://engstandards.lanl.gov

Table ADMIN-1-3-1

Documentation Requirements for Existing (including Legacy) Systems

Documentation Package Item	Required When	Owner Verification	PSO Verification
1. Form 1, LANL Pressure System Certification Status Form	Every Package		
2. Form 3, Code Non-Compliance Log (Form can be printed from Pressure Safety Database by PSO)	If Applicable		
3. Form 4, Minor Non-Compliance Log (Form can be printed from Pressure Safety Database by PSO)	If Applicable		
4. System schematics (If the owner does not have a system schematic, utilize the sketch prepared by the walkdown team until such time as system schematic is prepared)[2]	Every Package		

[1] The requirements for existing systems reflect the graded approach described in other sections of this Chapter, and take credit for successful operating history.

[2] Information required on system schematics may be documented in alternative documents or captured in controlled databases, such as the Master Equipment List (MEL) or Computerized Maintenance Management System (CMMS), but must be referenced and readily available for review. The evaluation shall be considered a record and must be managed per LANL P1020, P1020-1, and P1020-2

Existing (including Legacy) System Documentation Requirements

Documentation Package Item	Required When	Owner Verification	PSO Verification
5. Alternate Method/Variance or clarification/interpretation (if applicable).	If the system or any item of the system has an applicable alternate method/variance or clarification/interpretation to the requirements of this document		
6. Code Stamped Vessel Fabrication Documentation	If the code data report is not available, a manufacturer's construction drawing may be used to verify the item has not been modified. If the manufacturer's construction drawing is not available, personal knowledge may be used to establish the code stamped item has not been modified. This requires a person or persons with intimate and long term personal knowledge since original receipt and installation of the item to create a statement of compliance. This statement of compliance will be used to document the history of the item and be used as evidence the code stamped item has not been modified. This statement of compliance will be signed by the persons of record.		
7. Non-ASME code Fabricated Vessel Information (code-equivalent Documentation)	The pressure system contains Non-ASME-code stamped boilers and pressure vessels (which includes boilers, pressure vessels, heat exchangers, and accumulators)		
a. ASME code equivalent documentation for systems with pressure vessels which includes but is not limited to minimum wall thickness determination, corrosion allowance, weld efficiency rating, support structure loading, nozzle calculations. Calculations will use the material values specified in the ASME code.	A non-code boiler, pressure vessel, heat exchanger or accumulator is in the pressure system package		
b. Pressure Qualification Test Procedures and data OR in-service leak test for FS2 and FS3 as allowed in ESM Chapter 17.	Non-code boiler, pressure vessel, heat exchanger or accumulator is in the pressure system package		
c. Modification procedures/instructions	Modifications were made to non-code boilers, pressure vessels, heat exchangers or accumulators is in the pressure system package		
d. Non Destructive Evaluation (NDE) data reports	NDE was done to non-code boilers, pressure vessels, heat exchangers or accumulators is in the pressure system package		
e. Weld examination forms as described in ESM Chapter 13.	Welding was done to non-code boilers, pressure vessels, heat exchangers or accumulators is in the pressure system package		
f. Special Calculations such as welding	Special calculations are performed for non-code boilers, pressure vessels, heat exchangers or accumulators is in the pressure system package		

Existing (including Legacy) System Documentation Requirements

Documentation Package Item	Required When	Owner Verification	PSO Verification
g. Vendor Drawings	Piece parts are used to fabricate non-code boilers, pressure vessels, heat exchangers or accumulators is in the pressure system package		
h. Vessel modification reports	Vessel is modified from the as purchased condition.		
8. Pressure Safety Devices	The pressure system contains a pressure safety device (which includes but is not limited to relief valves and rupture discs)		
a. Flow Test documentation as described in this Chapter, if required	Whenever a relief valve has been modified, or when calculations cannot be generated.		
b. Safety Relief Calculations for relief valves and/or rupture discs, in accordance with ASME requirements	Every Package, unless calculations cannot be generated, a flow test is required in place of calculations.		
c. Pressure Relief Calculations for Rupture Disks in accordance with ASME requirements	Rupture Disks are in the pressure system		
d. Certified Test Data of relief valves, e.g. steam Pressure safety valves are certified by NBIC coded shop	A PRD is modified or tested by an outside facility		
e. Documentation of relief valve modification, (for example valve repair, orifice replacement, gasket replacement,	If a relief valve has been modified		
f. Identification as a liquid lock PRD on PRV Recall Summary Sheet and pressure system Component List spread sheet; in accordance with ASME B&PV Code	PRDs are used as protection against liquid lock overpressure. See ASME B&PVC UG-128.		
9. Piping System Documentation:			
a. Provide documentation required under "Section EXIST - Legacy System Requirements [*4.0 Disposition Requirements for Existing (Legacy, etc.) Pressure Systems*]"	The system contains pipe, tube, or other components not classed as boilers or vessels.		
b. Code required calculations e.g. flexibility analysis, pipe supports, wind loading, and seismic loading. See specific code for additional detail. (e.g. B31.3 paragraph 319 and 321)	A pressure system package contains piping system components		
10. Flexible pressure element external visual inspection records (Form 5)	The system contains flexible hoses		

Documentation Package Item	Required When	Owner Verification	PSO Verification
11. Pump or compressor discharge pressure curves, calculation, or table (If available)	The pressure system contains pumps or compressors		
12. Oxygen System Hazard Analysis (if applicable)	Pressure system is an oxygen system		

REDUCED REQUIREMENTS (LOW RISK)

System documentation requirements of Table ADMIN-1-3-1 may be reduced for legacy systems meeting the following criteria:

1. The pressure system is not subject to low-cycle fatigue (where significant plastic straining occurs).
2. High-cycle fatigue (where stresses and strains are largely confined to the elastic region) is controlled to less than 100,000 cycles for the life of the pressure system.
3. Corrosion is not a significant factor.
4. There are no stress intensification factors for examples cracks or acute angles of pressure boundaries.
5. The system components have exhibited extensive, successful service experience under comparable conditions with similarly proportioned components of the same or like materials.
6. The pressure system is not high pressure as defined by ASME B31.3 2010 Chapter IX.
7. The pressure system is fluid is not Category M fluid as defined by ASME B31.3 2010.
8. The pressure system fluid is not steam.
9. The pressure system does not operate in the creep range.
10. The pressure system is not an ASME Section I, IV, VIII, or XII stamped item or an unstamped item performing the same task (e.g. a code equivalent vessel).
11. ASME B31.3 Fluid Category Normal or D.

When the above criteria are met, the system must pass an initial service leak test at the normal system operational pressures. Then, Table ADMIN-1-3-1 items 7.b-f, 9.a-b, and 10 are not required and Table ADMIN-1-3-1 becomes Table ADMIN-1-3-1ALT as follows:

Table ADMIN-1-3-1ALT

Alternative Documentation Requirements for Existing (including Legacy) Systems[3]

Documentation Package Item	Required When	Owner Verification	PSO Verification
1. Form 1, LANL Pressure System Certification Status Form	Every Package		

[3] The requirements for existing systems reflect the graded approach described in other sections of this Chapter, and take credit for successful operating history.

Existing (including Legacy) System Documentation Requirements

Documentation Package Item	Required When	Owner Verification	PSO Verification
2. Form 3, Code Non-Compliance Log (Form can be printed from Pressure Safety Database by PSO), or reference on Form 1 to closed PFITS issue numbers.	If Applicable		
3. Form 4, Minor Non-Compliance Log (Form can be printed from Pressure Safety Database by PSO), or reference on Form 1 to closed PFITS issue numbers	If applicable		
4. System schematics (If the owner does not have a system schematic, utilize the sketch prepared by the walkdown team until such time as system schematic is prepared)[4]	Every package		
5. Alternate Method/Variance or clarification/interpretation (if applicable). Only include system-specific, rather than generic, alternate methods, variances, clarifications, or interpretations.	If the system or any item of the system has an applicable alternate method/variance or clarification/interpretation to the requirements of this document		
6. Code Stamped Vessel Fabrication Documentation	If the code data report is not available, a manufacturer's construction drawing may be used to verify the item has not been modified. Record the NBIC tag number. If the manufacturer's construction drawing is not available, personal knowledge may be used to establish the code stamped item has not been modified. This requires a person or persons with intimate and long term personal knowledge since original receipt and installation of the item to create a statement of compliance. This statement of compliance will be used to document the history of the item and be used as evidence the code stamped item has not been modified. This statement of compliance will be signed by the persons of record.		
7. Pressure Safety Devices	The pressure system contains a pressure safety device (which includes but is not limited to relief valves and rupture discs)		

[4] Information required on system schematics may be documented in alternative documents or captured in controlled databases, such as the Master Equipment List (MEL) or Computerized Maintenance Management System (CMMS), but must be referenced and readily available for review. The evaluation shall be considered a record and must be managed per LANL P1020, P1020-1, and P1020-2

Documentation Package Item		Required When	Owner Verification	PSO Verification
	a. Flow Test documentation as described in this Chapter, if required	Whenever a relief valve has been modified, or when calculations cannot be generated.		
	b. Safety Relief Calculations for relief valves, in accordance with ASME requirements	Every Package, unless calculations cannot be generated, a flow test is required in place of calculations.		
	c. Pressure Relief Calculations for Rupture Disks in accordance with ASME requirements	Rupture Disks are in the pressure system		
8.	Certified Test Data of relief valves, e.g. steam Pressure safety valves are certified by NBIC-coded shop	A PRD is modified or tested by an outside facility		
	a. Documentation of relief valve modification, if required	If a relief valve has been modified		
	b. Identification as a liquid lock PRD on PRV Recall Summary Sheet and pressure system Component List spread sheet.	PRDs are used as protection against liquid lock overpressure.		
	c. Pump or compressor discharge pressure curves, calculation, or table (if available)	The pressure system contains pumps or compressors		
	d. Oxygen System Hazard Analysis (if applicable)	Pressure system is an oxygen system		

Qualitative Risk-Based Evaluation (QR)-based Documentation Requirements for Legacy Pressure Systems

Tables ADMIN-1-3-A through ADMIN-1-3-U

Summary

In addition to the ADMIN-1-3-1ALT option above, and unless required by the CPSO (or when required by the risk-based evaluation), no detailed design information is required for B31.3 legacy pressure system documentation for systems that meet certain evaluation categories. This includes code-required piping and support calculations (e.g. ambient effects, weight effects, dynamic effects, flexibility analysis, pipe supports, wind loading, and seismic loading) see specific code for additional detail (e.g. B31.3 paragraphs 301.4 to 301.11, 319, and 321). In addition, no examination or inspection reports are required. These exemptions do not apply to pressure vessel and relief device analyses.

It is the user's responsibility to ensure that systems that use these general pressure system legacy risk evaluations meet all the criteria established by the QR contained in this document.

The requirements for a general legacy pressure system with the highest hazard rank shall dominate for that specific portion of the pressure system. If other portions of the pressure system are engineered differently at a lower hazard rank, then those portions of the pressure system may be evaluated to the applicable general legacy pressure system risk-based engineering evaluation.

Table 1-3-1-SUM summarizes documentation required for certification of pressure system that meet the General Legacy Pressure System Description. The "Replacement Table ADMIN-1-3-" column defines which table will replace the Table ADMIN-1-3-1 requirements.

Information required on system schematics or forms may be documented in alternative documents or captured in controlled databases such as the Master Equipment List (MEL) or Computerized Maintenance Management System (CMMS), but must be referenced and readily available for review. The information shall be considered a record and must be managed per LANL P1020, P1020-1, and/or P1020-2.

Table 1-3-1-SUM Summary of Legacy Qualitative Risk-Based Engineering Matrix Requirements

Evaluation Category	General Legacy Pressure System Description	Fluid Service	Hazard Rank	Replacement Table ADMIN-1-3-	PSO/CPSO Certification FM01	Relief Protection Calculation and FM02	ASME Vessel or Equivalent Calculations	Pipe/Tube Wall Thickness FM06	Known Component MAWP FM07	Sketch FM10	Piping and Support Design Calculations
1	High Pressure – Pneumatic	FS1	1	A	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	No
2	Toxics (Category M)	FS1	2	B	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	No
3	Steam	FS2	3	C	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
4	High Pressure – Liquid High Volumetric Rate	FS1	4	D	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	No
5	Corrosive[1]	FS2, FS3	5	E	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	No
6	Brittle Failure Mode (not leak before burst)	FS2, FS3	6	F	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	No
7	Oxygen[2]	FS2, FS3	7	G	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	No
8	Flammables	FS2	8	H	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	No
9	Cryogenic Liquids	FS2	9	J	**YES**	**YES**	**YES**	No	**YES**	**YES**	No
10	Steam Condensate	FS3	10	K	**YES**	**YES**	**YES**	No	No	**YES**	No
11	Compressed Air	FS2, FS3	11	M	**YES**	**YES**	**YES**	No	No	**YES**	No

Existing (including Legacy) System Documentation Requirements

Evaluation Category	General Legacy Pressure System Description	Fluid Service	Hazard Rank	Replacement Table ADMIN-1-3-	PSO/CPSO Certification FM01	Relief Protection Calculation and FM02	ASME Vessel or Equivalent Calculations	Pipe/Tube Wall Thickness FM06	Known Component MAWP FM07	Sketch FM10	Piping and Support Design Calculations
	with Receiver										
12	Compressed Inert Gases – DOT Cylinders	FS2, FS3	14	N	**YES**	**YES**	**YES**	No	No	**YES**	No
13	Compressed Air Without Receiver	FS2, FS3	12	P	**YES**	**YES**	No	No	No	**YES**	No
14	Compressed Inert Gases – Building Systems	FS3	13	R	**YES**	**YES**	**YES**	No	No	**YES**	No
15	High Pressure –Low Liquid Volume	FS1	15	S	**YES**	**YES**	No	No	No	**YES**	No
16	Hydronic piping	FS3	16	T	**YES**	**YES**	No	No	No	**YES**	No
17	Water Systems	FS3	17	U	**YES**	**YES**	No	No	No	**YES**	No

[1] **Corrosive Service** – A fluid service in which the internal fluid, or external environment, is expected to produce a progressive deterioration in the pressure boundary material.

[2] Evaluate oxygen systems as required in ASTM G128 and other referenced ASTM standards to determine the likelihood of fire.

(***Note**: New Table Numbers “ADMIN-1-3-I”, “ADMIN-1-3-L”, “ADMIN-1-3-O”, and “ADMIN-1-3-Q” were not used to eliminate confusion)

General Legacy Pressure System Description for High Pressure – Inert Pneumatic

Evaluation Category 1

Assumptions:

Fluid Service

1. The system fluid service is a FS1 as defined by ESM Chapter 17
   1.1. The pressure system fluid service is high pressure as define by ASME B31.3 2010 Chapter IX.
2. Corrosion is not a significant factor.
3. Materials of construction are compatible with the system fluid service.

System Operation

1. The pressure system is not subject to low-cycle fatigue (where significant plastic straining occurs).
2. High-cycle fatigue (where stresses and strains are largely confined to the elastic region) is controlled to less than 100,000 cycles for the life of the pressure system.
3. The pressure system does not operate in the creep range.
4. There are no stress intensification factors for example cracks or acute angles of pressure boundaries.

System Hardware

1. The system components have exhibited extensive, successful service experience under comparable conditions with similarly proportioned components of the same or like material.
2. The system is equipped with a properly sized, set, and functional pressure relief device(s), if needed, to protect against single point failures. Relief device exhaust locations are properly sized and located to protect personnel.
3. There are no locations in the system that requires relief protection that may be isolated from relief protection.
4. Flexible hoses over 12 inches in length and in service pressure greater than 150 psig are restrained in accordance with ESM Chapter 17.
5. In response to the PISA on LANL Welding Program (circa 2004) representative accessible welds were visually inspected and are free from indications. Solder or braze joints are not allowed.
6. External appearance is free from corrosion or indication of leakage.

Failure Mode

1. A ductile failure mode is assumed (not brittle fracture).

Consequence of Failure

1. The result of the failure will not result in serious personnel injury.

Safety Class

1. Applicable to ML4 only.

Existing (including Legacy) System Documentation Requirements

Documentation Requirements

1. These high pressure systems shall be exempt from the requirements of having code leak test documentation.
2. These high pressure systems may continue to use unlisted components provided they are used within the temperature and pressure ratings of the manufacturer.
3. This equipment will be considered grandfathered and will not be replaced with like items. System shall be upgraded to ASME compliance as items age out of service.
4. LANL ESM Chapter 17 documentation as required by Table ADMIN-1-3-A include: certification status form (FM01), relief device (FM02), component list (FM07), and sketch (FM10).
5. Piping shall be of known or verified wall thickness (FM06).
6. These high pressure systems may continue to use non-ASME stamped vessels provided calculations are performed to verify code-equivalent ratings.
7. When vessels are included as part of the high pressure system they must be evaluated for current MAWP based on the most applicable code or standard.

Qualitative Risk Assessment

Probability: Remote

Consequence: Significant

QR Factor: 4

Table 3 Qualitative Risk (QR) Determination

			Probability				
			A	**B**	**C**	**D**	**E**
			Frequent	**Probable**	**Occasional**	**Remote**	**Improbable**
Consequence	**I**	**Major**	1	1	1	2	3
	II	**Serious**	1	1	2	3	4
	III	**Significant**	1	2	3	4	5
	IV	**Minor**	2	3	4	5	6
	V	**Insignificant**	3	4	5	6	7

Table ADMIN-1-3-A

General Legacy Pressure System Documentation for High Pressure – Inert Pneumatic

Documentation Package Item	Comment	Owner Verification	PSO Verification
1. Form 1, LANL Pressure System Certification Status Form	Every Package		
2. Form 6, Piping System thickness verification	Every Package		
3. Form 7, Component List	Every Package		
4. Form 10, Form 10, System schematics (If the owner does not have a system schematic, utilize the sketch prepared by the walkdown team until such time as system schematic is prepared)[5]	Every Package		
5. Alternate Method/Variance or clarification/interpretation (if applicable).	If the system or any item of the system has an applicable alternate method/variance or clarification/interpretation to the requirements of this document		

[5] Information required on Form 10, System schematics may be documented in alternative documents or captured in controlled databases, such as the Master Equipment List (MEL) or Computerized Maintenance Management System (CMMS), but must be referenced and readily available for review. The evaluation shall be considered a record and must be managed per LANL P1020, P1020-1, and P1020-2

Table ADMIN-1-3-A

General Legacy Pressure System Documentation for High Pressure – Inert Pneumatic

Documentation Package Item	Comment	Owner Verification	PSO Verification
6. Code Stamped Vessel Fabrication Documentation	If the code data report is not available, a manufacturer's construction drawing may be used to verify the item has not been modified. Record the NBIC tag number. If the manufacturer's construction drawing is not available, personal knowledge may be used to establish the code stamped item has not been modified. This requires a person or persons with intimate and long term personal knowledge since original receipt and installation of the item to create a statement of compliance. This statement of compliance will be used to document the history of the item and be used as evidence the code stamped item has not been modified. This statement of compliance will be signed by the persons of record.		
a. Vessel thickness and remaining life estimate	Every Package		
7. Non-ASME code Fabricated Vessel Information (code-equivalent Documentation)	The pressure system contains Non-ASME-code stamped boilers and pressure vessels (which includes boilers, pressure vessels, heat exchangers, and accumulators)		
a. ASME code equivalent documentation for systems with pressure vessels which includes but is not limited to minimum wall thickness determination, corrosion allowance, weld efficiency rating, support structure loading, nozzle calculations. Calculations will use the material values specified in the ASME code.	A non-code boiler, pressure vessel, heat exchanger or accumulator is in the pressure system package		
b. Vessel thickness and remaining life estimate	Every Package		
8. Piping System Documentation:			

Table ADMIN-1-3-A

General Legacy Pressure System Documentation for High Pressure – Inert Pneumatic

Documentation Package Item	Comment	Owner Verification	PSO Verification
a. Form 06, Piping thickness and remaining life estimate	Every Package		
b. FM07	Every Package		
9. Pressure Safety Devices	The pressure system contains a pressure safety device (which includes but is not limited to relief valves and rupture discs)		
a. Safety Relief Calculations for relief valves, in accordance with ASME requirements	Every Package, unless calculations cannot be generated, a flow test is required in place of calculations.		
b. Pressure Relief Calculations for Rupture Disks in accordance with ASME requirements	Rupture Disks are in the pressure system		
c. Certified Test Data of relief valves, e.g. steam Pressure safety valves are certified by NBIC coded shop	A PRD is modified or tested by an outside facility		
10. Pump or compressor discharge pressure curves, calculation, or table (If available)	Only applicable if the pressure system contains pumps or compressors		

General Legacy Pressure System Description for Toxics

Evaluation Category 2

Assumptions:

Fluid Service

1. The system fluid service is a FS1 as defined by ESM Chapter 17
   1.1. The pressure system fluid service is Category M as define by ASME B31.3 2010 Chapter IX.
2. Corrosion is not a significant factor.
3. Materials of construction are compatible with the system fluid service.

System Operation

1. The pressure system is not subject to low-cycle fatigue (where significant plastic straining occurs).
2. High-cycle fatigue (where stresses and strains are largely confined to the elastic region) is controlled to less than 100,000 cycles for the life of the pressure system.
3. The pressure system does not operate in the creep range.
4. There are no stress intensification factors for example cracks or acute angles of pressure boundaries.

System Hardware

1. The system components have exhibited extensive, successful service experience under comparable conditions with similarly proportioned components of the same or like material.
2. The system is equipped with a properly sized, set, and functional pressure relief device(s), if needed, to protect against single point failures. Relief device exhaust locations are properly sized and located to protect personnel.
3. There are no locations in the system that requires relief protection that may be isolated from relief protection.
4. Flexible hoses over 12 inches in length and in service pressure greater than 150 psig are restrained in accordance with ESM Chapter 17.
5. In response to the PISA on LANL Welding Program (circa 2004) representative accessible welds were visually inspected and are free from indications. Solder or braze joints are not allowed.
6. External appearance is free from corrosion or indication of leakage.

Failure Mode

1. A ductile failure mode is assumed (not brittle fracture).

Consequence of Failure

1. The result of the failure may result in serious personnel injury

Safety Class

1. Applicable to ML4 only.

Existing (including Legacy) System Documentation Requirements

Documentation Requirements

1. These toxic pressure systems shall be exempt from the requirements of having code leak test documentation.
2. These toxic pressure systems may continue to use unlisted components provided the manufacturer's rating is adequate.
3. This equipment will be considered grandfathered and will not be replaced with like items. System shall be upgraded to ASME compliance as items age out of service by attrition.
4. LANL ESM Chapter 17 documentation as required by Table ADMIN-1-3-B include: certification status form (FM01), relief device (FM02), component list (FM07), and sketch (FM10).
5. Piping shall be of known or verified wall thickness (FM06).
6. These toxic pressure systems may continue to use non-ASME stamped vessels provided calculations are performed to verify code-equivalent ratings.
7. When vessels are included as part of the toxic pressure system they must be evaluated for current MAWP based on the most applicable code or standard.

Qualitative Risk Assessment

Probability: Remote

Consequence: Serious

QR Factor: 3

Table 3 Qualitative Risk (QR) Determination

			Probability				
			A	**B**	**C**	**D**	**E**
			Frequent	**Probable**	**Occasional**	**Remote**	**Improbable**
Consequence	**I**	**Major**	1	1	1	2	3
	II	**Serious**	1	1	2	3	4
	III	**Significant**	1	2	3	4	5
	IV	**Minor**	2	3	4	5	6
	V	**Insignificant**	3	4	5	6	7

Table ADMIN-1-3-B

General Legacy Pressure System Documentation for Toxic

Documentation Package Item	Required When	Owner Verification	PSO Verification
1. Form 1, LANL Pressure System Certification Status Form	Every Package		
2. Form 10, System schematics (If the owner does not have a system schematic, utilize the sketch prepared by the walkdown team until such time as system schematic is prepared)[78]	Every Package		
3. Alternate Method/Variance or clarification/interpretation (if applicable). See Part 10.0 of this standard.	If the system or any item of the system has an applicable alternate method/variance or clarification/interpretation to the requirements of this document		
4. Code Stamped Vessel Fabrication Documentation	If the code data report is not available, a manufacturer's construction drawing may be used to verify the item has not been modified. If the manufacturer's construction drawing is not available, personal knowledge may be used to establish the code stamped item has not been modified. This requires a person or persons with intimate and long term personal knowledge since original receipt and installation of the item to create a statement of compliance. This statement of compliance will be used to document the history of the item and be used as evidence the code stamped item has not been modified. This statement of compliance will be signed by the persons of record.		
a. Vessel thickness and remaining life estimate	Every Package		
5. Non-ASME code Fabricated Vessel Information (code-equivalent Documentation)	The pressure system contains Non-ASME-code stamped boilers and pressure vessels (which includes boilers, pressure vessels, heat exchangers, and accumulators)		

[78] Information required on Form 10, System schematics may be documented in alternative documents or captured in controlled databases, such as the Master Equipment List (MEL) or Computerized Maintenance Management System (CMMS), but must be referenced and readily available for review. The evaluation shall be considered a record and must be managed per LANL P1020, P1020-1, and P1020-2

Table ADMIN-1-3-B

General Legacy Pressure System Documentation for Toxic

Documentation Package Item	Required When	Owner Verification	PSO Verification
a. ASME code equivalent documentation for systems with pressure vessels which includes but is not limited to minimum wall thickness determination, corrosion allowance, weld efficiency rating, support structure loading, nozzle calculations. Calculations will use the material values specified in the ASME code.	A non-code boiler, pressure vessel, heat exchanger or accumulator is in the pressure system package		
b. Vessel thickness and remaining life estimate	Every Package		
6. Pressure Safety Devices	The pressure system contains a pressure safety device (which includes but is not limited to relief valves and rupture discs)		
a. Safety Relief Calculations for relief valves, in accordance with ASME requirements	Every Package, unless calculations cannot be generated, a flow test is required in place of calculations.		
b. Pressure Relief Calculations for Rupture Disks in accordance with ASME requirements	Rupture Disks are in the pressure system		
c. Certified Test Data of relief valves, e.g. steam Pressure safety valves are certified by NBIC coded shop	A PRD is modified or tested by an outside facility		
7. Piping System Documentation:			
a. Form 06, Piping thickness and remaining life estimate	Every Package		
a. FM07	Every Package		
8. Pump or compressor discharge pressure curves, calculation, or table (If available)	The pressure system contains pumps or compressors		

General Legacy Pressure System Description for Steam

Evaluation Category 3

Assumptions:

Fluid Service

1. The system fluid service is an FS2 as defined by ESM Chapter 17
   1.1. The pressure system fluid service is steam as define by ASME B31.1 (steam greater than 15 psig or high temperature water exceeding 160 psig).
   1.2. The pressure system fluid service is steam as define by ASME B31.9 (steam less than 15 psig or less, and water heating units to 160 psig)
2. Materials of construction are of known compatible with steam and an estimate of remaining life is available.

System Operation

1. The pressure system is not subject to low-cycle fatigue (where significant plastic straining occurs).
2. High-cycle fatigue (where stresses and strains are largely confined to the elastic region) is controlled to less than 100,000 cycles for the life of the pressure system.
3. The pressure system does not operate in the creep range.
4. There are no stress intensification factors for example cracks or acute angles of pressure boundaries.

System Hardware

1. The system components have exhibited extensive, successful service experience under comparable conditions with similarly proportioned components of the same or like material.
2. The system is equipped with a properly sized, set, and functional pressure relief device(s), if needed, to protect against single point failures. Relief device exhaust locations are properly sized and located to protect personnel.
3. There are no locations in the system that requires relief protection that may be isolated from relief protection.
4. Flexible hoses over 12 inches in length and in service pressure greater than 150 psig are restrained in accordance with ESM Chapter 17.
5. In response to the PISA on LANL Welding Program (circa 2004) representative accessible welds were visually inspected and are free from indications. Solder or braze joints are not allowed.
6. External appearance is free from corrosion or indication of leakage.
7. The steam system is constructed from iron metallic materials suitable for elevated service.

Failure Mode

1. A ductile failure mode is assumed (not brittle fracture).

Consequence of Failure

1. The result of the failure may result in serious personnel injury.

Safety Class

1. Applicable to ML4 only.

Existing (including Legacy) System Documentation Requirements

Documentation Requirements

1. Existing steam pressure systems shall be exempt from the requirements of having code leak test documentation.
2. Existing steam pressure systems may continue to use unlisted components provided the manufacturer's rating is adequate.
3. Existing steam systems equipment will be considered grandfathered and shall be upgraded to ASME requirements as items age out of service by attrition.
4. LANL ESM Chapter 17 documentation as required by Table ADMIN-1-3-C include: certification status form (FM01), relief device (FM02), component list (FM07), and sketch (FM10). .
5. Piping shall be of known or verified wall thickness (FM06).
6. Existing steam pressure systems may continue to use non-ASME stamped vessels provided calculations are performed to verify code-equivalent ratings.
7. When vessels are included as part of the steam pressure system they must be evaluated for current MAWP based on the most applicable code or standard.
8. Existing steam systems must be evaluated for thermal growth if evidence exists of previous repair or damaged caused by thermal growth (rupture, bending, etc…)

Qualitative Risk Assessment

Probability: Remote

Consequence: Serious

QR Factor: 3

Table 3 Qualitative Risk (QR) Determination

Consequence			Probability				
			A	B	C	D	E
			Frequent	Probable	Occasional	Remote	Improbable
	I	Major	1	1	1	2	3
	II	Serious	1	1	2	3	4
	III	Significant	1	2	3	4	5
	IV	Minor	2	3	4	5	6
	V	Insignificant	3	4	5	6	7

Table ADMIN-1-3-C

General Legacy Pressure System Documentation for Steam

Documentation Package Item	Required When	Owner Verification	PSO Verification
1. Form 1, LANL Pressure System Certification Status Form	Every Package		
2. Form 10, System schematics (If the owner does not have a system schematic, utilize the sketch prepared by the walkdown team until such time as system schematic is prepared)[7]	Every Package		
3. Alternate Method/Variance or clarification/interpretation (if applicable).	If the system or any item of the system has an applicable alternate method/variance or clarification/interpretation to the requirements of this document		
4. Code Stamped Vessel Fabrication Documentation	If the code data report is not available, a manufacturer's construction drawing may be used to verify the item has not been modified. If the manufacturer's construction drawing is not available, personal knowledge may be used to establish the code stamped item has not been modified. This requires a person or persons with intimate and long term personal knowledge since original receipt and installation of the item to create a statement of compliance. This statement of compliance will be used to document the history of the item and be used as evidence the code stamped item has not been modified. This statement of compliance will be signed by the persons of record.		
a. Vessel thickness and remaining life estimate	Every Package		
a. Vessel thickness and remaining life estimate	Every Package		

[7] Information required on Form 10, System schematics may be documented in alternative documents or captured in controlled databases, such as the Master Equipment List (MEL) or Computerized Maintenance Management System (CMMS), but must be referenced and readily available for review. The evaluation shall be considered a record and must be managed per LANL P1020, P1020-1, and P1020-2

Table ADMIN-1-3-C

General Legacy Pressure System Documentation for Steam

Documentation Package Item	Required When	Owner Verification	PSO Verification
7. Non-ASME code Fabricated Vessel Information (code-equivalent Documentation)	The pressure system contains Non-ASME-code stamped boilers and pressure vessels (which includes boilers, pressure vessels, heat exchangers, and accumulators)		
a. ASME code equivalent documentation for systems with pressure vessels which includes but is not limited to minimum wall thickness determination, corrosion allowance, weld efficiency rating, support structure loading, nozzle calculations. Calculations will use the material values specified in the ASME code.	A non-code boiler, pressure vessel, heat exchanger or accumulator is in the pressure system package		
b. Vessel thickness and remaining life estimate	Every Package		
8. Pressure Safety Devices	The pressure system contains a pressure safety device (which includes but is not limited to relief valves and rupture discs)		
a. Safety Relief Calculations for relief valves, in accordance with ASME requirements	Every Package, unless calculations cannot be generated, a flow test is required in place of calculations.		
b. Pressure Relief Calculations for Rupture Disks in accordance with ASME requirements	Rupture Disks are in the pressure system		
c. Certified Test Data of relief valves, e.g. steam Pressure safety valves are certified by NBIC coded shop	A PRD is modified or tested by an outside facility		
9. Piping System Documentation:			
a. Provide documentation evaluating effects of thermal growth.	If evidence of historical thermal growth problems.		
b. Form 06, Piping thickness and remaining life estimate	Every Package		
c. Form 07	Every Package		

General Legacy Pressure System Description for

High Pressure – Liquid High Volumetric Rate

Evaluation Category 4

Assumptions:

Fluid Service

1. The system fluid service is a FS1 liquid with a high flow liquid rate such that whipping of flex lines is an issue.
   1.1. The pressure system fluid service is high pressure as define by ASME B31.3 2010 Chapter IX.
2. Materials of construction are of known compatible with fluid and an estimate of remaining life is available.
3. Corrosion is not a significant factor.

System Operation

1. The pressure system is not subject to low-cycle fatigue (where significant plastic straining occurs).
2. High-cycle fatigue (where stresses and strains are largely confined to the elastic region) is controlled to less than 100,000 cycles for the life of the pressure system.
3. The pressure system does not operate in the creep range.
4. There are no stress intensification factors for example cracks or acute angles of pressure boundaries.

System Hardware

1. The system components have exhibited extensive, successful service experience under comparable conditions with similarly proportioned components of the same or like material.
2. The system is equipped with a properly sized, set, and functional pressure relief device(s), if needed, to protect against single point failures. Relief device exhaust locations are properly sized and located to protect personnel.
3. There are no locations in the system that requires relief protection that may be isolated from relief protection.
4. Flexible hoses over 12 inches in length and in service pressure greater than 150 psig are restrained in accordance with ESM Chapter 17.
5. In response to the PISA on LANL Welding Program (circa 2004) representative accessible welds were visually inspected and are free from indications. Solder or braze joints are not allowed.
6. External appearance is free from corrosion or indication of leakage.

Failure Mode

1. A ductile failure mode is assumed (not brittle fracture).

Consequence of Failure

2. The result of the failure will not result in serious personnel injury.

Safety Class

1. Applicable to ML4 only.

Existing (including Legacy) System Documentation Requirements

Documentation Requirements

1. The existing high pressure – liquid high volumetric rate pressure systems shall be exempt from the requirements of having code leak test documentation.
2. The existing high pressure – liquid high volumetric rate pressure systems may continue to use unlisted components provided the manufacturer's rating is adequate.
3. The existing high pressure – liquid high volumetric rate pressure systems equipment will be considered grandfathered and shall be upgraded to ASME requirements as items age out of service by attrition.
4. LANL ESM Chapter 17 documentation as required by Table ADMIN-1-3-D include: certification status form (FM01), relief device (FM02), component list (FM07), and sketch (FM10).
5. Piping shall be of known or verified wall thickness (FM06).
6. The existing high pressure – liquid high volumetric rate pressure systems may continue to use non-ASME stamped vessels provided calculations are performed to verify code-equivalent ratings.
7. When vessels are included as part of the high pressure – liquid high volumetric rate pressure system they must be evaluated for current MAWP based on the most applicable code or standard.

Qualitative Risk Assessment

Probability: Remote

Consequence: Significant

QR Factor: 4

Table 3 Qualitative Risk (QR) Determination

			Probability				
			A	**B**	**C**	**D**	**E**
			Frequent	**Probable**	**Occasional**	**Remote**	**Improbable**
Consequence	**I**	**Major**	1	1	1	2	3
	II	**Serious**	1	1	2	3	4
	III	**Significant**	1	2	3	4	5
	IV	**Minor**	2	3	4	5	6
	V	**Insignificant**	3	4	5	6	7

Table ADMIN-1-3-D

General Legacy Pressure System Documentation for High Pressure – Liquid High Volumetric Rate

Documentation Package Item	Required When	Owner Verification	PSO Verification
1. Form 1, LANL Pressure System Certification Status Form	Every Package		
2. Form 10, System schematics (If the owner does not have a system schematic, utilize the sketch prepared by the walkdown team until such time as system schematic is prepared)[8]	Every Package		
3. Alternate Method/Variance or clarification/interpretation (if applicable).	If the system or any item of the system has an applicable alternate method/variance or clarification/interpretation to the requirements of this document		
4. Code Stamped Vessel Fabrication Documentation	If the code data report is not available, a manufacturer's construction drawing may be used to verify the item has not been modified. If the manufacturer's construction drawing is not available, personal knowledge may be used to establish the code stamped item has not been modified. This requires a person or persons with intimate and long term personal knowledge since original receipt and installation of the item to create a statement of compliance. This statement of compliance will be used to document the history of the item and be used as evidence the code stamped item has not been modified. This statement of compliance will be signed by the persons of record.		
a. Vessel thickness and remaining life estimate	Every Package		
5. Non-ASME code Fabricated Vessel Information (code-equivalent Documentation)	The pressure system contains Non-ASME-code stamped boilers and pressure vessels (which includes boilers, pressure vessels, heat exchangers, and accumulators)		

[8] Information required on Form 10, System schematics may be documented in alternative documents or captured in controlled databases, such as the Master Equipment List (MEL) or Computerized Maintenance Management System (CMMS), but must be referenced and readily available for review. The evaluation shall be considered a record and must be managed per LANL P1020, P1020-1, and P1020-2

Table ADMIN-1-3-D

General Legacy Pressure System Documentation for High Pressure – Liquid High Volumetric Rate

Documentation Package Item	Required When	Owner Verification	PSO Verification
a. ASME code equivalent documentation for systems with pressure vessels which includes but is not limited to minimum wall thickness determination, corrosion allowance, weld efficiency rating, support structure loading, nozzle calculations. Calculations will use the material values specified in the ASME code.	A non-code boiler, pressure vessel, heat exchanger or accumulator is in the pressure system package		
b. Vessel thickness and remaining life estimate	Every Package		
6. Pressure Safety Devices	The pressure system contains a pressure safety device (which includes but is not limited to relief valves and rupture discs)		
a. Safety Relief Calculations for relief valves, in accordance with ASME requirements	Every Package, unless calculations cannot be generated, a flow test is required in place of calculations.		
b. Pressure Relief Calculations for Rupture Disks in accordance with ASME requirements	Rupture Disks are in the pressure system		
c. Certified Test Data of relief valves, e.g. steam Pressure safety valves are certified by NBIC coded shop	A PRD is modified or tested by an outside facility		
7. Piping System Documentation:			
a. Form 06, Piping thickness and remaining life estimate	Every Package		
b. FM07	Every Package		

General Legacy Pressure System Description for Corrosives

Evaluation Category 5

Assumptions:

Fluid Service

1. The system fluid service is a FS2 or FS3 as defined by ESM Chapter 17
2. The pressure system fluid service is corrosive and is defined as Fluid Category Normal by ASME B31.3 2010 Chapter IX.
3. Materials of construction are of known compatible with fluid and an estimate of remaining life is available.

System Operation

1. The pressure system is not subject to low-cycle fatigue (where significant plastic straining occurs).
2. High-cycle fatigue (where stresses and strains are largely confined to the elastic region) is controlled to less than 100,000 cycles for the life of the pressure system.
3. The pressure system does not operate in the creep range.
4. There are no stress intensification factors for example cracks or acute angles of pressure boundaries.

System Hardware

1. The system components have exhibited extensive, successful service experience under comparable conditions with similarly proportioned components of the same or like material.
2. The system is equipped with a properly sized, set, and functional pressure relief device(s), if needed, to protect against single point failures. Relief device exhaust locations are properly sized and located to protect personnel.
3. There are no locations in the system that requires relief protection that may be isolated from relief protection.
4. Flexible hoses over 12 inches in length and in service pressure greater than 150 psig are restrained in accordance with ESM Chapter 17.
5. In response to the PISA on LANL Welding Program (circa 2004) representative accessible welds were visually inspected and are free from indications. Solder or braze joints are not allowed.
6. External appearance is free from corrosion or indication of leakage.

Failure Mode

1. A ductile failure mode is assumed (not brittle fracture).

Consequence of Failure

1. The result of the failure will not result in serious personnel injury.

Safety Class

1. Applicable to ML4 only.

Documentation Requirements

1. The existing corrosive pressure systems shall be exempt from the requirements of having code leak test documentation.

2. The existing corrosive pressure systems may continue to use unlisted components provided the manufacturer's rating is adequate.
3. The existing corrosive pressure systems equipment will be considered grandfathered and shall be upgraded to ASME requirements as items age out of service by attrition.
4. LANL ESM Chapter 17 documentation as required by Table ADMIN-1-3-E include: certification status form (FM01), relief device (FM02), component list (FM07), and sketch (FM10).
5. Piping shall be of known or verified wall thickness (FM06).
6. Existing corrosive pressure systems may continue to use non-ASME stamped vessels provided calculations are performed to verify code-equivalent ratings.
7. When vessels are included as part of the corrosive pressure system they must be evaluated for current MAWP based on the most applicable code or standard.

Qualitative Risk Assessment

Probability: Remote

Consequence: Significant

QR Factor: 4

Table 3 Qualitative Risk (QR) Determination

			Probability				
			A	**B**	**C**	**D**	**E**
			Frequent	**Probable**	**Occasional**	**Remote**	**Improbable**
Consequence	**I**	**Major**	1	1	1	2	3
	II	**Serious**	1	1	2	3	4
	III	**Significant**	1	2	3	4	5
	IV	**Minor**	2	3	4	5	6
	V	**Insignificant**	3	4	5	6	7

Existing (including Legacy) System Documentation Requirements

Table ADMIN-1-3-E

General Legacy Pressure System Documentation for Corrosive (characteristic of fluid and boundary materials)

Documentation Package Item	Required When	Owner Verification	PSO Verification
1. Form 1, LANL Pressure System Certification Status Form	Every Package		
2. Form 10, System schematics (If the owner does not have a system schematic, utilize the sketch prepared by the walk down team until such time as system schematic is prepared)[9]	Every Package		
3. Alternate Method/Variance or clarification/interpretation (if applicable).	If the system or any item of the system has an applicable alternate method/variance or clarification/interpretation to the requirements of this document		
4. Code Stamped Vessel Fabrication Documentation	If the code data report is not available, a manufacturer's construction drawing may be used to verify the item has not been modified. If the manufacturer's construction drawing is not available, personal knowledge may be used to establish the code stamped item has not been modified. This requires a person or persons with intimate and long term personal knowledge since original receipt and installation of the item to create a statement of compliance. This statement of compliance will be used to document the history of the item and be used as evidence the code stamped item has not been modified. This statement of compliance will be signed by the persons of record.		
a. Vessel thickness and remaining life estimate	Every Package		
5. Non-ASME code Fabricated Vessel Information (code-equivalent Documentation)	The pressure system contains Non-ASME-code stamped boilers and pressure vessels (which includes boilers, pressure vessels, heat exchangers, and accumulators)		

[9] Information required on Form 10, System schematics may be documented in alternative documents or captured in controlled databases, such as the Master Equipment List (MEL) or Computerized Maintenance Management System (CMMS), but must be referenced and readily available for review. The evaluation shall be considered a record and must be managed per LANL P1020, P1020-1, and P1020-2

Table ADMIN-1-3-E

General Legacy Pressure System Documentation for Corrosive (characteristic of fluid and boundary materials)

Documentation Package Item	Required When	Owner Verification	PSO Verification
a. ASME code equivalent documentation for systems with pressure vessels which includes but is not limited to minimum wall thickness determination, corrosion allowance, weld efficiency rating, support structure loading, nozzle calculations. Calculations will use the material values specified in the ASME code.	A non-code boiler, pressure vessel, heat exchanger or accumulator is in the pressure system package		
b. Vessel thickness and remaining life estimate	Every Package		
6. Pressure Safety Devices	The pressure system contains a pressure safety device (which includes but is not limited to relief valves and rupture discs)		
a. Safety Relief Calculations for relief valves, in accordance with ASME requirements	Every Package, unless calculations cannot be generated, a flow test is required in place of calculations.		
b. Pressure Relief Calculations for Rupture Disks in accordance with ASME requirements	Rupture Disks are in the pressure system		
c. Certified Test Data of relief valves, e.g. steam Pressure safety valves are certified by NBIC coded shop	A PRD is modified or tested by an outside facility		
7. Piping System Documentation:			
a. Form 06, Piping thickness and remaining life estimate	Every Package		
b. FM07	Every Package		
8. Pump or compressor discharge pressure curves, calculation, or table (If available)	The pressure system contains pumps or compressors		

General Legacy Pressure System Description for Brittle Failure Mode

Evaluation Category 6

Assumptions:

Fluid Service

1. The system fluid service is a FS2 or FS3 as defined by ESM Chapter 17
2. Materials of construction are compatible with the system fluid service.

System Operation

1. The pressure system does not operate in the creep range.
2. There are no stress intensification factors for example cracks or acute angles of pressure boundaries.
3. The system is not subject to pressure spikes for example water or steam hammer.

System Hardware

1. The system components have exhibited extensive, successful service experience under comparable conditions with similarly proportioned components of the same or like material.
2. The system is equipped with a properly sized, set, and functional pressure relief device(s), if needed, to protect against single point failures. Relief device exhaust locations are properly sized and located to protect personnel.
3. There are no locations in the system that requires relief protection that may be isolated from relief protection.
4. Flexible hoses over 12 inches in length and in service pressure greater than 150 psig are restrained in accordance with ESM Chapter 17.
5. In response to the PISA on LANL Welding Program (circa 2004) representative accessible welds were visually inspected and are free from indications. Solder or braze joints are not allowed.
6. External appearance is free from corrosion or indication of leakage.

Failure Mode

1. A brittle failure mode is assumed.

Consequence of Failure

1. The result of the failure will not result in serious personnel injury. Safe-guarding will be applied if necessary.

Safety Class

1. Applicable to ML4 only.

Documentation Requirements

1. These brittle pressure systems shall be exempt from the requirements of having code leak test documentation.
2. These brittle pressure systems may continue to use unlisted components provided they are used within the temperature and pressure ratings of the manufacturer’s.
3. This equipment will be considered grandfathered and will not be replaced with like items. System shall be upgraded to ASME compliance as items age out of service by attrition.

4. LANL ESM Chapter 17 documentation as required by Table ADMIN-1-3-F include: certification status form (FM01), relief device (FM02), component list (FM07), and sketch (FM10).
5. Piping shall be of known or verified wall thickness (FM06).
6. These brittle pressure systems may continue to use non-ASME stamped vessels provided calculations are performed to verify code-equivalent ratings.
7. When vessels are included as part of the brittle pressure system they must be evaluated for current MAWP based on the most applicable code or standard.

Qualitative Risk Assessment

Probability: Remote

Consequence: Significant

QR Factor: 4

Table 3 Qualitative Risk (QR) Determination

			Probability				
			A	**B**	**C**	**D**	**E**
			Frequent	**Probable**	**Occasional**	**Remote**	**Improbable**
Consequence	**I**	**Major**	1	1	1	2	3
	II	**Serious**	1	1	2	3	4
	III	**Significant**	1	2	3	4	5
	IV	**Minor**	2	3	4	5	6
	V	**Insignificant**	3	4	5	6	7

Table ADMIN-1-3-F

General Legacy Pressure System Documentation for Brittle Failure Mode (not leak before burst)

Documentation Package Item	Comment	Owner Verification	PSO Verification
1. Form 1, LANL Pressure System Certification Status Form	Every Package		
2. Form 6, Piping System thickness verification	Every Package		
3. Form 7, Component List	Every Package		
4. Form 10, Form 10, System schematics (If the owner does not have a system schematic, utilize the sketch prepared by the walkdown team until such time as system schematic is prepared)[10]	Every Package		
5. Alternate Method/Variance or clarification/interpretation (if applicable).	If the system or any item of the system has an applicable alternate method/variance or clarification/interpretation to the requirements of this document		
6. Code Stamped Vessel Fabrication Documentation	If the code data report is not available, a manufacturer's construction drawing may be used to verify the item has not been modified. If the manufacturer's construction drawing is not available, personal knowledge may be used to establish the code stamped item has not been modified. This requires a person or persons with intimate and long term personal knowledge since original receipt and installation of the item to create a statement of compliance. This statement of compliance will be used to document the history of the item and be used as evidence the code stamped item has not been modified. This statement of compliance will be signed by the persons of record.		
a. Vessel thickness and remaining life estimate	Every Package		
7. Non-ASME code Fabricated Vessel Information (code-equivalent Documentation)	The pressure system contains Non-ASME-code stamped boilers and pressure vessels (which includes boilers, pressure vessels, heat exchangers, and accumulators)		

[10] Information required on Form 10, System schematics may be documented in alternative documents or captured in controlled databases, such as the Master Equipment List (MEL) or Computerized Maintenance Management System (CMMS), but must be referenced and readily available for review. The evaluation shall be considered a record and must be managed per LANL P1020, P1020-1, and P1020-2

Table ADMIN-1-3-F

General Legacy Pressure System Documentation for Brittle Failure Mode (not leak before burst)

Documentation Package Item	Comment	Owner Verification	PSO Verification
a. ASME code equivalent documentation for systems with pressure vessels which includes but is not limited to minimum wall thickness determination, corrosion allowance, weld efficiency rating, support structure loading, nozzle calculations. Calculations will use the material values specified in the ASME code.	A non-code boiler, pressure vessel, heat exchanger or accumulator is in the pressure system package		
b. Vessel thickness and remaining life estimate	Every Package		
8. Pressure Safety Devices	The pressure system contains a pressure safety device (which includes but is not limited to relief valves and rupture discs)		
a. Safety Relief Calculations for relief valves, in accordance with ASME requirements	Every Package, unless calculations cannot be generated, a flow test is required in place of calculations.		
b. Pressure Relief Calculations for Rupture Disks in accordance with ASME requirements	Rupture Disks are in the pressure system		
c. Certified Test Data of relief valves, e.g. steam Pressure safety valves are certified by NBIC coded shop	A PRD is modified or tested by an outside facility		
9. Piping System Documentation:			
a. Form 06, Piping thickness and remaining life estimate	Every Package		
b. FM07	Every Package		
c. MAWP determination of brittle component	Determination of MAWP of brittle component will all loads required by code.		
10. Pump or compressor discharge pressure curves, calculation, or table (If available)	Only applicable if the pressure system contains pumps or compressors		

General Legacy Pressure System Description for Oxygen

Evaluation Category 7

Assumptions:

Fluid Service

1. The system fluid service is FS2 or FS3 as defined by ESM Chapter 17
2. Materials of construction are compatible with the oxygen at the design pressure.

System Operation

1. The pressure system does not operate in the creep range.
2. There are no stress intensification factors for example cracks or acute angles of pressure boundaries.

System Hardware

1. The system components have exhibited extensive, successful service experience under comparable conditions with similarly proportioned components of the same or like material.
2. The system is equipped with a properly sized, set, and functional pressure relief device(s), if needed, to protect against single point failures. Relief device exhaust locations are properly sized and located to protect personnel.
3. There are no locations in the system that requires relief protection that may be isolated from relief protection.
4. Flexible hoses over 12 inches in length and in service pressure greater than 150 psig are restrained in accordance with ESM Chapter 17.
5. In response to the PISA on LANL Welding Program (circa 2004) representative accessible welds were visually inspected and are free from indications. Solder or braze joints are not allowed.
6. External appearance is free from corrosion or indication of leakage.

Failure Mode

1. A ductile failure mode is assumed (leak before burst).
2. Fire is an evaluated failure mode.

Consequence of Failure

1. The result of the failure will not result in serious personnel injury. Safe-guarding will be applied if necessary.

Safety Class

1. Applicable to ML4 only.

Documentation Requirements

1. These oxygen pressure systems shall be exempt from the requirements of having code leak test documentation.
2. These oxygen pressure systems may continue to use unlisted components provided they are used within the temperature and pressure ratings of the manufacturer’s.
3. This equipment will be considered grandfathered and will not be replaced with like items. System shall be upgraded to ASME compliance and cleaned as required by ESM Chapter 17 as items age out of service by attrition.

4. LANL ESM Chapter 17 documentation as required by Table ADMIN-1-3-G include: certification status form (FM01), relief device (FM02), component list (FM07), and sketch (FM10).
5. Piping shall be of known or verified wall thickness (FM06).
6. These oxygen pressure systems may continue to use non-ASME stamped vessels provided calculations are performed to verify code-equivalent ratings.
7. When vessels are included as part of the oxygen pressure system they must be evaluated for current MAWP based on the most applicable code or standard.
8. Oxygen system hazards analysis that defines the areas of potential fire and any necessary safe guarding.

Qualitative Risk Assessment

Probability: Remote

Consequence: Significant

QR Factor: 4

Table 3 Qualitative Risk (QR) Determination

			Probability				
			A	**B**	**C**	**D**	**E**
			Frequent	**Probable**	**Occasional**	**Remote**	**Improbable**
Consequence	**I**	**Major**	1	1	1	2	3
	II	**Serious**	1	1	2	3	4
	III	**Significant**	1	2	3	4	5
	IV	**Minor**	2	3	4	5	6
	V	**Insignificant**	3	4	5	6	7

Table ADMIN-1-3-G

General Legacy Pressure System Documentation for Oxygen

Documentation Package Item	Required When	Owner Verification	PSO Verification
1. Form 1, LANL Pressure System Certification Status Form	Every Package		
2. Form 10, System schematics (If the owner does not have a system schematic, utilize the sketch prepared by the walkdown team until such time as system schematic is prepared)[83]	Every Package		
3. Alternate Method/Variance or clarification/interpretation (if applicable).	If the system or any item of the system has an applicable alternate method/variance or clarification/interpretation to the requirements of this document		
4. Code Stamped Vessel Fabrication Documentation	If the code data report is not available, a manufacturer's construction drawing may be used to verify the item has not been modified. If the manufacturer's construction drawing is not available, personal knowledge may be used to establish the code stamped item has not been modified. This requires a person or persons with intimate and long term personal knowledge since original receipt and installation of the item to create a statement of compliance. This statement of compliance will be used to document the history of the item and be used as evidence the code stamped item has not been modified. This statement of compliance will be signed by the persons of record.		
a. Vessel thickness and remaining life estimate	Every Package		
5. Non-ASME code Fabricated Vessel Information (code-equivalent Documentation)	The pressure system contains Non-ASME-code stamped boilers and pressure vessels (which includes boilers, pressure vessels, heat exchangers, and accumulators)		

[83] Information required on Form 10, System schematics may be documented in alternative documents or captured in controlled databases, such as the Master Equipment List (MEL) or Computerized Maintenance Management System (CMMS), but must be referenced and readily available for review. The evaluation shall be considered a record and must be managed per LANL P1020, P1020-1, and P1020-2

Table ADMIN-1-3-G

General Legacy Pressure System Documentation for Oxygen

Documentation Package Item	Required When	Owner Verification	PSO Verification
a. ASME code equivalent documentation for systems with pressure vessels which includes but is not limited to minimum wall thickness determination, corrosion allowance, weld efficiency rating, support structure loading, nozzle calculations. Calculations will use the material values specified in the ASME code.	A non-code boiler, pressure vessel, heat exchanger or accumulator is in the pressure system package		
b. Vessel thickness and remaining life estimate	Every Package		
6. Pressure Safety Devices	The pressure system contains a pressure safety device (which includes but is not limited to relief valves and rupture discs)		
a. Safety Relief Calculations for relief valves, in accordance with ASME requirements	Every Package, unless calculations cannot be generated, a flow test is required in place of calculations.		
b. Pressure Relief Calculations for Rupture Disks in accordance with ASME requirements	Rupture Disks are in the pressure system		
c. Certified Test Data of relief valves, e.g. steam Pressure safety valves are certified by NBIC coded shop	A PRD is modified or tested by an outside facility		
7. Piping System Documentation:			
a. Form 06, Piping thickness and remaining life estimate	Every Package		
b. FM07	Every Package		
8. Pump or compressor discharge pressure curves, calculation, or table (If available)	The pressure system contains pumps or compressors		
9. Oxygen System Hazard Analysis (if applicable)	Pressure system is an oxygen system		

General Legacy Pressure System Description for Flammables

Evaluation Category 8

Assumptions:

Fluid Service

1. The system fluid service is a FS2 as defined by ESM Chapter 17
2. The pressure system fluid service is Normal as define by ASME B31.3 2010.
3. Materials of construction are compatible with the system fluid service.
4. Flammable is defined in accordance with NFPA 55 *Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders, and Tanks* and CGA P-23 *Standard for Categorizing Gas Mixtures Containing Flammable an Nonflammable Components*.

System Operation

1. The pressure system does not operate in the creep range.
2. There are no stress intensification factors for example cracks or acute angles of pressure boundaries.

System Hardware

1. The system components have exhibited extensive, successful service experience under comparable conditions with similarly proportioned components of the same or like material.
2. The system is equipped with a properly sized, set, and functional pressure relief device(s), if needed, to protect against single point failures. Relief device exhaust locations are properly sized and located to protect personnel.
3. There are no locations in the system that requires relief protection that may be isolated from relief protection.
4. Flexible hoses over 12 inches in length and in service pressure greater than 150 psig are restrained in accordance with ESM Chapter 17.
5. In response to the PISA on LANL Welding Program (circa 2004) representative accessible welds were visually inspected and are free from indications. Solder or braze joints are not allowed.
6. External appearance is free from corrosion or indication of leakage.

Failure Mode

1. A ductile failure mode is assumed (leak before burst).

Consequence of Failure

1. The result of the failure will not result in serious personnel injury. Safe-guarding will be applied if necessary.

Safety Class

1. Applicable to ML4 only.

Documentation Requirements

1. These flammable pressure systems shall be exempt from the requirements of having code leak test documentation.

2. These flammable pressure systems may continue to use unlisted components provided they are used within the temperature and pressure ratings of the manufacturer's.
3. This equipment will be considered grandfathered and will not be replaced with like items. System shall be upgraded to ASME compliance as items age out of service by attrition.
4. LANL ESM Chapter 17 documentation as required by Table ADMIN-1-3-H include: certification status form (FM01), relief device (FM02), component list (FM07), and sketch (FM10).
5. Piping shall be of known or verified wall thickness (FM06).
6. These flammable pressure systems may continue to use non-ASME stamped vessels provided calculations are performed to verify code-equivalent ratings.
7. When vessels are included as part of the flammable pressure system they must be evaluated for current MAWP based on the most applicable code or standard.

Qualitative Risk Assessment

Probability: Remote

Consequence: Significant

QR Factor: 4

Table 3 Qualitative Risk (QR) Determination

			Probability				
			A	**B**	**C**	**D**	**E**
			Frequent	**Probable**	**Occasional**	**Remote**	**Improbable**
Consequence	**I**	**Major**	1	1	1	2	3
	II	**Serious**	1	1	2	3	4
	III	**Significant**	1	2	3	4	5
	IV	**Minor**	2	3	4	5	6
	V	**Insignificant**	3	4	5	6	7

Table ADMIN-1-3-H

General Legacy Pressure System Documentation for Flammable Gases

Documentation Package Item	Required When	Owner Verification	PSO Verification
1. Form 1, LANL Pressure System Certification Status Form	Every Package		
2. Form 10, System schematics (If the owner does not have a system schematic, utilize the sketch prepared by the walk down team until such time as system schematic is prepared)[12]	Every Package		
3. Alternate Method/Variance or clarification/interpretation (if applicable).	If the system or any item of the system has an applicable alternate method/variance or clarification/interpretation to the requirements of this document		
4. Code Stamped Vessel Fabrication Documentation	If the code data report is not available, a manufacturer's construction drawing may be used to verify the item has not been modified. If the manufacturer's construction drawing is not available, personal knowledge may be used to establish the code stamped item has not been modified. This requires a person or persons with intimate and long term personal knowledge since original receipt and installation of the item to create a statement of compliance. This statement of compliance will be used to document the history of the item and be used as evidence the code stamped item has not been modified. This statement of compliance will be signed by the persons of record.		
a. Vessel thickness and remaining life estimate	Every package		
5. Non-ASME code Fabricated Vessel Information (code-equivalent Documentation)	The pressure system contains Non-ASME-code stamped boilers and pressure vessels (which includes boilers, pressure vessels, heat exchangers, and accumulators)		

[12] Information required on Form 10, System schematics may be documented in alternative documents or captured in controlled databases, such as the Master Equipment List (MEL) or Computerized Maintenance Management System (CMMS), but must be referenced and readily available for review. The evaluation shall be considered a record and must be managed per LANL P1020, P1020-1, and P1020-2

Table ADMIN-1-3-H

General Legacy Pressure System Documentation for Flammable Gases

Documentation Package Item	Required When	Owner Verification	PSO Verification
a. ASME code equivalent documentation for systems with pressure vessels which includes but is not limited to minimum wall thickness determination, corrosion allowance, weld efficiency rating, support structure loading, nozzle calculations. Calculations will use the material values specified in the ASME code.	A non-code boiler, pressure vessel, heat exchanger or accumulator is in the pressure system package		
b. Vessel thickness and remaining life estimate	Every Package		
6. Pressure Safety Devices	The pressure system contains a pressure safety device (which includes but is not limited to relief valves and rupture discs)		
a. Safety Relief Calculations for relief valves, in accordance with ASME requirements	Every Package, unless calculations cannot be generated, a flow test is required in place of calculations.		
b. Pressure Relief Calculations for Rupture Disks in accordance with ASME requirements	Rupture Disks are in the pressure system		
c. Certified Test Data of relief valves, e.g. steam Pressure safety valves are certified by NBIC coded shop	A PRD is modified or tested by an outside facility		
7. Piping System Documentation:			
a. Form 06, Piping thickness and remaining life estimate	Every Package		
b. Form 07	Every Package		
8. Pump or compressor discharge pressure curves, calculation, or table (If available)	The pressure system contains pumps or compressors		

General Legacy Pressure System Description for Cryogenic Liquids (Helium, Neon, Argon, Krypton, Xenon, Nitrogen, Oxygen, Air)

Evaluation Category 9

Assumptions:

Fluid Service

1. The system fluid service is a FS2 as defined by ESM Chapter 17
2. The pressure system fluid service is Normal as define by ASME B31.3 2010.
3. Materials of construction are compatible with the system fluid service.

System Operation

1. There are no stress intensification factors for example cracks or acute angles of pressure boundaries.
2. Pressure is limited to 150 psig.

System Hardware

1. The system components have exhibited extensive, successful service experience under comparable conditions with similarly proportioned components of the same or like material.
2. The system is equipped with a properly sized, set, and functional pressure relief device(s), if needed, to protect against single point failures. Relief device exhaust locations are properly sized and located to protect personnel.
3. There are no locations in the system that may be isolated from relief protection with cryogenic liquid present.
4. System is constructed of metallic components with materials rated in the ASME B31.3 Table A-1 for the cryogenic temperatures.
5. In response to the PISA on LANL Welding Program (circa 2004) representative accessible welds were visually inspected and are free from indications. Solder or braze joints are not allowed.
6. External appearance is free from corrosion or indication of leakage.
7. Flexible elements are rated for the cryogenic temperatures.
8. Flexible hoses over 12 inches in length and in service pressure greater than 150 psig are restrained in accordance with ESM Chapter 17.
9. Insulation is adequate to preclude the formation of liquid air.

Failure Mode

1. A ductile failure mode is assumed (leak before burst).

Consequence of Failure

1. The result of the failure will not result in serious personnel injury. Safe-guarding will be applied if necessary.

Safety Class

1. Applicable to ML4 only.

Documentation Requirements

1. These cryogenic liquid pressure systems shall be exempt from the requirements of having code leak test documentation.
2. These cryogenic liquid pressure systems may continue to use unlisted components provided they are used within the temperature and pressure ratings of the manufacturer's.
3. This equipment will be considered grandfathered and will not be replaced with like items. System shall be upgraded to ASME compliance as items age out of service by attrition.
4. LANL ESM Chapter 17 documentation as required by Table ADMIN-1-3-J include: certification status form (FM01), relief device (FM02), component list (FM07), and sketch (FM10).
5. Existing cryogenic liquid systems may continue to use non-ASME stamped vessels provided calculations are performed to verify code-equivalent ratings.
6. When vessels are included as part of the cryogenic liquid pressure system they must be evaluated for current MAWP based on the most applicable code or standard.

Qualitative Risk Assessment

Probability: Remote

Consequence: Significant

QR Factor: 4

Table 3 Qualitative Risk (QR) Determination

Consequence			Probability				
			A	B	C	D	E
			Frequent	Probable	Occasional	Remote	Improbable
	I	Major	1	1	1	2	3
	II	Serious	1	1	2	3	4
	III	Significant	1	2	3	4	5
	IV	Minor	2	3	4	5	6
	V	Insignificant	3	4	5	6	7

Table ADMIN-1-3-J

General Legacy Pressure System Documentation for Cryogenic Liquids

Documentation Package Item	Required When	Owner Verification	PSO Verification
1. Form 1, LANL Pressure System Certification Status Form	Every Package		
2. Form 10, System schematics (If the owner does not have a system schematic, utilize the sketch prepared by the walkdown team until such time as system schematic is prepared)[13]	Every Package		
3. Alternate Method/Variance or clarification/interpretation (if applicable).	If the system or any item of the system has an applicable alternate method/variance or clarification/interpretation to the requirements of this document		
4. Code Stamped Vessel Fabrication Documentation	If the code data report is not available, a manufacturer's construction drawing may be used to verify the item has not been modified. If the manufacturer's construction drawing is not available, personal knowledge may be used to establish the code stamped item has not been modified. This requires a person or persons with intimate and long term personal knowledge since original receipt and installation of the item to create a statement of compliance. This statement of compliance will be used to document the history of the item and be used as evidence the code stamped item has not been modified. This statement of compliance will be signed by the persons of record.		
a. Vessel thickness and remaining life estimate	Every Package		
5. Non-ASME code Fabricated Vessel Information (code-equivalent Documentation)	The pressure system contains Non-ASME-code stamped boilers and pressure vessels (which includes boilers, pressure vessels, heat exchangers, and accumulators)		

[13] Information required on Form 10, System schematics may be documented in alternative documents or captured in controlled databases, such as the Master Equipment List (MEL) or Computerized Maintenance Management System (CMMS), but must be referenced and readily available for review. The evaluation shall be considered a record and must be managed per LANL P1020, P1020-1, and P1020-2

Table ADMIN-1-3-J

General Legacy Pressure System Documentation for Cryogenic Liquids

Documentation Package Item	Required When	Owner Verification	PSO Verification
a. ASME code equivalent documentation for systems with pressure vessels which includes but is not limited to minimum wall thickness determination, corrosion allowance, weld efficiency rating, support structure loading, nozzle calculations. Calculations will use the material values specified in the ASME code.	A non-code boiler, pressure vessel, heat exchanger or accumulator is in the pressure system package		
a. Vessel thickness and remaining life estimate	Every Package		
6. Pressure Safety Devices	The pressure system contains a pressure safety device (which includes but is not limited to relief valves and rupture discs)		
a. Safety Relief Calculations for relief valves, in accordance with ASME requirements	Every Package, unless calculations cannot be generated, a flow test is required in place of calculations.		
b. Pressure Relief Calculations for Rupture Disks in accordance with ASME requirements	Rupture Disks are in the pressure system		
c. Certified Test Data of relief valves, e.g. steam Pressure safety valves are certified by NBIC coded shop	A PRD is modified or tested by an outside facility		
d. Identification as a liquid lock PRD on PRV Recall Summary Sheet and pressure system Component List spread sheet.	PRD's are used as protection against liquid lock overpressure		
e. Identification as vacuum insulation relief device	PRD's are used as protection against vacuum system overpressure		
7. Piping System Documentation:			
a. Form 7; Manufacturer's data indicates component is within temperature and pressure operational specifications	Every Package		
8. Pump or compressor discharge pressure curves, calculation, or table (If available)	The pressure system contains pumps or compressors		

General Legacy Pressure System Description for Steam Condensate

Evaluation Category 10

Assumptions:

Fluid Service

1. The system fluid service is a FS3 as defined by ESM Chapter 17

System Operation

1. There are no stress intensification factors for example cracks or acute angles of pressure boundaries.
2. Pressure is limited to 150 psig.

System Hardware

1. The system components have exhibited extensive, successful service experience under comparable conditions with similarly proportioned components of the same or like material.
2. The system is equipped with a properly sized, set, and functional pressure relief device(s), if needed, to protect against single point failures. Relief device exhaust locations are properly sized and located to protect personnel.
3. There are no locations in the system that requires relief protection that may be isolated from relief protection.
4. Steam condensate systems are effectively isolated from steam lines for example steam traps.
5. System is constructed of metallic components and pipe.
6. In response to the PISA on LANL Welding Program (circa 2004) representative accessible welds were visually inspected and are free from indications. Solder or braze joints are not allowed.
7. External appearance is free from corrosion or indication of leakage.

Failure Mode

1. A ductile failure mode is assumed (leak before burst).

Consequence of Failure

1. The result of the failure will not result in serious personnel injury. Safe-guarding will be applied if necessary.

Safety Class

1. Applicable to ML4 only.

Documentation Requirements

1. These steam condensate pressure systems shall be exempt from the requirements of having code leak test documentation.
2. These steam condensate pressure systems may continue to use unlisted components,
3. This equipment will be considered grandfathered and will not be replaced with like items. System shall be upgraded to ASME compliance as items age out of service by attrition.

4. LANL ESM Chapter 17 documentation as required by Table ADMIN-1-3-K include: certification status form (FM01), relief device (FM02), component list (FM07), and sketch (FM10).
5. Existing steam condensate pressure systems may continue to use non-ASME stamped vessels provided calculations are performed to verify code-equivalent ratings.
6. When vessels are included as part of the steam condensate pressure system they must be evaluated for current MAWP based on the most applicable code or standard.

Qualitative Risk Assessment

Probability: Remote

Consequence: Minor

QR Factor: 5

Table 3 Qualitative Risk (QR) Determination

			Probability				
			A	B	C	D	E
			Frequent	Probable	Occasional	Remote	Improbable
Consequence	I	Major	1	1	1	2	3
	II	Serious	1	1	2	3	4
	III	Significant	1	2	3	4	5
	IV	Minor	2	3	4	5	6
	V	Insignificant	3	4	5	6	7

Table ADMIN-1-3-K

General Legacy Pressure System Documentation for Steam Condensate

Documentation Package Item	Required When	Owner Verification	PSO Verification
1. Form 1, LANL Pressure System Certification Status Form	Every Package		
2. Form 10, System schematics (If the owner does not have a system schematic, utilize the sketch prepared by the walkdown team until such time as system schematic is prepared)[14]	Every Package		
3. Alternate Method/Variance or clarification/interpretation (if applicable).	If the system or any item of the system has an applicable alternate method/variance or clarification/interpretation to the requirements of this document		
4. Code Stamped Vessel Fabrication Documentation	If the code data report is not available, a manufacturer's construction drawing may be used to verify the item has not been modified. If the manufacturer's construction drawing is not available, personal knowledge may be used to establish the code stamped item has not been modified. This requires a person or persons with intimate and long term personal knowledge since original receipt and installation of the item to create a statement of compliance. This statement of compliance will be used to document the history of the item and be used as evidence the code stamped item has not been modified. This statement of compliance will be signed by the persons of record.		
a. Vessel thickness and remaining life estimate	Every Package		
5. Non-ASME code Fabricated Vessel Information (code-equivalent Documentation)	The pressure system contains Non-ASME-code stamped boilers and pressure vessels (which includes boilers, pressure vessels, heat exchangers, and accumulators)		

[14] Information required on Form 10, System schematics may be documented in alternative documents or captured in controlled databases, such as the Master Equipment List (MEL) or Computerized Maintenance Management System (CMMS), but must be referenced and readily available for review. The evaluation shall be considered a record and must be managed per LANL P1020, P1020-1, and P1020-2

Table ADMIN-1-3-K

General Legacy Pressure System Documentation for Steam Condensate

Documentation Package Item	Required When	Owner Verification	PSO Verification
a. ASME code equivalent documentation for systems with pressure vessels which includes but is not limited to minimum wall thickness determination, corrosion allowance, weld efficiency rating, support structure loading, nozzle calculations. Calculations will use the material values specified in the ASME code.	A non-code boiler, pressure vessel, heat exchanger or accumulator is in the pressure system package		
b. Vessel thickness and remaining life estimate	Every Package		
6. Pressure Safety Devices	The pressure system contains a pressure safety device (which includes but is not limited to relief valves and rupture discs)		
a. Safety Relief Calculations for relief valves, in accordance with ASME requirements	Every Package, unless calculations cannot be generated, a flow test is required in place of calculations.		
b. Pressure Relief Calculations for Rupture Disks in accordance with ASME requirements	Rupture Disks are in the pressure system		
c. Certified Test Data of relief valves, e.g. steam Pressure safety valves are certified by NBIC coded shop	A PRD is modified or tested by an outside facility		
7. Piping System Documentation:			
a. FM07; for available components	Every Package		
8. Pump or compressor discharge pressure curves, calculation, or table (If available)	The pressure system contains pumps or compressors		

General Legacy Pressure System Description for Compressed Air with Receiver

Evaluation Category 11

Assumptions:

Fluid Service

1. The system fluid service is a FS2 or FS3 as defined by ESM Chapter 17
   1.1. The pressure system fluid service is Normal as define by ASME B31.3 2010.
   1.2. The pressure systems are within the scope of ASME B31.9-2011.
2. Materials of construction are compatible with the system fluid service.

System Operation

1. There are no stress intensification factors for example cracks or acute angles of pressure boundaries.
2. Pressure is limited to 150 psig.

System Hardware

1. The system components have exhibited extensive, successful service experience under comparable conditions with similarly proportioned components of the same or like material.
2. The system is equipped with a properly sized, set, and functional pressure relief device(s), if needed, to protect against single point failures. Relief device exhaust locations are properly sized and located to protect personnel.
3. There are no locations in the system that requires relief protection that may be isolated from relief protection.
4. Flexible hoses over 12 inches in length and in service pressure greater than 150 psig are restrained in accordance with ESM Chapter 17.
5. System is constructed of metallic components, pipe, and tube.
6. In response to the PISA on LANL Welding Program (circa 2004) representative accessible welds were visually inspected and are free from indications. Solder or braze joints are not allowed.
7. External appearance is free from corrosion or indication of leakage.

Failure Mode

1. A ductile failure mode is assumed (leak before burst).

Consequence of Failure

1. The result of the failure will not result in serious personnel injury. Safe-guarding will be applied if necessary.

Safety Class

1. Applicable to ML4 only.

Documentation Requirements

1. These compressed air with receiver pressure systems shall be exempt from the requirements of having code leak test documentation.
2. These compressed air with receiver pressure systems may continue to use unlisted components provided they are used within the temperature and pressure ratings of the manufacturer's.

3. This equipment will be considered grandfathered and will not be replaced with like items. System shall be upgraded to ASME compliance as items age out of service by attrition.
4. LANL ESM Chapter 17 documentation as required by Table ADMIN-1-3-M include: certification status form (FM01), relief device (FM02), component list (FM07), and sketch (FM10).
5. Existing compressed air with receiver pressure systems may continue to use non-ASME stamped vessels provided calculations are performed to verify code-equivalent ratings.
6. When vessels are included as part of the compressed air with receiver pressure system they must be evaluated for current MAWP based on the most applicable code or standard.

Qualitative Risk Assessment

Probability: Remote

Consequence: Significant

QR Factor: 4

Table 3 Qualitative Risk (QR) Determination

			Probability				
			A	**B**	**C**	**D**	**E**
			Frequent	**Probable**	**Occasional**	**Remote**	**Improbable**
Consequence	**I**	**Major**	1	1	1	2	3
	II	**Serious**	1	1	2	3	4
	III	**Significant**	1	2	3	4	5
	IV	**Minor**	2	3	4	5	6
	V	**Insignificant**	3	4	5	6	7

Table ADMIN-1-3-M

General Legacy Pressure System Documentation for Compressed Air with Receiver

Documentation Package Item	Comment	Owner Verification	PSO Verification
1. Form 1, LANL Pressure System Certification Status Form	Every Package		
2. Form 10, System schematics (If the owner does not have a system schematic, utilize the sketch prepared by the walkdown team until such time as system schematic is prepared)[15]	Every Package		
3. Alternate Method/Variance or clarification/interpretation (if applicable).	If the system or any item of the system has an applicable alternate method/variance or clarification/interpretation to the requirements of this document		
4. Code Stamped Vessel Fabrication Documentation	If the code data report is not available, a manufacturer's construction drawing may be used to verify the item has not been modified. If the manufacturer's construction drawing is not available, personal knowledge may be used to establish the code stamped item has not been modified. This requires a person or persons with intimate and long term personal knowledge since original receipt and installation of the item to create a statement of compliance. This statement of compliance will be used to document the history of the item and be used as evidence the code stamped item has not been modified. This statement of compliance will be signed by the persons of record.		
a. Vessel thickness and remaining life estimate	Every Package		
5. Non-ASME code Fabricated Vessel Information (code-equivalent Documentation)	The pressure system contains Non-ASME-code stamped boilers and pressure vessels (which includes boilers, pressure vessels, heat exchangers, and accumulators)		

[15] Information required on Form 10, System schematics may be documented in alternative documents or captured in controlled databases, such as the Master Equipment List (MEL) or Computerized Maintenance Management System (CMMS), but must be referenced and readily available for review. The evaluation shall be considered a record and must be managed per LANL P1020, P1020-1, and P1020-2

Table ADMIN-1-3-M

General Legacy Pressure System Documentation for Compressed Air with Receiver

Documentation Package Item	Comment	Owner Verification	PSO Verification
a. ASME code equivalent documentation for systems with pressure vessels which includes but is not limited to minimum wall thickness determination, corrosion allowance, weld efficiency rating, support structure loading, nozzle calculations. Calculations will use the material values specified in the ASME code.	A non-code boiler, pressure vessel, heat exchanger or accumulator is in the pressure system package		
b. Vessel thickness and remaining life estimate	Every Package		
6. Pressure Safety Devices	The pressure system contains a pressure safety device (which includes but is not limited to relief valves and rupture discs)		
a. Flow Test documentation as described in this Chapter, if required	Whenever a relief valve has been modified, or when calculations cannot be generated.		
b. Safety Relief Calculations for relief valves, in accordance with ASME requirements	Every Package, unless calculations cannot be generated, a flow test is required in place of calculations.		
c. Pressure Relief Calculations for Rupture Disks in accordance with ASME requirements	Rupture Disks are in the pressure system		
7. Piping System Documentation:			
a. FM07; for available components	Every Package		
8. Pump or compressor discharge pressure curves, calculation, or table (If available)	Only applicable if the pressure system contains pumps or compressors		

General Legacy Pressure System Description for Compressed Inert Gases – DOT Cylinders

Evaluation Category 12

Assumptions:

Fluid Service

1. The system fluid service is FS2 or FS3 as defined by ESM Chapter 17
   1.1. The pressure system fluid service is Category D as define by ASME B31.3 2010.
   1.2. The pressure system fluid service is Category Normal as define by ASME B31.3 2010.
2. Materials of construction are compatible with the system fluid service.

System Operation

1. There are no stress intensification factors for example cracks or acute angles of pressure boundaries.

System Hardware

1. The system components have exhibited extensive, successful service experience under comparable conditions with similarly proportioned components of the same or like material.
2. The system is equipped with a properly sized, set, and functional pressure relief device(s), if needed, to protect against single point failures. Relief device exhaust locations are properly sized and located to protect personnel.
3. There are no locations in the system that requires relief protection that may be isolated from relief protection.
4. Flexible hoses over 12 inches in length and in service pressure greater than 150 psig are restrained in accordance with ESM Chapter 17.
5. System is constructed of metallic components.
6. In response to the PISA on LANL Welding Program (circa 2004) representative accessible welds were visually inspected and are free from indications. Solder or braze joints are not allowed.
7. External appearance is free from corrosion or indication of leakage.

Failure Mode

1. A ductile failure mode is assumed (leak before burst).

Consequence of Failure

1. The result of the failure will not result in serious personnel injury. Safe-guarding will be applied if necessary.

Safety Class

1. Applicable to ML4 only.

Documentation Requirements

1. These Compressed Inert Gases – DOT Cylinders pressure systems shall be exempt from the requirements of having code leak test documentation.

2. These Compressed Inert Gases – DOT Cylinders pressure systems may continue to use unlisted components provided they are used within the temperature and pressure ratings of the manufacturer's.
3. This equipment will be considered grandfathered and will not be replaced with like items. System shall be upgraded to ASME compliance as items age out of service by attrition.
4. LANL ESM Chapter 17 documentation as required by Table ADMIN-1-3-N include: certification status form (FM01), relief device (FM02), component list (FM07), and sketch (FM10).
5. Existing Compressed Inert Gases – DOT Cylinders pressure systems may continue to use non-ASME stamped vessels provided calculations are performed to verify code-equivalent ratings.
6. When vessels are included as part of the Compressed Inert Gases – DOT Cylinders pressure system they must be evaluated for current MAWP based on the most applicable code or standard.

Qualitative Risk Assessment

Probability: Remote

Consequence: Significant

QR Factor: 5

Table 3 Qualitative Risk (QR) Determination

			Probability				
			A	**B**	**C**	**D**	**E**
Consequence			**Frequent**	**Probable**	**Occasional**	**Remote**	**Improbable**
	I	**Major**	1	1	1	2	3
	II	**Serious**	1	1	2	3	4
	III	**Significant**	1	2	3	4	5
	IV	**Minor**	2	3	4	5	6
	V	**Insignificant**	3	4	5	6	7

Table ADMIN-1-3-N

General Legacy Pressure System Documentation for Compressed Inert Gases – DOT Cylinders

Documentation Package Item	Required When	Owner Verification	PSO Verification
1. Form 1, LANL Pressure System Certification Status Form	Every Package		
2. Form 10, System schematics (If the owner does not have a system schematic, utilize the sketch prepared by the walkdown team until such time as system schematic is prepared)[16]	Every Package		
3. Alternate Method/Variance or clarification/interpretation (if applicable).	If the system or any item of the system has an applicable alternate method/variance or clarification/interpretation to the requirements of this document		
4. Code Stamped Vessel Fabrication Documentation	If the code data report is not available, a manufacturer's construction drawing may be used to verify the item has not been modified. If the manufacturer's construction drawing is not available, personal knowledge may be used to establish the code stamped item has not been modified. This requires a person or persons with intimate and long term personal knowledge since original receipt and installation of the item to create a statement of compliance. This statement of compliance will be used to document the history of the item and be used as evidence the code stamped item has not been modified. This statement of compliance will be signed by the persons of record.		
a. Vessel thickness and remaining life estimate	Every Package		
5. Non-ASME code Fabricated Vessel Information (code-equivalent Documentation)	The pressure system contains Non-ASME-code stamped boilers and pressure vessels (which includes boilers, pressure vessels, heat exchangers, and accumulators)		

[16] Information required on Form 10, System schematics may be documented in alternative documents or captured in controlled databases, such as the Master Equipment List (MEL) or Computerized Maintenance Management System (CMMS), but must be referenced and readily available for review. The evaluation shall be considered a record and must be managed per LANL P1020, P1020-1, and P1020-2

Table ADMIN-1-3-N

General Legacy Pressure System Documentation for Compressed Inert Gases – DOT Cylinders

Documentation Package Item	Required When	Owner Verification	PSO Verification
a. ASME code equivalent documentation for systems with pressure vessels which includes but is not limited to minimum wall thickness determination, corrosion allowance, weld efficiency rating, support structure loading, nozzle calculations. Calculations will use the material values specified in the ASME code.	A non-code boiler, pressure vessel, heat exchanger or accumulator is in the pressure system package		
b. Vessel thickness and remaining life estimate	Every Package		
6. Pressure Safety Devices	The pressure system contains a pressure safety device (which includes but is not limited to relief valves and rupture discs)		
a. Safety Relief Calculations for relief valves, in accordance with ASME requirements	Every Package, unless calculations cannot be generated, a flow test is required in place of calculations.		
b. Pressure Relief Calculations for Rupture Disks in accordance with ASME requirements	Rupture Disks are in the pressure system		
c. Certified Test Data of relief valves, e.g. steam Pressure safety valves are certified by NBIC coded shop	A PRD is modified or tested by an outside facility		
7. Piping System Documentation:			
b. FM07; for available components	Every Package		
8. Pump or compressor discharge pressure curves, calculation, or table (If available)	The pressure system contains pumps or compressors		

General Legacy Pressure System Description for Compressed Air without Receiver

Evaluation Category 13

Assumptions:

Fluid Service

1. The system fluid service is FS2 or FS3 as defined by ESM Chapter 17
   1.1. The pressure system fluid service is Category D as define by ASME B31.3 2010.
   1.2. The pressure system fluid service is Category Normal as define by ASME B31.3 2010.
   1.3. The pressure systems are within the scope of ASME B31.9-2011.
2. Materials of construction are compatible with the system fluid service.

System Operation

1. There are no stress intensification factors for example cracks or acute angles of pressure boundaries.

System Hardware

1. The system components have exhibited extensive, successful service experience under comparable conditions with similarly proportioned components of the same or like material.
2. The system is equipped with a properly sized, set, and functional pressure relief device(s), if needed, to protect against single point failures. Relief device exhaust locations are properly sized and located to protect personnel.
3. There are no locations in the system that requires relief protection that may be isolated from relief protection.
4. Flexible hoses over 12 inches in length and in service pressure greater than 150 psig are restrained in accordance with ESM Chapter 17.
5. System is constructed of metallic components.
6. In response to the PISA on LANL Welding Program (circa 2004) representative accessible welds were visually inspected and are free from indications. Solder or braze joints are not allowed.
7. External appearance is free from corrosion or indication of leakage.

Failure Mode

1. A ductile failure mode is assumed (leak before burst).

Consequence of Failure

1. The result of the failure will not result in serious personnel injury. Safe-guarding will be applied if necessary.

Safety Class

1. Applicable to ML4 only.

Documentation Requirements

1. These compressed air pressure systems shall be exempt from the requirements of having code leak test documentation.

2. These compressed air pressure systems may continue to use unlisted components provided they are used within the temperature and pressure ratings of the manufacturer's.
3. This equipment will be considered grandfathered and will not be replaced with like items. System shall be upgraded to ASME compliance as items age out of service by attrition.
4. LANL ESM Chapter 17 documentation as required by Table ADMIN-1-3-P include: certification status form (FM01), relief device (FM02), component list (FM07), and sketch (FM10).

Qualitative Risk Assessment

Probability: Remote

Consequence: Minor

QR Factor: 4

Table 3 Qualitative Risk (QR) Determination

			Probability				
			A	B	C	D	E
			Frequent	Probable	Occasional	Remote	Improbable
Consequence	I	Major	1	1	1	2	3
	II	Serious	1	1	2	3	4
	III	Significant	1	2	3	4	5
	IV	Minor	2	3	4	5	6
	V	Insignificant	3	4	5	6	7

Existing (including Legacy) System Documentation Requirements

Table ADMIN-1-3-P

General Legacy Pressure System Description for Compressed Air without Receiver

Documentation Package Item	Required When	Owner Verification	PSO Verification
1. Form 1, LANL Pressure System Certification Status Form	Every Package		
2. Form 10, System schematics (If the owner does not have a system schematic, utilize the sketch prepared by the walkdown team until such time as system schematic is prepared)[89]	Every Package		
3. Alternate Method/Variance or clarification/interpretation (if applicable).	If the system or any item of the system has an applicable alternate method/variance or clarification/interpretation to the requirements of this document		
4. Pressure Safety Devices	The pressure system contains a pressure safety device (which includes but is not limited to relief valves and rupture discs)		
a. Safety Relief Calculations for relief valves, in accordance with ASME requirements	Every Package, unless calculations cannot be generated, a flow test is required in place of calculations.		
b. Pressure Relief Calculations for Rupture Disks in accordance with ASME requirements	Rupture Disks are in the pressure system		
c. Certified Test Data of relief valves, e.g. steam Pressure safety valves are certified by NBIC coded shop	A PRD is modified or tested by an outside facility		
5. Piping System Documentation:			
a. FM07; for available components	Every Package		
6. Pump or compressor discharge pressure curves, calculation, or table (If available)	The pressure system contains pumps or compressors		

[89] Information required on Form 10, System schematics may be documented in alternative documents or captured in controlled databases, such as the Master Equipment List (MEL) or Computerized Maintenance Management System (CMMS), but must be referenced and readily available for review. The evaluation shall be considered a record and must be managed per LANL P1020, P1020-1, and P1020-2

General Legacy Pressure System Description for Compressed Inert Gases – Building Systems

Evaluation Category 14

Assumptions:

Fluid Service

1. The system fluid service is a FS3 as defined by ESM Chapter 17
   1.1. The pressure system fluid service is Category D as define by ASME B31.3 2010.
   1.2. The pressure system fluid service is Category Normal as define by ASME B31.3 2010. (liquids)
   1.3. The pressure systems are within the scope of ASME B31.9-2011.
2. Materials of construction are compatible with the system fluid service.

System Operation

1. There are no stress intensification factors for example cracks or acute angles of pressure boundaries.

System Hardware

1. The system components have exhibited extensive, successful service experience under comparable conditions with similarly proportioned components of the same or like material.
2. The system is equipped with a properly sized, set, and functional pressure relief device(s), if needed, to protect against single point failures. Relief device exhaust locations are properly sized and located to protect personnel.
3. There are no locations in the system that requires relief protection that may be isolated from relief protection.
4. System is constructed of metallic components.
5. In response to the PISA on LANL Welding Program (circa 2004) representative accessible welds were visually inspected and are free from indications. Solder or braze joints are not allowed.
6. External appearance is free from corrosion or indication of leakage.

Failure Mode

1. A ductile failure mode is assumed (leak before burst).

Consequence of Failure

1. The result of the failure will not result in serious personnel injury. Safe-guarding will be applied if necessary.

Safety Class

1. Applicable to ML4 only.

Documentation Requirements

1. These Compressed Inert Gases – Building pressure systems shall be exempt from the requirements of having code leak test documentation.
2. These Compressed Inert Gases – Building pressure systems may continue to use unlisted components provided they are used within the temperature and pressure ratings of the manufacturer’s.

3. This equipment will be considered grandfathered and will not be replaced with like items. System shall be upgraded to ASME compliance as items age out of service by attrition.
4. LANL ESM Chapter 17 documentation as required by Table ADMIN-1-3-R include: certification status form (FM01), relief device (FM02), component list (FM07), and sketch (FM10).
5. Existing Compressed Inert Gases – Building pressure systems may continue to use non-ASME stamped vessels provided calculations are performed to verify code-equivalent ratings.
6. When vessels are included as part of the Compressed Inert Gases – Building pressure system they must be evaluated for current MAWP based on the most applicable code or standard.

Qualitative Risk Assessment

Probability: Remote

Consequence: Minor

QR Factor: 5

Table 3 Qualitative Risk (QR) Determination

			Probability				
			A	**B**	**C**	**D**	**E**
			Frequent	**Probable**	**Occasional**	**Remote**	**Improbable**
Consequence	**I**	**Major**	1	1	1	2	3
	II	**Serious**	1	1	2	3	4
	III	**Significant**	1	2	3	4	5
	IV	**Minor**	2	3	4	5	6
	V	**Insignificant**	3	4	5	6	7

Table ADMIN-1-3-R

General Legacy Pressure System Documentation for Compressed Inert Gases - Buildings

Documentation Package Item	Required When	Owner Verification	PSO Verification
1. Form 1, LANL Pressure System Certification Status Form	Every Package		
2. Form 10, System schematics (If the owner does not have a system schematic, utilize the sketch prepared by the walkdown team until such time as system schematic is prepared)[18]	Every Package		
3. Alternate Method/Variance or clarification/interpretation (if applicable).	If the system or any item of the system has an applicable alternate method/variance or clarification/interpretation to the requirements of this document		
4. Code Stamped Vessel Fabrication Documentation	If the code data report is not available, a manufacturer's construction drawing may be used to verify the item has not been modified. If the manufacturer's construction drawing is not available, personal knowledge may be used to establish the code stamped item has not been modified. This requires a person or persons with intimate and long term personal knowledge since original receipt and installation of the item to create a statement of compliance. This statement of compliance will be used to document the history of the item and be used as evidence the code stamped item has not been modified. This statement of compliance will be signed by the persons of record.		
a. Vessel thickness and remaining life estimate	Every Package		

[18] Information required on Form 10, System schematics may be documented in alternative documents or captured in controlled databases, such as the Master Equipment List (MEL) or Computerized Maintenance Management System (CMMS), but must be referenced and readily available for review. The evaluation shall be considered a record and must be managed per LANL P1020, P1020-1, and P1020-2

Table ADMIN-1-3-R

General Legacy Pressure System Documentation for Compressed Inert Gases - Buildings

Documentation Package Item	Required When	Owner Verification	PSO Verification
5. Non-ASME code Fabricated Vessel Information (code-equivalent Documentation)	The pressure system contains Non-ASME-code stamped boilers and pressure vessels (which includes boilers, pressure vessels, heat exchangers, and accumulators)		
a. ASME code equivalent documentation for systems with pressure vessels which includes but is not limited to minimum wall thickness determination, corrosion allowance, weld efficiency rating, support structure loading, nozzle calculations. Calculations will use the material values specified in the ASME code.	A non-code boiler, pressure vessel, heat exchanger or accumulator is in the pressure system package		
b. Vessel thickness and remaining life estimate	Every Package		
6. Pressure Safety Devices	The pressure system contains a pressure safety device (which includes but is not limited to relief valves and rupture discs)		
a. Safety Relief Calculations for relief valves, in accordance with ASME requirements	Every Package, unless calculations cannot be generated, a flow test is required in place of calculations.		
b. Pressure Relief Calculations for Rupture Disks in accordance with ASME requirements	Rupture Disks are in the pressure system		
c. Certified Test Data of relief valves, e.g. steam Pressure safety valves are certified by NBIC coded shop	A PRD is modified or tested by an outside facility		
7. Piping System Documentation:			
a. FM07; for available components	Every Package		
8. Pump or compressor discharge pressure curves, calculation, or table (If available)	The pressure system contains pumps or compressors		

General Legacy Pressure System Description for High Pressure – Low Liquid Volume

Evaluation Category 15

Assumptions:

Fluid Service

1. The system fluid service is a FS1 liquid with a low flow liquid rate such that whipping of flex lines is not an issue.
   1.1. The pressure system fluid service is High Pressure as define by ASME B31.3 2010.
   1.2. The fluid used is not toxic, corrosive, or immediately dangerous to humans.
2. Materials of construction are compatible with the system fluid service.

System Operation

1. There are no stress intensification factors for example cracks or acute angles of pressure boundaries.

System Hardware

1. The system components have exhibited extensive, successful service experience under comparable conditions with similarly proportioned components of the same or like material.
2. The system is equipped with a properly sized, set, and functional pressure relief device(s), if needed, to protect against single point failures. Relief device exhaust locations are properly sized and located to protect personnel.
3. There are no locations in the system that requires relief protection that may be isolated from relief protection.
4. Flexible hoses over 12 inches in length and in service pressure greater than 150 psig are restrained in accordance with ESM Chapter 17 only in locations where adequate volume is present to present a whipping problem.
5. Pumping rates are low enough to preclude hose whipping and fluid jetting from leaks.
6. System is constructed of metallic components.
7. In response to the PISA on LANL Welding Program (circa 2004) representative accessible welds were visually inspected and are free from indications. Solder or braze joints are not allowed.
8. External appearance is free from corrosion or indication of leakage.

Failure Mode

1. A ductile failure mode is assumed (leak before burst).

Consequence of Failure

1. The result of the failure will not result in serious personnel injury. Safe-guarding will be applied if necessary.

Safety Class

1. Applicable to ML4 only.

Existing (including Legacy) System Documentation Requirements

Documentation Requirements

1. These High Pressure – Low Liquid Volume pressure systems shall be exempt from the requirements of having code leak test documentation.
2. These High Pressure – Low Liquid Volume pressure systems may continue to use unlisted components provided they are used within the temperature and pressure ratings of the manufacturer's.
3. This equipment will be considered grandfathered and will not be replaced with like items. System shall be upgraded to ASME compliance as items age out of service by attrition.
4. LANL ESM Chapter 17 documentation as required by Table ADMIN-1-3-S include: certification status form (FM01), relief device (FM02), component list (FM07), and sketch (FM10).

Qualitative Risk Assessment

Probability: Remote

Consequence: Significant

QR Factor: Insignificant

Table 3 Qualitative Risk (QR) Determination

			Probability				
			A	**B**	**C**	**D**	**E**
			Frequent	**Probable**	**Occasional**	**Remote**	**Improbable**
Consequence	**I**	**Major**	1	1	1	2	3
	II	**Serious**	1	1	2	3	4
	III	**Significant**	1	2	3	4	5
	IV	**Minor**	2	3	4	5	6
	V	**Insignificant**	3	4	5	6	7

Table ADMIN-1-3-S

General Legacy Pressure System Documentation for High Pressure – Low Liquid Volume

Documentation Package Item	Required When	Owner Verification	PSO Verification
1. Form 1, LANL Pressure System Certification Status Form	Every Package		
2. Form 10, System schematics (If the owner does not have a system schematic, utilize the sketch prepared by the walk down team until such time as system schematic is prepared)[19]	Every Package		
3. Alternate Method/Variance or clarification/interpretation (if applicable).	If the system or any item of the system has an applicable alternate method/variance or clarification/interpretation to the requirements of this document		
4. Pressure Safety Devices	The pressure system contains a pressure safety device (which includes but is not limited to relief valves and rupture discs)		
a. Safety Relief Calculations for relief valves, in accordance with ASME requirements	Every Package, unless calculations cannot be generated, a flow test is required in place of calculations.		
b. Pressure Relief Calculations for Rupture Disks in accordance with ASME requirements	Rupture Disks are in the pressure system		
c. Certified Test Data of relief valves, e.g. steam Pressure safety valves are certified by NBIC coded shop	A PRD is modified or tested by an outside facility		
5. Piping System Documentation:			
a. FM07; for available components	Every Package		
6. Pump or compressor discharge pressure curves, calculation, or table (If available)	The pressure system contains pumps or compressors		

[19] Information required on Form 10, System schematics may be documented in alternative documents or captured in controlled databases, such as the Master Equipment List (MEL) or Computerized Maintenance Management System (CMMS), but must be referenced and readily available for review. The evaluation shall be considered a record and must be managed per LANL P1020, P1020-1, and P1020-2

General Legacy Pressure System Description for Hydronic Piping

Evaluation Category 16

Assumptions:

Fluid Service

1. The system fluid service is FS3 as defined by ESM Chapter 17
   1.1. The pressure system fluid service is Category D as define by ASME B31.3 2010.
   1.2. The pressure systems are within the scope of ASME B31.9-2011.

System Operation

1. There are no stress intensification factors for example cracks or acute angles of pressure boundaries.

System Hardware

1. The system components have exhibited extensive, successful service experience under comparable conditions with similarly proportioned components of the same or like material.
2. The system is equipped with a properly sized, set, and functional pressure relief device(s), if needed, to protect against single point failures. Relief device exhaust locations are properly sized and located to protect personnel.
3. There are no locations in the system that requires relief protection that may be isolated from relief protection.
4. System is constructed of metallic components.
5. In response to the PISA on LANL Welding Program (circa 2004) representative accessible welds were visually inspected and are free from indications. Solder or braze joints are not allowed.
6. External appearance is free from corrosion or indication of leakage.

Failure Mode

1. A ductile failure mode is assumed (leak before burst).

Consequence of Failure

1. The result of the failure will not result in serious personnel injury. Safe-guarding will be applied if necessary.

Safety Class

1. Applicable to ML4 only.

Documentation Requirements

1. These hydronic pressure systems shall be exempt from the requirements of having code leak test documentation.
2. These hydronic pressure systems may continue to use unlisted components provided they are used within the temperature and pressure ratings of the manufacturer's.
3. This equipment will be considered grandfathered and will not be replaced with like items. System shall be upgraded to ASME compliance as items age out of service by attrition.

4. LANL ESM Chapter 17 documentation as required by Table ADMIN-1-3-T include: certification status form (FM01), relief device (FM02), component list (FM07), and sketch (FM10).

Qualitative Risk Assessment

Probability: Remote

Consequence: Minor

QR Factor: 5

Table 3 Qualitative Risk (QR) Determination

			Probability				
			A	**B**	**C**	**D**	**E**
			Frequent	**Probable**	**Occasional**	**Remote**	**Improbable**
Consequence	**I**	**Major**	1	1	1	2	3
	II	**Serious**	1	1	2	3	4
	III	**Significant**	1	2	3	4	5
	IV	**Minor**	2	3	4	5	6
	V	**Insignificant**	3	4	5	6	7

Existing (including Legacy) System Documentation Requirements

Table ADMIN-1-3-T

General Legacy Pressure System Documentation for Hydronic Piping

Documentation Package Item	Required When	Owner Verification	PSO Verification
1. Form 1, LANL Pressure System Certification Status Form	Every Package		
2. Form 10, System schematics (If the owner does not have a system schematic, utilize the sketch prepared by the walkdown team until such time as system schematic is prepared)[20]	Every Package		
3. Alternate Method/Variance or clarification/interpretation (if applicable).	If the system or any item of the system has an applicable alternate method/variance or clarification/interpretation to the requirements of this document		
4. Pressure Safety Devices	The pressure system contains a pressure safety device (which includes but is not limited to relief valves and rupture discs)		
a. Safety Relief Calculations for relief valves, in accordance with ASME requirements	Every Package, unless calculations cannot be generated, a flow test is required in place of calculations.		
b. Pressure Relief Calculations for Rupture Disks in accordance with ASME requirements	Rupture Disks are in the pressure system		
c. Certified Test Data of relief valves, e.g. steam Pressure safety valves are certified by NBIC coded shop	A PRD is modified or tested by an outside facility		
5. Piping System Documentation:			
a. FM07; for available components	Every Package		
6. Pump or compressor discharge pressure curves, calculation, or table (If available)	The pressure system contains pumps or compressors		

[20] Information required on Form 10, System schematics may be documented in alternative documents or captured in controlled databases, such as the Master Equipment List (MEL) or Computerized Maintenance Management System (CMMS), but must be referenced and readily available for review. The evaluation shall be considered a record and must be managed per LANL P1020, P1020-1, and P1020-2

General Legacy Pressure System Description for Water Systems

Evaluation Category 17

Assumptions:

Fluid Service

1. The system fluid service is FS3 as defined by ESM Chapter 17
   1.1. The pressure system fluid service is Category D as define by ASME B31.3 2010.
   1.2. The pressure systems are within the scope of ASME B31.9-2011.

System Operation

1. There are no stress intensification factors for example cracks or acute angles of pressure boundaries.

System Hardware

1. The system components have exhibited extensive, successful service experience under comparable conditions with similarly proportioned components of the same or like material.
2. The system is equipped with a properly sized, set, and functional pressure relief device(s), if needed, to protect against single point failures. Relief device exhaust locations are properly sized and located to protect personnel.
3. There are no locations in the system that requires relief protection that may be isolated from relief protection.
4. System is constructed of metallic components.
5. External appearance is free from corrosion or indication of leakage.
6. In response to the PISA on LANL Welding Program (circa 2004) representative accessible welds were visually inspected and are free from indications. Solder or braze joints are not allowed.
7. External appearance is free from corrosion or indication of leakage.

Failure Mode

1. A ductile failure mode is assumed (leak before burst).

Consequence of Failure

1. The result of the failure will not result in serious personnel injury. Safe-guarding will be applied if necessary.

Safety Class

1. Applicable to ML4 only.

Documentation Requirements

1. These water pressure systems shall be exempt from the requirements of having code leak test documentation.
2. These water pressure systems may continue to use unlisted components provided they are used within the temperature and pressure ratings of the manufacturer's.

Existing (including Legacy) System Documentation Requirements

3. This equipment will be considered grandfathered and will not be replaced with like items. System shall be upgraded to ASME compliance as items age out of service by attrition.
4. LANL ESM Chapter 17 documentation as required by Table ADMIN-1-3-U include: certification status form (FM01), relief device (FM02), component list (FM07), and sketch (FM10).

Qualitative Risk Assessment

Probability: Remote

Consequence: Insignificant

QR Factor: 6

Table 3 Qualitative Risk (QR) Determination

			Probability				
			A	**B**	**C**	**D**	**E**
			Frequent	**Probable**	**Occasional**	**Remote**	**Improbable**
Consequence	**I**	**Major**	1	1	1	2	3
	II	**Serious**	1	1	2	3	4
	III	**Significant**	1	2	3	4	5
	IV	**Minor**	2	3	4	5	6
	V	**Insignificant**	3	4	5	6	7

Attachment ADMIN-1-3 Rev. 0.1, 5/04/2016

Existing (including Legacy) System Documentation Requirements

Table ADMIN-1-3-U

General Legacy Pressure System Documentation for Water Systems

Documentation Package Item	Comment	Owner Verification	PSO Verification
1. Form 1, LANL Pressure System Certification Status Form	Every Package		
2. Form 7, Component List	Every Package		
3. Form 10, System schematics (if the owner does not have a system schematic, utilize the sketch prepared by the walkdown team until such time as system schematic is prepared)[21]	Every Package		
4. Alternate Method/Variance or clarification/interpretation (if applicable).	If the system or any item of the system has an applicable alternate method/variance or clarification/interpretation to the requirements of this document		
5. Pressure Safety Devices	The pressure system contains a pressure safety device (which includes but is not limited to relief valves and rupture discs)		
a. Safety Relief Calculations for relief valves, in accordance with ASME requirements	Every Package, unless calculations cannot be generated, a flow test is required in place of calculations.		
b. Pressure Relief Calculations for Rupture Disks in accordance with ASME requirements	Rupture Disks are in the pressure system		
c. Certified Test Data of relief valves, e.g. steam Pressure safety valves are certified by NBIC coded shop	A PRD is modified or tested by an outside facility		
6. Piping System Documentation:			
a. FM07; for available components			
7. Pump or compressor discharge pressure curves, calculation, or table (If available)	The pressure system contains pumps or compressors		

[21] Information required on Form 10, System schematics may be documented in alternative documents or captured in controlled databases, such as the Master Equipment List (MEL) or Computerized Maintenance Management System (CMMS), but must be referenced and readily available for review. The evaluation shall be considered a record and must be managed per LANL P1020, P1020-1, and P1020-2

New System Document Requirements

RECORD OF REVISIONS

Rev	Date	Description	POC	RM
0	9/17/2014	Initial issue.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*

Contact the Standards POC for upkeep, interpretation, and variance issues.

Chapter 17	Pressure Safety POC and Committee

This document is online at http://engstandards.lanl.gov

Documentation Package Item	Required When	Owner Verification	PSO Verification
1. All forms contained in Attachment ADMIN-1-1 of this standard[1]	Every Package		
2. System drawings and schematics[2]	Every Package		
3. Alternate Method/Variance (if applicable)	If the system or any item of the system has an applicable alternate method/variance to the requirements of this document		
4. Code Stamped Vessel Fabrication Documentation	The system contains a code stamped vessel		
5. Non-ASME code Fabricated Vessel Information (code-equivalent Documentation)	The pressure system contains Non-ASME-code stamped boilers and pressure vessels (which includes boilers, pressure vessels, heat exchangers, and accumulators)		

[1] Information required on the forms may be documented in alternative documents or captured in controlled databases, such as the MEL or CMMS, but must be referenced and readily available for review. The evaluation shall be considered a record and must be managed per LANL P1020, P1020-1, and P1020-2

[2] Information required on system drawings and schematics may be documented in alternative documents or captured in controlled databases, such as the MEL or the CMMS, but must be referenced and readily available for review. The evaluation shall be considered a record and must be managed per LANL P1020, P1020-1, and P1020-2

Documentation Package Item	Required When	Owner Verification	PSO Verification
a. ASME code equivalent documentation for systems with pressure vessels which includes but is not limited to minimum wall thickness determination, corrosion allowance, weld efficiency rating, support structure loading, nozzle calculations. Calculations will use the material values specified in the ASME code.	A non-code boiler, pressure vessel, heat exchanger and accumulator is in the pressure system package		
b. Pressure Qualification Test Procedures and data	Non code boilers, pressure vessels, heat exchangers and accumulators is in the pressure system package		
c. Modification procedures/instructions	Modifications were made to non-code boilers, pressure vessels, heat exchangers and accumulators is in the pressure system package		
d. Non-Destructive Evaluation (NDE) data reports	NDE was done to non-code boilers, pressure vessels, heat exchangers and accumulators is in the pressure system package		
e. Weld examination forms as described in ESM Chapter 13.	Welding was done to non-code boilers, pressure vessels, heat exchangers and accumulators is in the pressure system package		
f. Special Calculations such as welding	Special calculations are performed for non-code boilers, pressure vessels, heat exchangers and accumulators is in the pressure system package		
g. Vendor Drawings	Piece parts are used to fabricate non-code boilers, pressure vessels, heat exchangers and accumulators is in the pressure system package		
h. Vessel modification reports	Vessel is modified by other than LANL personnel		
6. Pressure Safety Devices	The pressure system contains a pressure safety device (which includes but is not limited to relief valves and rupture discs)		
a. Flow Test documentation as described in this Chapter	Whenever a relief valve has been modified, or when calculations cannot be generated.		
b. Safety Relief Calculations for relief valves, in accordance with ASME requirements	Every Package, unless calculations cannot be generated, a flow test is required in place of calculations.		
c. Pressure Relief Calculations for Rupture Disks in accordance with ASME requirements	Rupture Disks are in the pressure system		
d. Thermal Load Calculations (Fire Sizing)	A relief device is used to protect against thermal induced over pressure.		
e. Certified Test Data of relief valves, e.g. steam Pressure safety valves are certified by NBIC coded shop	A PRD is modified or tested by an outside facility		
f. Documentation of relief valve modification	If a relief valve has been modified		

Documentation Package Item	Required When	Owner Verification	PSO Verification
g. Identification as a liquid lock PRD on PRV Recall Summary Sheet and pressure system Component List (e.g., spread sheet)	PRDs are used as protection against liquid lock overpressure.		
7. Piping System Documentation	The system contains pipe, tube, or other components not classed as boilers or vessels.		
a. Fabrication Documentation	Code-equivalent systems must have records of all fabrication, inspection, test, and design data required by the applicable code.		
b. Pressure Qualification Test Procedures and data as defined by the applicable piping code	A pressure system package contains piping system components		
c. Examiner qualification	Examinations are preformed		
d. Owner's Inspector Checklist	Every package		
e. Modification procedures/instructions	Components of a system were modified from original construction		
f. Non-Destructive Evaluation (NDE) data reports	NDE is performed on piping system components		
g. Special Calculations such as Welds and Orifices	A pressure system package contains piping system components that have been welded, modified with "home-made" orifices, or unlisted components.		
h. Corrosion allowance calculations per ASME B31G	Piping is used in corrosive fluid service		
i. Code required calculations e.g. flexibility analysis, pipe supports, wind loading, and seismic loading. See specific code for additional detail. (e.g. B31.3 paragraph 319 and 321)	A pressure system package contains piping system components		
j. Weld examination forms in accordance with ESM Chapter 13, and special required examinations defined in the applicable code	Welding of pipe or tube in a pressure system package was performed		
k. Weld In-Process Forms in accordance with ESM Chapter 13, and the most applicable code.	When in-process examination of welding is used		
l. Vendor Drawings or sketches	A pressure system package contains vendor supplied systems, piping, or components		
m. Manufacturers' data sheets	Using component is pressure system		
n. Unlisted Component Evaluation	Using a non-listed component in pressure system		
8. Flex-hose external visual inspection records (see attached forms)	The system contains flexible hoses		
9. Pump or compressor discharge pressure curves, calculation, or table	The pressure system contains pumps or compressors		
10. Oxygen System Hazard Analysis	Pressure system is an oxygen system		

Pressure System Owner Checklist

for New or Modified Systems

(Guidance)

Before Design

- ☐ Select applicable ASME code for design and fabrication (consult with PSO)
- ☐ Select qualified Pressure System Designer

During Design

- ☐ Establish system design conditions (e.g., temperature, pressure, flow, ambient effects, dynamic effects)
- ☐ Perform system design calculations in accordance with applicable ASME B31 piping code

Before Fabrication

- ☐ Designate qualified Examiner and establish Examiner witness and hold points
- ☐ Engage qualified Owner's Inspector and establish Inspector witness and hold points
- ☐ Procure listed piping components in accordance with applicable ASME B31 piping code (or obtain variance using request)
- ☐ Procure pressure vessels in accordance with ASME B&PV Code, Section VIII (or obtain variance by request)

During Fabrication

- ☐ Utilize qualified personnel for performance of fabrication steps (e.g., qualified welders or compression fitting assemblers)
- ☐ Perform examinations and inspections as agreed with examiner and inspector

Before Operation

- ☐ Perform leak test in accordance with applicable ASME B31 piping code
    - o Ensure that instrumentation has been calibrated
    - o Ensure that Owner's Inspector is present to witness test
    - o Contact PSO to review documentation package and obtain system certification

During Operation

- ☐ Ensure that personnel operating the system have received applicable institutional training in accordance with P101-34
- ☐ Establish periodic maintenance requirements in accordance with ESM Chapter 17

Risk-Based Certification Processing and Maintenance (Guidance)

RECORD OF REVISIONS

Rev	Date	Description	POC	RM
0	9/17/2014	Initial issue.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*

Contact the Standards POC for upkeep, interpretation, and variance issues.

Chapter 17	**Pressure Safety POC and Committee**

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A phased approach should be implemented with regard to certification of existing pressure systems.

Priority should be given provide the highest level of risk reduction in pressure systems in accordance with Table ADMIN-1-6 below. The implementation of the pressure safety preventive maintenance process at LANL is risk-based.

With regard to maintenance:

1. The maintenance periods defined in Section ADMIN-4 *Inspection and Testing* articles on Inspection/Testing Interval and Corrosion and Remaining Life are postponed until the risk-based implementation of the pressure safety preventive maintenance process at LANL is complete for a specific system.

   a. As each pressure system receives initial maintenance and moved into a preventative maintenance program the maintenance intervals of articles on Inspection/Testing Interval and Corrosion and Remaining Life will be applied.

2. Implementation of pressure safety preventive maintenance should emphasize the graded approach of reducing the risk based on the nature of the fluid and the type of hazard; those that pose the greatest risk should be implemented first. Risk-based implementation of the preventive maintenance process at LANL will be to process systems based on the order established in the table. Those systems defined as “High” risk should be implemented first. After the “High” risk, “Medium” and “Low” risk implementation will follow in that order. Where specific conditions of the pressure system warrant the category of risk implementation may be changed with approval from the CPSO and the Safety Management Program Owner.

3. It is the responsibility of the FOD or RAD to ensure the safety of pressure systems, and implementation of the ESM Chapter 17 maintenance requirements.

   a. Implementation of the pressure safety preventive maintenance cycle should include the following:

      1) Verification of adequacy of safety devices and archival of the data in the pressure safety package.

      2) Initial servicing of relief devices.

      3) Wall thickness measurements for remaining life evaluation (for vessels and piping as appropriate).

      4) Tagging of all relief devices and vessels in accordance with ESM Chapter 1 Section 200.

      5) Release of a CMMS preventative maintenance work order (with cost codes) for non-programmatic systems.

      6) Implementation of a centralized data repository for the maintenance process for relief devices and vessels in programmatic systems.

Table ADMIN-1-6: Pressure Safety Maintenance Implementation Plan

Type of Pressure System	Risk-Based Pressure System Ranking
SC/SS (ML1/ML2)	High
High Pressure – Pneumatic	
Toxics (Category M)	
Steam	
High Pressure – Liquid High Volumetric Rate	

Type of Pressure System	Risk-Based Pressure System Ranking
Corrosive[1]	Medium
Brittle Failure Mode (not leak before burst)	
Oxygen[2]	
Flammables	
Cryogenic Liquids	
Steam Condensate	
Compressed Air with Receiver	
Compressed Inert Gases – DOT Cylinders	

Type of Pressure System	Risk-Based Pressure System Ranking
Compressed Air Without Receiver	Low
Compressed Inert Gases – Building Systems	
High Pressure –Low Liquid Volume	
Hydronic piping	
Water Systems	

[1] Corrosive Service – A fluid service in which the internal fluid, or external environment, is expected to produce a progressive deterioration in the pressure boundary material.

[2] Evaluate oxygen systems as required in ASTM G128 and other referenced ASTM standards to determine the likelihood of fire.

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1.0 Design and Documentation

A. Calculations

1. Calculations and documentation must be performed/provided using U.S. customary units (psi, inches, gpm, scfm, °F, lbs., etc.).[1]

2. Calculations for utility and facility systems, including welding calculations, must be performed per AP-341-605, Calculations (or LANL-approved equivalent), and ESM Chapter 1 Section Z10 (re: Design Output Documentation) and must be maintained in the pressure system documentation package.

3. Relief devices on new systems (other than Excluded) must have sizing calculations performed showing that the capacity of the designated relief device maintains system pressure at or below 110% (or other percentage defined by ASME Section VIII, Division 1 Part UG-125) of the system MAWP.[2]

4. Where system flow characteristics cannot be determined through calculations, capacity of the relief system must be verified by performing an in-place flow test of the relief devices upon completion of fabrication as defined in ASME PTC-25 and API 521 for pressure systems with supplied pressure. Flow test must be documented and maintained in the pressure system documentation package.

5. Calculations of relief devices shall be based on single-point-failure analysis. In the case of a pressure regulator this requires assuming the regulator fails fully open (regulator Cv used to calculate flow) and the flow exiting from the regulator must be matched by a relief device capable of relieving sufficient flow that the accumulation pressures meets code requirements typically less than or equal to 10% overpressure. For example a relief device set pressure is 100 psig. The relief device must flow sufficient amount of material to prevent the system pressure from exceeding 110 psig.

Note: Any existing pressure system that does not have sizing calculations on relief devices must either perform and document an in-place flow test for existing relief valves, or generate flow capacity calculations. The calculated relieving capacity of pressure relief systems utilizing rupture disks as the sole relief device must not exceed a value based on ASME BPVC Section VIII Division 1, Part UG-127 (a)(2).

B. Cryogenic Systems

1. For systems using ball valves, the ball must have a pressure relief hole designed into the ball to prevent over pressurization inside the ball cavity due to thermal expansion when the valve is in the closed position.

2. All valves and components must be designed and approved for use by the manufacturer for cryogen media.

3. Polymer-lined flexhoses shall not be used.[3]

[1] Relief devices are rated in US units; eliminates conversion errors.
[2] See ASME Section I and IV for boiler-specific capacity allowances
[3] The extreme low temperatures will cause the hoses to become brittle, increasing the risk of rupture and leakage

4. Flexibility analysis (as defined in the most applicable piping code)[4] must be performed on rigid piping to ensure adequate strain relief is designed into the assembly due to thermal contraction.

5. Soft goods in components must be compatible with the fluid and be suitable for both the temperature and pressure. (Example: Many PTFE material combinations are compatible with hazardous fluids, yet maintain a seal at cryogenic temperatures, at different pressure ranges).

C. DOT Vessels

1. DOT vessels that are greater than 6" I.D. and are permanently installed in a pressure system must either maintain their DOT inspection intervals or, if it cannot be removed for recertification, must be evaluated as ASME equivalent as follows:

   a. The material specification of the vessel must be determined as listed in the appropriate 49 CFR 178.xx cylinder specification (e.g., material specification for a 3A cylinder is listed in 49 CFR 178.36)

   b. Using the appropriate maximum allowable stress for the material (at temperature) found in ASME BPVC Section II, Part D (matching the material specification of the DOT Cylinder).

   c. Perform the ASME pressure calculations as described in Section VIII, Div 1, Part UG-27 or UG-28 as appropriate.

   d. Maintain a copy of the calculations in the pressure system documentation package indicating the vessel's revised MAWP rating.

   e. The vessel must be entered into CMMS and must be periodically inspected per the appropriate internal and external inspection intervals.

2. All other DOT vessels must maintain their inspection and certification intervals, with the due date of certification clearly identified on the vessel, see Ch. 17 Section NASME (*para. 2.0, DOT, IM, and UM Portable Tanks*).

   Guidance: Vessels less than 6" ID are considered piping components, not pressure vessels.[5]

D. Drawings and Sketches

1. Design information required by this chapter, where appropriate, may alternatively be captured in other documents or in controlled databases, such as the electronic document management system (EDMS) or Computerized Maintenance Management System (CMMS), but must be referenced and readily available for review. The documents shall be considered a record and must be managed per LANL P1020, P1020-1, and P1020-2.

2. At a minimum, non-excluded pressure systems must have accurate system schematics providing information of fluid flow paths, and system interactions of all wetted/pressurized components in the fluid path.

[4] For example, see B31.9 Chapter 2 Part 5 or ASME B31.3 Paragraph 319.
[5] ASME B&PV Code Section VIII (e.g., Div 1, UG-1)

3. System schematics must ultimately be in accordance with ESM Chapter 8 (*Appendix I, "PFD and P&ID Diagrams*)." PRV sizing calculations may be performed from accurate, dimensioned sketches.

    a. *Drawings and sketches should comply with AP-341-608, Engineering Drawings and Sketches, the LANL CAD Manual, or LANL-approved equivalent.*

4. Fluid components must be identified using the identification system established in ESM Chapter 1, Section 200, "Numbering and Labeling".

5. Diameters, wall thickness, and material type of all tubing and piping used in the system must be shown.

6. Sketches specific for relief device calculations must show all dimensions required to generate the calculation.

7. Pressure safety devices: Maximum pressure setting must be shown. Note that the actual setting of the device in the system may be lower than the drawing maximum set point.

8. Pressure regulators: The following must be shown on the system schematic:

    a. Maximum operating inlet pressure, and operating outlet pressure (not to be confused with MAWP)

    b. Pressure regulator (Cv) flow rate coefficient is not required to be shown when a smaller orifice is installed upstream or immediately downstream of a pressure regulator, or when tubing I.D. before (or immediately after) the regulator is less than regulator flow area. *It is good practice to show Cv in these cases.*

10. Pressure gages and transducers: Pressure range must be shown. *This is not to be confused with MAWP.*

11. Vessels: MAWP as rated by ASME code stamp or alternative calculations based on wall thickness evaluation must be shown.

12. System MAWP including new MAWP downstream of a pressure-controlling component must be shown.

13. Inside diameter of orifices must be indicated.

E. Finite Element Analysis and Other Software

1. Use of computer software (e.g., Cosmos, NASTRAN, Pro/Mechanica, Ansys, Algor, custom shells, etc.) to perform analysis of pressure systems and components is acceptable in performing engineering calculations; however, software must be verified and validated as defined in LANL policy P1040 and DOE O 414.1 *Quality Assurance*, including use within established bounding conditions and on operating systems for which the specific release (version) was tested.

2. Finite element analysis and computer calculations must follow ESM Chapter 1 – General, Section Z10 on "Design Output Requirements".

F. Fitting and Fastener Assembly

1. Must comply with one of the following:

    a. A published specification or controlled standard

b. Manufacturer standards based on the joint design and all materials of construction.

c. Special calculations by the designer.

G. Flexible Hoses and Tubing

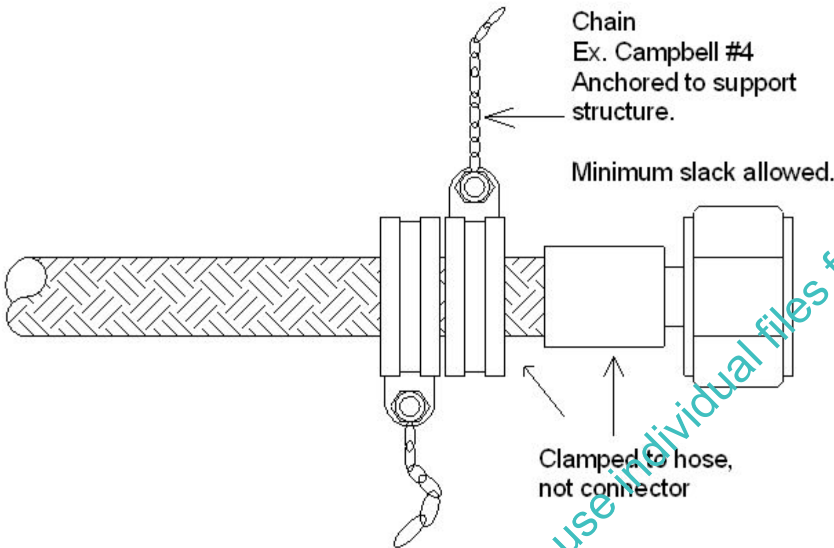
1. All preassembled flexible hoses must be procured from the manufacturer with the MAWP stamped, etched, or tagged on the hose or end connectors indicating the maximum allowable working pressure of the assembly.
2. Flexible hose assemblies without manufacturer's MAWP indicated on the hose/flexible tubing must not be used on non-excluded pressure systems.
3. Hoses used for cryogenic service must be convoluted stainless steel or specifically designed for such service.
4. Consider material compatibility per NFPA 30 and 45
5. Flexible "Poly-flo" type plastic and rubber hoses/tubing must not be used for the conveying of flammable gases and flammable liquids per NFPA 30 (*27.3.1*) and NFPA 45 (*10.2*).
6. "Poly-Flo" or similar non-metallic tubing must comply with ASME B31.3, Chapter VII.
7. Flexible hoses must be installed and used in such a manner as to prevent kinking and to minimize torsion, axial loads, twisting, and abrasion.
8. Several Swagelok flexhoses (*FM, FJ, FL, T, X, S, C, N, W, F, and U*) are approved for use at LANL; see Chapter 17 Attachment ASME-4-2 Swagelok Flexhose.

H. Restraints for Flexible Hoses and Relief Device Discharge Tubing

1. Relief device discharge lines, flexible tubing, and vent lines must be evaluated for reaction thrust considerations, and must be sufficiently braced to withstand the maximum and sustained thrust potential.[6]
2. Approved alternatives (of those shown below) or restraining devices approved by a designer may be used if the restraining device withstands the thrust challenge posed by both the initial surge thrust and the sustained surge thrust.
3. Flexible tubing and hoses over 12 inches in length and in service pressure greater than 150 psig must be constrained at both ends or shielded in case of end-connector failure. Hoses inside glove-boxes where whipping poses no personnel danger are considered adequately shielded for the hazard. The maximum separation distance between flexible hose restraints must not exceed 6-ft intervals. (e.g., an 8-ft. flexhose must use 3 restraints).
4. Safety grips (e.g., Kellums® grips or Adel® clamps #MS-21919DG shown below) connected from hose to hose, hose to structure, or from hose to other components must be used and must be capable of restraining the hose or end fittings in the event of joint

[6] ASME Section VIII, Division 1 Part UG-22, and Appendix M (M-12). ASME B31.3 Paras. 301.5.5, 319.5, and 322.6.2.

separation unless an adequate alternative for personnel protection is provided. Example shown below:[7]



Hubbell Kellums grips

5. Flex tubing/hoses located inside glove boxes, equipment, or test setups where whipping poses no nuclear safety or personnel danger are exempt from requirements for flexible element restraints.

[7] Flexible element restraints concepts throughout this section: WSTF WSI-SW-0024.B (NASA White Sands Test Facility Standard Instruction), industry standard, and lessons learned.

6. Specifically excluded are free-rotating/translating systems whose designs prohibit securing at 6-ft intervals.

7. Section ASME Attachment ASME-4-1 contains information on allowable hose restraints and methods for calculating the force from a line failure.

I. Fluid Category Determination

1. The CPSO must make the final determination of fluid category for all systems if there is any question. Determination of fluid category must be determined using ASME B31.3 (e.g., Appendix M, Figure M300).

   a. *The CPSO may evaluate the fluid service of a pressure system on an individual basis to determine if they meet Fig. M300 in B31.3 even if listed in ESM Chapter 17 Section II Attachment II-3 Category M fluids, and will consider relevant information in the evaluation, including protection of personnel against exposure. One of the relevant criteria is protection of personnel against exposure during system operation. A record of successful service may be created by the Industrial Hygiene and Deployed Services Group (IHS-IH) documenting the historical exposure record for the system confirming that personnel have been protected against exposure.*

2. A piping system will be considered "High Pressure Fluid Service" and must meet the requirements of ASME B31.3 Chapter IX if the design pressure is in excess of that allowed by the ASME B16.5 Class 2500 flange rating for the specified design temperature and material group. See High Pressure in Definitions section of this chapter for additional information.

3. Pressure systems (including repairs or alterations) with fluids identified as "lethal substance" must comply with the following:

   a. Pressure vessels must be designed and constructed per ASME Section VIII "lethal substances."

   b. Piping systems will comply with the code by using the flow chart (Figure M300 from ASME B31.3) to determine fluid media requirements (Category M vs. Normal). See listing in Appendix F of this document.

4. Systems designated as Category M fluid service must be designed and tested per ASME B31.3, Chapter VIII, "Piping for Category M Fluid Service."

5. For further guidance see LANL's "B31.3 Process Piping Guide," Chapter 17 REF-3.

J. Gas Cylinder Pressure Systems

1. Pressure systems utilizing pressurized cylinders as the pressure source must meet all the applicable requirements of this document, including certification.[8]

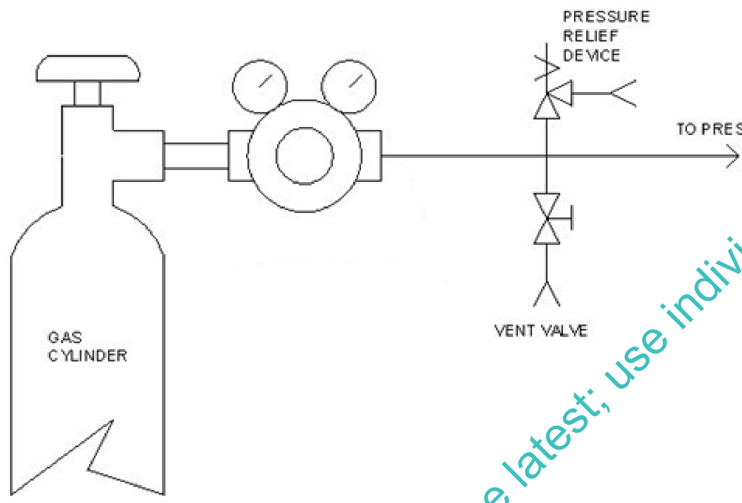
2. Pressure relief devices incorporated integrally into the design of pressure regulators do not perform a pressure protection function for downstream components and must not be considered as sufficient pressure relief.

[8] ASME B31.3 does not apply to gas regulators, and regulators are not required to be evaluated against requirements associated with unlisted components. For pressure system evaluation purposes, the gas regulator manufacturer's inlet pressure rating or range shall be considered the gas regulator MAWP.

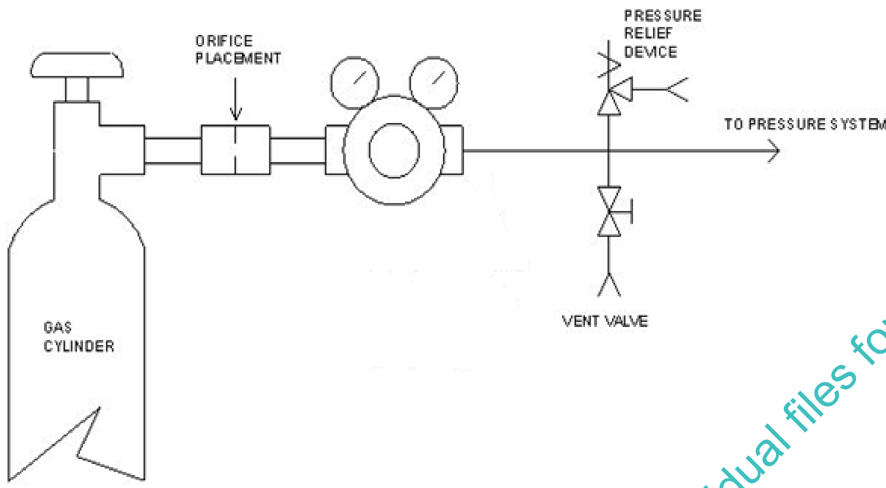
3. Orifices used must be rated for full bottle pressure.

4. Cylinders must be braced, chained, in place to prevent toppling.

5. Gas cylinders must have a pressure safety manifold system incorporated into the design after the regulator as shown below (note in some cases the vent valve and relief device may not be allowed to vent locally for example when a flammable or toxic material is used):



6. The following illustration shows the placement of a flow reducing orifice on a gas cylinder system which is used to reduce the mass flow rate from the gas cylinder so that the downstream (undersized) pressure relief device is not overwhelmed if the pressure regulator fails. Use of orifices is not required provided the pressure relief device and regulator are matched appropriately during the design process (note in some cases the vent valve and relief device may not be allowed to vent locally for example when a flammable or toxic material is used).



7. *The same orifice may be placed after the regulator, but may present operational issues since the orifice restriction may decrease operational flowrates.* In addition, all items between the regulator and the orifice must be suitable for upstream bottle pressure (in the event a regulator fails open). This would include the gauge in the sketch above.

8. *Where specific flow requirements are not a required function of the fluid flow, the installation of flow-reducing orifices is highly recommended to slow the flow rate of gas caused by failure of a regulator, or operator error.*

9. Open flow systems (e.g., purge systems) that are not designed for and cannot accommodate full bottle pressure/flow rates must utilize flow reducing orifices.

10. Pressure systems that are not "open flow" at all times, but require the use of RFOs, must have appropriate pressure relief installed in the appropriate location(s) in the pressure system.

11. Pressure systems that are designed in accordance with the applicable ASME code that are capable of withstanding the full gas cylinder pressure are not required to have pressure relief. Such cases must be proven to be designed per the ASME code, and must be evaluated against ASME Section VIII, Division 1, Part UG-140. Such applications must be reviewed by the CPSO.

12. *Guidance for selection of pressure relief devices for gas cylinder pressure systems is provided in Attachment ADMIN-2-1, Relief Device Selection Process for Gas Bottle Systems.*

K. Hydrogen and Flammable Fluid Pressure Systems

1. Pressure systems containing such fluids must be designed and evaluated against the requirements of ESM Chapter 10, *Hazardous Processes*, and its appendices.

2. Systems containing hydrogen must be evaluated for hydrogen embrittlement.

3. Bonding and grounding must be evaluated for storage vessels and systems containing such fluids.

4. Electrical components (solenoid valves, power strips, electrical control cabinets) must be intrinsically safe when required by the NEC.

L. Instruments

1. When a manufacturer's published operating range is equal to, or greater than, the design pressure of the system, the instrument shall be considered as meeting the requirements of 10 CFR 851.
2. When manufacturer's published operating range does not bound the design pressure, then safeguarding shall be applied to instruments to provide an equal level of protection in accordance with 10 CFR 851. These safeguards shall be in order of precedence: 1) engineering controls, 2) administrative controls, 3) personnel protective equipment.
3. Pressure and Vacuum Gauges: Overpressure relief protection must be provided on Bourdon-tube, dial-indicating pressure gauges that operate at pressures greater than 15 psig by one of the following means:
   a. Pressure gauges approved by Underwriters Laboratories (UL) in accordance with UL-404, "Standard for Gauges, Indicating Pressure, for Compressed Gas Service" Standard for Safety.
   b. Tempered safety glass or plastic face or shield and a blowout back or plug for pressure relief.
4. Pressure gauges that serve primarily a pressure indication for over pressure protection (i.e., not used for process data collection) must have a range of at least 1.25 times, but no more than twice the set pressure of the relief device as recommended in ASME Section VIII, Div. 1, Appendix M, Para. M-14.
5. *MAWP should be known. This value is typically greater than the dial indicator range.*
6. Labeling and Tagging of Components
   a. Components in a pressure system other than piping, tubing, flanges, and fittings must be tagged or labeled in accordance with the P&ID or system schematic and ESM Chapter 1, Section 200, "Numbering and Labeling."
   b. Physical labeling must match the system schematic, and vice versa.

M. Liquid lock

1. Provisions must be made in the design either to withstand or to relieve the pressure increase caused by heating of static fluid in a piping component from environmental temperature changes.
2. For cryogenic systems utilizing ball valves, the ball must have an upstream relief hole to prevent over pressurization inside the ball cavity due to thermal expansion.
3. When relief protection is used, the piping system must be in accordance with ASME B31.3 Paragraph 301.4.2 (fluid expansion effects).
   a. Liquid lock relief valves must be installed whenever cryogenic liquids can be trapped between closures.
   b. For all liquids, relief valves must be installed between closures to prevent over pressurization of the pressure system, except when an analysis indicates the

pressure of the trapped liquid will not exceed the MAWP of the components that contain the trapped liquid. A copy of this engineering analysis must be contained in the pressure system documentation.

c. Liquid lock relief valves must not have a set point greater than 120% of the MAWP.[9]

d. An engineering evaluation is required for liquid lock relief valves.

N. Material Compatibility

1. General

a. It is the designer's responsibility to select materials suitable for the fluid service. Materials are to be selected that resist deterioration in service and give a good service life.

b. When selecting materials such as adhesives, cements, solvents, solders, brazing materials, packing, and o-rings for making or sealing joints, the designer shall consider their suitability for the intended service.

c. The nonmetallic components shall be made of materials which are compatible with the fluid service in the piping system and shall be capable of withstanding the pressures and temperatures to which they will be subjected in service.

d. Select materials that will not contaminate the fluid service.

e. ASME B31.3 F323 shall be followed.

2. Corrosion

a. Corrosion rates must be established for materials used for the fluid service at the temperature and pressure they will be subjected to during service.

b. *For systems with active corrosion (e.g. carbon steel and water), corrosion inhibitors should be utilized to reduce the corrosion rate.*

c. Corrosion rates must be evaluated prior to selecting materials for fluid service at temperature and pressure. *The manufacturer's compatibility information may be used or a general guide like the National Association of Corrosion Engineers "Corrosion Data Survey" ISBN 0-915567-07-5.*

d. Passive Corrosion

1) *Systems that with passive corrosion (aluminum oxide, fluorine systems) should not be disturbed. Care should be taken to re-establish the passive corrosion layer.*

2) Fluorine systems shall be passivated (*see Ultrapure Gas Delivery "Preparing a gas delivery system for excimer lasers with fluorine passivation of 316L stainless steel" by Eugene, J. Karwacki Jr., Kerry R. Berger, Ronald M. Pearlstein, and Robert J. Haney Air Products and Chemicals)*

[9] ASME B31.3 Chapter II, Part 6, paragraph 322.6.3

e. Corrosion effects shall be considered by the designer for the fluid service and the temperature and pressure of the fluid service:

1) The susceptibility of the piping material to crevice corrosion under backing rings, in threaded joints, in socket welded joints, and in other stagnant, confined areas

2) The possibility of adverse electrolytic effects if the metal is subject to contact with a dissimilar metal

3) The effect of stress corrosion

4) The effect of intergranular corrosion (austenitic stainless steel carbide precipitation and chromium depletion)

5) The effect of hydrogen embrittlement

6) The effect of pitting corrosion

7) The effect of Microbiologically Influenced Corrosion

8) The possible corrosion under insulation effect

9) The effect of erosion corrosion

10) The effect of environmental cracking

11) The effect of electrolytic corrosion

12) The effect of selective corrosion attack on structural constituents

13) The effect of exfoliation corrosion

14) The effect of interfacial corrosion

f. Stress Corrosion Cracking

1) Stress corrosion cracking (SCC) is the cracking induced from the combined influence of tensile stress and a corrosive environment. The impact of SCC on a material usually falls between dry cracking and the fatigue threshold of that material. The required tensile stresses may be in the form of directly applied stresses or in the form of residual stresses, see an example of SCC of an aircraft component. The problem itself can be quite complex. The situation with buried pipelines is a good example of such complexity.

2) Cold deformation and forming, welding, heat treatment, machining and grinding can introduce residual stresses. The magnitude and importance of such stresses is often underestimated. The residual stresses set up as a result of welding operations tend to approach the yield strength. The build-up of corrosion products in confined spaces can also generate significant stresses and should not be overlooked. SCC usually occurs in certain specific alloy-environment-stress combinations.

3) Usually, most of the surface remains unattacked, but with fine cracks penetrating into the material. In the microstructure, these cracks can have an intergranular or a transgranular morphology. Macroscopically, SCC fractures have a brittle appearance. SCC is classified as a *catastrophic form of corrosion, as the detection of such fine cracks can be very difficult and the damage not easily predicted. Experimental SCC data is notorious for a wide range of scatter. A disastrous failure may occur unexpectedly, with minimal overall material loss.*

g. *Chloride Stress Corrosion Cracking - CSCC*

1) *Chloride Stress Corrosion Cracking is a localized corrosion mechanisms like pitting and crevice corrosion. The three conditions that must be present for chloride stress corrosion to occur are as follows.*

- *Chloride ions are present in the environment*
- *Dissolved oxygen is present in the environment*
- *Metal is under tensile stress*

2) *Austenitic stainless steel is a non-magnetic stainless steel grades consisting of iron, chromium, and nickel, with a low carbon content. This alloy is highly corrosion resistant and has desirable mechanical properties. One type of corrosion which can attack austenitic stainless steel is chloride stress corrosion. Chloride stress corrosion is a type of intergranular corrosion. Chloride stress corrosion involves selective attack of the metal along grain boundaries. In the formation of the steel, a chromium-rich carbide precipitates at the grain boundaries leaving these areas low in protective chromium, and thereby, susceptible to attack. It has been found that this is closely associated with certain heat treatments resulting from welding. This can be minimized considerably by proper annealing processes.*

3) *This form of corrosion is controlled by maintaining low chloride ion and oxygen content in the environment and the use of low carbon steels. Environments containing dissolved oxygen and chloride ions can readily be created in auxiliary water systems.*

3. Gaskets

a. Gaskets shall be selected so that the required seating load is compatible with the flange rating and facing, the strength of the flange, and its bolting.

b. Gaskets shall be made of material which is compatible with the fluid service and shall be capable of withstanding the pressures and temperatures to which they will be subjected in service.

4. Lubricants and Thread Compound

a. Any compound or lubricant used in threaded joints shall be suitable for the service conditions, and shall be compatible with the piping material and the service fluid.

5. Cleaning

a. The purpose of cleaning is to remove harmful deposits from all parts of the fluid system that come into contact with the fluid service during operation. All foreign materials, fatty acids, oils and grease, loose mill scale, rust, paint, and similar materials should be removed. Any solution employed should be a good cleaning agent for these purposes and should be compatible with the materials of construction.

b. Chemical cleaning is conducted with solvent solution primarily for the purpose of removing mill scale and products of corrosion. The solvent solution may be acidic or basic, or successive solutions of differing character may be employed. Because of the chemical control required to ensure a successful cleaning, to avoid damage to both ferrous and nonferrous materials through improper use of the solvent, and because of the potential dangers involved in dealing with corrosive solutions and possibly explosive and toxic products of the cleaning process, effect of the cleaning agent on the substrate must be evaluated.

c. Cleaning agents must be evaluated to verify compatibility with the fluid service.

d. Cleaning agents must also be evaluated to verify removal based on the engineering design.

6. For oxidizer fluid or fluorine service, special cleaning and inspection is required to 175A or better as defined in ASTM G93 (*para. 11.4.3).*

7. Low Temperature

a. At operating temperatures below −191°C (−312°F) in ambient air, condensation and oxygen enrichment occur. These shall be considered in selecting materials, including insulation, and adequate shielding and/or disposal shall be provided.

8. Flexible Elastomeric Sealed Joints

a. Assembly of flexible elastomeric sealed joints shall be in accordance with the manufacturer's recommendations.

b. Any solvents or lubricant used to facilitate joint assembly shall be compatible with the joint components and the intended service.

c. Flammable vapors shall be purged prior to hot work.

9. Hydrogen, Deuterium, and Tritium Service

a. Systems in hydrogen, deuterium, or tritium service shall follow ASME B31.12.

b. Tritium system design shall consider DOE-HDBK-1129, Tritium Handling and Storage.

10. Welding, Brazing, and Soldering Materials

a. When required, fluxes shall either be compatible with the fluid service or removed.

b. Dissimilar material connections involving welding or brazing of piping components or attachments to those piping components shall be as required by the engineering design.

11. Plastic Piping

a. Adhesives, cements, and sealers used to join piping components shall be compatible with the materials being joined and shall conform to applicable ASTM specifications.

b. Joining materials that have deteriorated by exposure to air, that are beyond the shelf life recommended by the manufacturer, or that will not spread smoothly shall not be used.

12. Organic material selection

a. Manufacturer's compatibility information must be reviewed prior to selection of material for fluid service at the system temperature and pressure.

b. *For general use, the Parker Hannifin Corporation O-Ring Division "Parker O-Ring Handbook" ORD 5700 may be used to evaluate the materials.*

13. Acetylene

a. In all cases, copper, silver, and mercury must be excluded from contact with acetylene in transmission and control systems; copper content of 65% may be used if the designer specifies the specific item.

b. *The common nonmetallic materials that have been found satisfactory for use with acetylene include asbestos, poltytetrafluoroethylene (PTFE), polychlorotrifuoroethylene (PCTFE), polyamide (PA), natural and synthetic rubbers, and leather.*

c. Use of cast iron and semi-steel that may be exposed to the pressure effects of an acetylene deflagration or detonation is not recommended.

d. Aluminum should be avoided, since it may become corroded by exposure to calcium hydroxide formed in the production of acetylene from calcium carbide.

e. For additional information reference CGA G1.2-2006 Acetylene Metering and Piping.

O. Oxygen Systems

1. Oxygen systems shall be designed (including materials selection), tested, cleaned, and assembled in accordance with ASTM G128 and other referenced ASTM standards. The design, testing, cleaning, and assembly shall be documented as an oxygen hazards analysis and shall be approved by the CPSO. The system shall be evaluated to reduce the likely hood of fire."

2. Design systems used for oxygen/oxidizer service to NFPA 55.

3. If system design cannot be controlled through component selection, operating practices, compatible materials, or when the system cannot be modified to improve its compatibility then shielding, must be placed around the system.

4. Follow ESM Chapter 2 to ensure adequate fire suppression devices/systems are strategically located near or around all oxygen/oxidizer systems (*see NFPA 45 for guidance in laboratory areas).*

P. Piping and Tubing

1. Piping or tubing must be protected with a pressure relieving device. In instances where a pressure relieving device cannot be installed, the piping must be designed to withstand the highest pressure that can be developed (see Code Case 2211, and ASME Section VIII, Division 1, part UG-140).

2. Wall thinning caused by bending of tubing must be accounted for when performing MAWP calculations, as defined in ASME B31.3 Chapter II, Paragraph 304.2.

3. Determination of piping/tubing MAWP, or wall thickness required for a specific internal design pressure, must be verified prior to selection by performing the following calculation as found in ASME B31.3, paragraph 304 for piping/tubing where t < D/6:

$$\text{To find wall thickness: } t = \frac{PD}{2(SEW + PY)}$$

$$\text{To find MAWP: } P = \frac{2SEWt}{D - 2tY}$$

Where:

t = pressure design wall thickness of tubing.

P = internal design pressure

D = outside diameter of pipe/tubing as measured

S = stress value for material from ASME B31.3 Table A-1

E = quality factor from ASME B31.3 Table A-1A or A-1B

W = weld joint strength reduction factor per ASME B31.3 Paragraph 302.3.5(e).

Y = coefficient from ASME B31.3 Table 304.1.1

4. The following formula may be used for determination of piping schedule. Variables are the same as above.

$$\text{Schedule} = \frac{1000P}{S}$$

5. For piping/tubing used in pressure systems designated as "High Pressure Fluid Service" (as defined in B31.3 Chapter IX), wall thickness of piping and tubing must be determined using ASME B31.3 Chapter IX, Para K304.

6. Unlisted piping/tubing must meet the requirements of ASME B31.3 Chapter III.

7. Piping/tubing of unknown material specifications must not be used in pressure systems.

8. Non-metallic piping and piping lined with nonmetals must conform to ASME B31.3 Chapter VII.

9. ASME B31.1 must be used for steam system piping where the steam, or vapor generated is greater than 15 psig, and high temperature water is generated at pressure exceeding 160 psig, and/or temperatures exceeding 250°F.

Guidance: Use of seam-welded pipe or tubing is strongly discouraged.

Q. Piping Components

1. See Section GEN-1 definition of Piping Components which clarifies which pressure system components are subject to the listing requirements of ASME B31.3.

2. Piping components that meet a listed standard in ASME B31.3 must be selected for use in construction or fabrication of a piping system. Piping components that conform to a

published specification or standard may be used, provided that a documented review of the specification indicates the component meets the ASME code. Unlisted piping components must be evaluated based upon criteria of ASME B31.1, ASME B31.3, or ASME Section VIII.

a. Records of acceptable components and evaluations shall be kept by the CPSO and made available to all LANL employees.

3. ASME B31.3 does not apply to instruments, except for inline portions of instruments. Non-inline instrumentation is not required to be evaluated against guidance for piping components. Refer to Instrumentation heading above.

4. Pressure systems must have all major components (flex-hoses, valves, pumps, vessels, gages, pressure transducers, flow meters, etc.) documented on the attached components list form and must be maintained in the pressure system documentation package. The following must be provided as a minimum for all components:

   a. Manufacturer

   b. Model Number

   c. MAWP

   d. Material (316 stainless, brass, etc.)

R. Piping Flanged Joint Connection Assembly

1. Follow the most applicable of the following:

   a. Manufacturer recommendations based on the joint design and all materials of construction

   b. ASME PCC-1, "Guideline for Pressure Boundary Bolted Flange Joint Assembly"

   c. ASME Section VIII Appendix 2, Rules for Bolted Flange Connections with Ring Type Gaskets

   d. Special calculations by the designer with concurrence by CPSO

   e. Applicable B31 piping code

S. Piping Supports and Flexibility Analysis

1. Follow B31.3 Process Piping for piping supports. Guidance: LANL B31.3 Process Piping Guide is also available as an attachment to this Section.

2. Flexibility analysis of a piping system must be performed on all systems. The analysis must conform to the requirements as defined in ASME B31.3, Chapter II paragraph 319.4.2. Exceptions to this requirement are the following, as defined by B31.3 paragraph 319.4.1:

   a. Those that are duplicates of successfully operating installations.

   b. Those that can be judged adequate by comparison with previously analyzed systems.

c. Systems of uniform size that have no more than two anchor points, no intermediate restraints, and fall within the limitation of the equation found in ASME B31.3 Paragraph 319.4.1.

1) Tubing that is anchored to beams of dissimilar material properties, in temperature varying environments (e.g., stainless steel tubing braced to a carbon steel I-beam on the exterior of a building) must incorporate flexibility which is necessary to accommodate thermal expansion/contraction.

3. Additional requirements for anchoring are in ESM Chapter 5 Structural[10] and Master Specifications 22 0529 *Hangers and Supports for Plumbing, Piping, and Equipment*; 22 0548 *Vibration and Seismic Controls for Plumbing, Piping, and Equipment; and* 13 4800 *Sound, Vibration and Seismic Control*. When a system is not required to be rated for seismic service, no seismic evaluations are required.

T. Pressure Relief Requirements

1. Pressure vessels and piping must have protection against over-pressurization.

a. Maximum inlet piping pressure drop must be in accordance with ASME Section VIII, Div 1, Part M-6 and Div II, Section 9.

2. The nominal pipe size of piping, valves and fittings, and vessel components between a pressure vessel and its safety, safety relief, or pilot operated pressure relief valve must be at least as large as the nominal size of the device inlet.

3. For the above, the cumulative total of all non-recoverable inlet pressure losses must not exceed 3% of the valve set pressure, as based on the valve nameplate capacity, corrected for the fluid characteristics.

4. Discharge lines from pressure relief devices must be in accordance with ASME Section VIII, Div. 1 Parts M-7 through M-12, and Div. II Parts 9.A.4 through 9.A.5.

a. The design characteristics of the discharge system must be designed as such to accommodate the requirements of ASME Section VIII Div. 1 Part UG-125.[11]

b. If unable to vent to a captured vent vessel, relief devices that vent flammable and/or toxic fluids must vent to the building exterior and away from ignition sources as defined in NFPA 30 and 45.

c. Discharge lines must be run as direct as practicable.

d. Water boilers: Pipe discharge from safety relief valve, full size, to floor drain with a union or flange between the valve and discharge piping. Do not allow weight of piping to bear on relief valve.[12]

e. Steam boilers: Pipe relief from safety valve to atmosphere above roof. Refer to Mechanical Drawing(s) ST-D3020-4, Steam Drip Pan Elbow, for additional requirements.[13]

[10] ESM 5 based on ASCE-7, DOE 420.1-1A, DOE Standard 1020, etc.
[11] See ASME B&PVC Section I and IV for boiler-specific capacities.
[12] 1997 IAPMO UMC, Section 1008. The referenced mechanical drawing provides piping detail for steam safety valves and additional design criteria.

5. Pressure relief devices must have calculations meeting AP-341-605. A copy of the calculations must be maintained in the pressure system documentation package. Calculations must define required flow capacity to prevent system pressure from exceeding 110% (or 116%, 120%, or 121% when allowed by ASME Section VIII, Div. 1 part UG-125) of the MAWP of the component it is protecting during maximum fault conditions (see Exclusions section).

6. A full verification record is not required for relief devices installed, and designed by the original manufacturer of a pressure system. However, if the manufacturer or system owner cannot supply documentation justifying the design of the pressure relief system, then calculations must be generated to ensure safe design.

7. Pressure relief devices for vessels that are to operate completely filled with liquid must be designed for liquid service, unless the vessel is otherwise protected against overpressure.

8. Pressure relief devices need not be installed directly on vessels, or components they are protecting, provided the following is met:

    a. There are no flow control, or shut off valves between the component being protected and the relief device,

    b. The relief device is suitable for the fluid service, meeting the capacity requirements for the application, and

    c. Design ensures that the pressure of the vessel or component the valve is protecting does not exceed the MAWP at operating conditions, except as permitted in Section VIII Division 1.

9. In cases where the required use of pressure relief devices is not practical, pressure control methods may be used only by approval from the CPSO (e.g., UG-140 may be used to substantiate the safety of the vessel).

10. Pressure relief designs must include a calculation report that includes at least, but not limited to the following (for rupture disks adjust as appropriate):

    a. Manufacturer

    b. Model number

    c. Inlet size and type

    d. Outlet size and type

    e. Set/burst pressure (psig)

    f. Service fluid

    g. Relieving capacity

    h. Relieving capacity at overpressure percent[14]

    i. Orifice trim (Not applicable to rupture disks)

    j. ASME Code Section

[13] Ibid.
[14] Allowable percentage as defined by ASME Section VIII, Division 1 Parts UG-125 through UG-136, or ASME Section I and IV.

k. Blow down (if critical, not required for rupture disks)

l. Determination of pressure relief device sizing

m. Determination of required relieving flow

n. Determination of inlet/outlet pressure drop at relieving conditions.

11. Pressure relief devices installed into a pressure system that protect ASME BPVC Section I, IV, VIII, or X equipment must be an ASME UV or UD stamped relief device as defined in Section VIII, Division 1 Part UG-125(a).[15]

12. A pressure relief device's set point must not exceed the MAWP of the system, except where allowed by the applicable ASME code (e.g., liquid lock and fire sizing).

13. A pressure relief device must have sufficient flow capacity such that system pressure does not exceed 110% of the system MAWP (or 116% as defined by ASME Section VIII Div. 1 Part UG-125 for multiple relief devices), at full open source pressure.

14. Relief device fire sizing calculations are required for relief devices that are used when a vessel and/or piping meet the definition as found in ASME Section VIII, Division 1 Part UG-125(c)(3), which states: "Pressure relief devices intended primarily for protection against exposure of a pressure vessel to fire or other unexpected sources of external heat installed on vessels having no permanent supply connection and used for storage at ambient temperature of non-refrigerated liquefied compressed gases."[16]

15. Flow capacity of pressure relief devices that are intended primarily for protection against exposure of a pressure vessel to fire or other unexpected sources of external heat, that are installed on vessels having no permanent supply pressure connection (or can be isolated from pressure relief) and used for storage at ambient temperatures of non-refrigerated liquefied compressed gases, must not exceed 120% of the stamped set pressure of the valve, or the MAWP.[17]

16. When performing a B31.3 345.5.3 Leak Test the test system must be protected by a relief device. If the owner's representative approves a pneumatic leak test and the test rig has a pressure relief that will not exceed the any components MAWP then the system shall be considered as satisfactorily protected.

17. Boiler Pressure Relief

a. For hot water heating boilers, the pressure differential between the safety relief valve set pressure and the boiler operating pressure must be a least 10 psi, or 25 percent of the boiler operating pressure, whichever is greater.[18]

b. For low pressure steam heating boilers, the pressure differential between the safety valve set pressure and boiler operating pressure must be at least 5 psi, and the boiler operating pressure should not exceed 10 psi. [19]

[15] Not a requirement for devices protecting only B31 piping systems.
[16] Pressure System Designer must determine need for fire sizing calculations. This Chapter does not impose specific requirements with regard to the manner in which the Pressure System Designer documents the determination of the need to evaluate a fire scenario in sizing pressure relief devices.
[17] ASME Section VIII, Division 1 Part UG-125 (c)(3)(a). See API 521 for calculations.
[18] NB-23, National Board Inspection Code, Appendix F.
[19] Ibid.

c. For high pressure steam boilers (power boilers), relief systems must be designed using the calculations found in B31.1 Appendix II. Also, refer to ANSI/NB-23, Appendix F, for pressure differential between the safety valve set pressure and the boiler operating pressure.

18. Pressure Relief Valve Flow Tests: Where this is the only accurate method for determining relief system capacity, flow tests of relief systems must be performed. The objective of the test is to ensure that system pressure will not exceed over pressure percentage as defined in ASME Section VIII, Division 1 Part UG-125[20] (typically 110% above the MAWP), when allowed/approved by CPSO.[21]

a. For systems with multiple PRVs, liquid lock PRVs, and fire scenario PRVs, refer to ASME Section VIII Div 1, Parts UG-125 through UG-136 for further guidance:

1) Relief devices must be tested in-place, installed in their designated systems, without modification to plumbing arrangement.

2) The pressure measurement device that measures the pressure downstream of the flow-limiting device must be calibrated.

3) Must be tested with the maximum supply (source pressure) pressure at full open flow (i.e. pressure regulator increased to maximum) while observing pressure readings.

4) If it appears, as the pressure is gradually increased as the relief valve is flowing, that the pressure in the system will exceed 110% of the MAWP of the system, the test must be stopped immediately. The valve is undersized, or the pressure relief tubing is causing too much flow restriction. The relief system design has failed the test and needs to be redesigned.

i. System must not be allowed to operate until provisions have been made to accommodate for required relief capacity as defined by ASME Section VIII, Div. 1 Part UG-125.

5) If the relief valve maintains the system pressure below 110% of the MAWP, (at maximum flow of the pressure regulator) of the system, then the relief system is designed and sized appropriately.

b. Relief device flow tests must be documented and witnessed by PSO.

c. The following information must be obtained after the flow check with the pressure system documentation:

1) The source supply pressure

[20] See also ASME B&PVC Section I and IV for boiler specific applications

[21] ASME Section VIII Div 1, UG-131 requires flow checks to validate capacity of relief valves. Method used to validate relief system flow characteristics and performance to ensure UG-125 percentages are maintained/ achieved when piping and fittings are installed on relief valve ports. Testing must comply with NBIC/NB-23 Part 2, section 2.5.7, and ASME PTC-25 Part II, Section 4, part 4.3 "In-service Testing Procedures". Capacity compliance must be based on ASME Section VIII, Division 1 Part UG-125

2) Manufacturers model number and serial number of the relief device

3) Set pressure of the relief device

4) Gauge calibration tracking number and due date (manufacturer or calibration lab).

5) Maximum pressure obtained during the flow check

6) Indication of design/sizing failure to maintain pressure below 110% MAWP (or as specified by ASME Section VIII, Division 1, part UG-125)

7) Pressure measurement device calibration tracking number, and due date

8) Any special provisions must be stated in the flow test documentation (i.e. installation of an upstream orifice at the pressure source to minimize flow rate.)

19. The use of stop valves is not allowed for heating boiler applications, and is discouraged for other applications, but may be used when all the following requirements are met:[22]

a. The increase in pressure drop from the stop valve does not reduce the relieving capacity of the vent system below what is required.

b. The stop valve must be locked in the open position during system operation. For a stop valve to be satisfactorily locked in the open position it must have a physical means to inhibit unplanned operation of the valve. The lock must be key-operated.

c. Closing of the stop valve requires the system to be safe with strict procedural controls in place to warn personnel of the possible hazards.

d. If the above cannot be met, but a stop valve is required for operations, documented approval/variance must be obtained through the CPSO.

U. Pressure Vessel Requirements

1. When U-1 or U-1A documentation reports cannot be obtained for pressure vessels, pressure vessel calculations (as defined by ASME B&PVC Section VIII) are required to be generated using LANL AP-341-605 or CPSO-approved equivalent procedure.

2. Pressure vessels, in a pressure system, that fall under the scope of ASME Section VIII, must be ASME stamped, NBIC numbered and registered, and copies of the manufacturer's data reports (U-1A forms), must be provided as part of the procurement package. A copy of these documents must be maintained in the pressure system documentation package.

3. Pressure vessels with a design pressure less than 10,000 psig must be designed, and fabricated according to ASME BPVC Section VIII, Divisions 1 and 2, where Division 2 focuses on design by analysis.

4. Pressure vessels with a design pressure exceeding 10,000 psig must be designed, and fabricated in accordance with ASME BPVC Section VIII, Division 3.

[22] See ASME Section VIII Div 1 Part UG-135(d), and B31.3 paragraph 322.6.1

5. Vessels that, by design limitations, cannot be ASME-code-stamped must be proven equivalent as code stamped using the most applicable ASME B&PV code(s) for design, inspection, and testing. All requirements of the applicable code(s) must be documented and maintained in the pressure system documentation package, and must be approved by the CPSO.

6. Vessels, other than ASME-stamped vessels or DOT vessels, used within their intended service must have documentation justifying their use. Requirements in ASME Section VIII or other applicable code for this specific type of construction must be followed and verified. Documentation must include, but is not limited to:

   a. Material

   b. Material condition

   c. Thickness of major pieces

   d. Corrosion allowance

   e. Weld qualification

   f. Calculations, to include flanges, manholes, nozzles, etc.

   g. Loading listed in ASME Section VIII, Div 1 Part UG-22

7. Vendor Assembled or Manufactured Pressure Systems (those types of components or systems that are considered to be non-excluded as defined by this document).

   a. Procurement specifications for new pressure systems or vessels, or modifications to existing pressure systems must be submitted to the CPSO designee for review and evaluation before the procurement action or the modification.

   b. Manufacturer's supplied data must be stored in the pressure system documentation package.

   c. The designer must review and define the contents of the pressure system documentation package specifically for the vendor supplied pressure system/vessel.

   d. When a component of a vendor-supplied pressure system is serviced or changed from the original delivered configuration that item must be processed per this chapter.

8. Fiber-Reinforced Pressure Vessels (ASME Section X)

   a. Fiber-reinforced plastic pressure vessels in a pressure system must be ASME-stamped (RP stamp) and NBIC-registered, and copies of the manufacturer's data reports (e.g., RP-1, RP-2, Q106, Q107, etc.) must be maintained in the system documentation package.

9. Cryogenic Vessels

   a. The internal portion of a stationary cryogenic vessel shall meet ASME Boiler and Pressure Vessel Code Section VIII.

   b. The vacuum jacket may also meet the ASME Boiler and Pressure Vessel Code Section VIII or other suitable commercial standards such as:

1) CGA 341, Specification for Insulated Cargo Tank for Nonflammable Cryogenic Liquids

2) CGA H-3, Cryogenic Hydrogen Storage

3) NFPA 55, Compressed Gases and Cryogenic Fluids Code

V. Radioactive Liquid Waste (RLW)

1. The Owners' representative, the Chief Engineer, has directed that (as of July 18, 2014) all new RLW system designs or new modifications to existing RLW systems be treated as ASME B31.3 Fluid Category Normal (not "D') as the default minimum. Systems or system modifications started before this date may be completed under the existing design.

W. System Interactions

1. Where two or more dissimilar pressure systems tie into each other and/or are fed by a single pressure supply, they must be reviewed to determine the need for installation of check valves. *The following scenarios should be considered:*

   a. *Use of double block and bleed may fail due to human error*

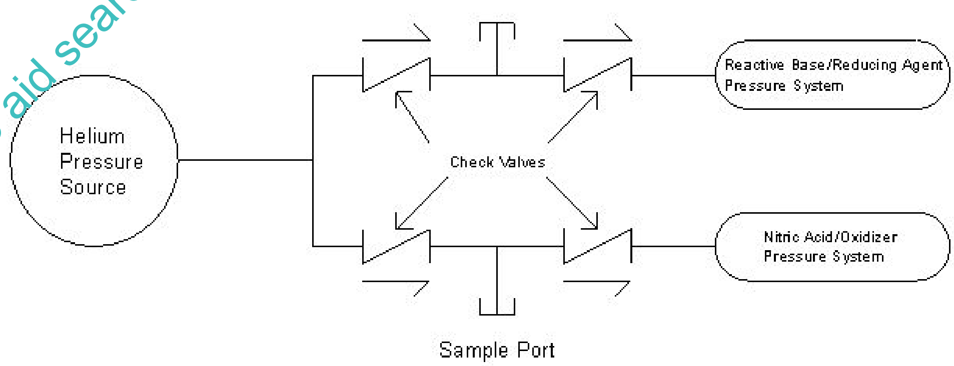
   b. *Where two dissimilar systems must be continuously pressurized from a single pressure source.*

   c. *Systems can be potentially over pressurized by the other.*

   d. *System contents may back flow into the other and cause contamination or over pressurization.*

   e. *System contents migration into the source pressure supply, which can potentially contaminate all other systems that connect to the same source.*

2. Double check valves in series must be installed on pressure systems to mitigate system fluid migrations and interactions where two or more incompatible fluid systems are pressurized by the same pressure source (e.g., monomethyl hydrazine and dinitrogen tetroxide systems pressurized by the same helium source). See example in figure below.



X. Vacuum and Externally Pressurized Components and Piping

1. Vacuum Vessels

   a. Vessels that are subject to external pressure must be designed in accordance with ASME Section VIII. For example: See ASME Section VIII Division 1 parts UG-28 and UG-29.

b. Vacuum vessels and vacuum systems that have a source pressure or purge gas that exceeds 15 psig must be designed, fabricated, and tested according to ASME Code Section VIII, and B31.3.

2. Vessels, Piping and Tubing

a. Externally pressurized piping or vessels must be designed in accordance with ASME B31.3 Chapter II, Para 304.1.3 which references ASME Section VIII, Div 1 parts UG-28 thru UG-30 (vessels under external pressure).[23]

Y. Vent Systems

1. All pressure systems must be designed with a means to manually vent pressure from the system.

2. Breaking loose fittings to vent pressure is absolutely prohibited. Vent systems must be supplied with means of controlled venting through a valve.

3. Except for captured vent systems (for lethal or toxic systems), vents must not be plugged.[24]

4. Relief devices and vents that are in an environment which could cause the exhaust ports to be plugged (e.g., insect nests) must be fitted with a metallic screen or other device to keep them from becoming plugged. Screens/covers must not inhibit the flow capacity of the relief device.

Z. Unlisted, Specialty, or Unique Components25

1. Unlisted components allowed for new construction must demonstrate equal or greater level of safety at the pressure and temperature of the system. ASME B31.3 requires a safety factor of 3:1 and ASME B31.1 requires a safety factor of 4:1. For existing systems, refer to Chapter 17 Section EXIST.

a. Swagelok components (tubing, fittings, and valves only) are allowed for use in construction of new, code-compliant systems at LANL.[26] See Section Attachment ASME-4-2 for flex hose.

2. The master list of Unlisted Components allowed for use is maintained by the CPSO and made available for both internal and external web access.

3. Components that are not built to the standards listed in the codes -- including those built to other standards, manufacturers' standards, or built by LANL -- must be qualified by the owner and/or the designer (per the code of record) as follows (B31.3 302.2.3):

a. Unlisted Components - (a) Components not listed in Table 326.1, but which conform to a published specification or standard, may be used within the following limitations.

[23] ASME B31.3 has specific requirements for variables, "L" and "S" as defined in Section VIII, Div 1.
[24] In case venting is required in an emergency
[25] See ASME B31.3, para 302.2.3. Listed components can be found in Table 326.1.
[26] Variance VAR-2010-001.0 evaluated Swagelok (including the old brands of Whitey, Cajon, and Nupro) to ASME B31.3 304.7.2 requirements

1) The designer shall be satisfied that composition, mechanical properties, method of manufacture, and quality control are comparable to the corresponding characteristics of listed components.

2) Pressure design shall be verified in accordance with para. 304:

304 PRESSURE DESIGN OF COMPONENTS

304.1 Straight Pipe

304.2 Curved and Mitered Segments of Pipe

304.3 Branch Connections

304.4 Closures

304.5 Pressure Design of Flanges and Blanks

304.6 Reducers

304.7 Pressure Design of Other Components

NOTE: Items that are not evaluated per 304.1, 304.2, 304.3, 304.4, 304.5, or 304.6 MUST BE evaluated by 304.7.

3) Other unlisted components shall be qualified for pressure design as required by para. 304.7.2.

4) Components built at LANL

a. Require qualification by engineering calculation to support pressure design consistent with the applicable code. Documentation showing compliance with the design criteria of the code approved by the owner shall be by one of the following:

i. Extensive successful service under the same loading and service conditions

ii. Experimental stress analysis[27]

iii. Proof test (e.g., Sect VIII UG-101 would be 4 times MAWP)

iv. Detailed stress analysis (such as finite element method)[28]

4. Documentation of acceptability must be by calculation. *A form is also available to assist in evaluating unlisted components.*

5. Unlisted components allowed for new construction must demonstrate equal or greater level of safety at the pressure and temperature of the system. *For example, an unlisted component rated at 16000 psig at 500 °F used in a system with a design pressure of 4,000 psig at 300 °F would have a factor of safety of 4:1. ASME B31.3 requires a factor of safety of 3:1. ASME B31.1 requires a safety factor of 4:1. This factor of safety would*

[27] See ASME Section VIII, Division 2, Annex 5.F.
[28] See evaluation as described in ASME Section VIII, Division 2, Part 5.

be acceptable for use either a B31.3 or B31.1 system. This same analysis may be used to evaluate existing system components.

6. Other criteria may be employed to evaluate pressure systems if:
   a. The pressure system is not subject to low-cycle fatigue (where significant plastic straining occurs)
      1) High-cycle fatigue (where stresses and strains are largely confined to the elastic region) is controlled to less than 100,000 cycles for the life of the pressure system.
      2) Corrosion is not a significant factor.
      3) There are no stress intensification factors for example cracks or acute angles or pressure boundaries
      4) The system components have exhibited extensive, successful service experience under comparable conditions with similarly proportioned
      5) If all the criteria above are met then the unlisted component used in an existing pressure system may be qualified as follows:
         a. Information provided by a reputable organization may be used to establish the MAWP of the unlisted item.
         b. The system shall be subjected to an initial service leak test per ASME B31.3 Initial Service Leak Test.
7. Information or testing results required may be documented in multiple formats, but must be referenced and readily available for review. This information shall be considered a record and be managed per LANL P1020, P1020-1, and P1020-2.

AA. Welding Systems

1. Welding systems meeting the criteria of OSHA 1910.253 *Welding, Cutting, and Brazing, Oxygen-fuel Gas Welding and Cutting* shall be designed in accordance with ASME B31.3 Process Piping.

BB. Welding Design

1. Design must address the following criteria (e.g., weld design calculations, drawings) as defined by the applicable code of construction and ESM Chapter 13, Welding, Joining, & NDE:
   a. Weld procedure specifications (WPS)
2. List of welding materials, to include filler materials
3. Heat treatment requirements
4. Method of welding, brazing or soldering (e.g., GTAW, SMAW, oxyacetylene, etc.)
5. Cleaning methods
6. Contain engineering design calculations or other approved ASME method that establishes the structural integrity of the design.

7. Specify the method(s) to examine the weld as defined by the appropriate ASME code (e.g., Section VIII Div 1 or B31.3)

8. Specify the pass/fail criteria to apply to the method(s) used to examine the weld.

9. Detail joint geometry, weld type, size, material type, and specification.

10. Utilize welding symbols in accordance with AWS A2.4 "Standard Symbols for Welding, Brazing, and Nondestructive Examination.

11. See also ESM Chapter 13 Welding Fabrication Procedure WFP 2-01, ASME B31 Series Piping Codes.

2.0 Computer Records

A. General

1. Facility systems must be included in the CMMS database for repetitive (preventive) and corrective maintenance.

2. Programmatic systems may elect to use either the CMMS database (*like LANSCE has*) or the PSCS database for repetitive maintenance.

3. All pressure safety unique files will be maintained in the PSCS database.

B. CMMS Database

1. The addition of a pressure vessel, removal of a pressure relief device, replacement of a pressure relief device and inspection of flex hoses shall be entered into CMMS for facility pressure systems.

2. Items that are not an exact replacement or engineered equivalent shall be updated in CMMS for facility equipment or the data repository for programmatic systems.

3. The MEL shall be maintained in accordance with AP-341-404.

C. DMAPS

1. Vessel inspection data must be entered into the DMAPS Database program. *Contact the LANL NDE/vessel inspection team (AET-6, 7-7077 or admin 7-6273) for assistance.*

2. A copy of the vessel inspection report produced by DMAPS must be provided to the pressure vessel owner, CPSO or designee

3. Vessel inspection reports must be maintained in the pressure system documentation package.

4. The DMAPS report will reference the TA-Bldg-Room (if applicable) and the system type so that it may be coordinated with the pressure system identification tag number.

D. Pressure Safety Certification Storage (PSCS)

1. PSOs may access the PSCS

2. Requires proof of UCNI training and crypto card.

3. Access is sponsored by CPSO or designee.

4. All walk down information is located on the PSCS database

5. PSCS is equipped with statistics for example to show number of systems certified, pending certification, in-active, exempt, and excluded by fluid service and FOD.
6. The PSCS is designed to allow electronic files to be attached to the system. In this way it may accommodate alternative formats that have the correct information.
7. FM03 and FM04 non-hardware issues observed by the original walk down teams reside in the PSCS. The Owner, PSO, and CPSO will review these findings and based on the requirements of ESM Chapter 17 determine which if any of the items must be completed prior to certification.
8. An FM02 is required for all relief devices and vessels that have a mandatory recall period.

ATTACHMENTS

Attachment ADMIN-2-1, Relief Device Selection Process for Gas Bottle Systems (Guidance)

Relief Device Selection Process for Gas Bottle Systems (Guidance)

RECORD OF REVISIONS

Rev	Date	Description	POC	RM
0	9/17/2014	Initial issue. Was Appendix D of Section I, rev. 3	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*

Contact the Standards POC for upkeep, interpretation, and variance issues.

Chapter 17	**Pressure Safety POC and Committee**

This document is online at http://engstandards.lanl.gov

This document provides a sample calculation to illustrate the methodology to be used to size a relief device for a gas bottle system.[1]

This sample calculation evaluates two cases: (1) without a restriction orifice and (2) with a restriction orifice.

> Note: Both cases involve the placement of the orifice upstream of the regulator. The orifice may be placed downstream of the regulator, but different calculations must be performed.

The following design parameters are assumed for this pressure system:

Gas Bottle: Nitrogen at 2265 psig

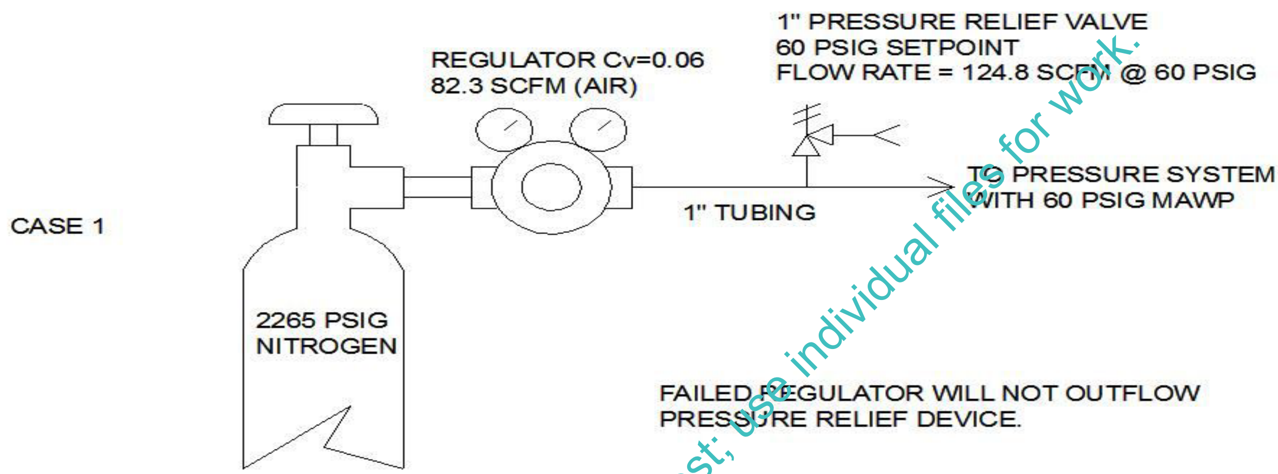
Regulator: Scott model 51-3300E-CGA, with a $C_v = 0.06$

Regulator downstream MAWP = 60 psig

Relief valve set pressure = 60 psig

[1] This sample calculation uses information contained in ARES calculation 0633301.52-M-062 (LANL CALC-10-00-786-PSS-GEN-00001r0), which is available as "Compressed Gas System Flow Calculation (pdf)" via the Pressure Protection Program Website: http://int.lanl.gov/org/padops/adnhho/engineering-services/pressure-protection-program/index.shtml

CASE 1



Case 1

From the ARES calculation (page 9), the flow, $Q_{air\_nitrogen}$ = 82.3 scfm for a C_v = 0.06

Regulator downstream pipe size: 1 inch

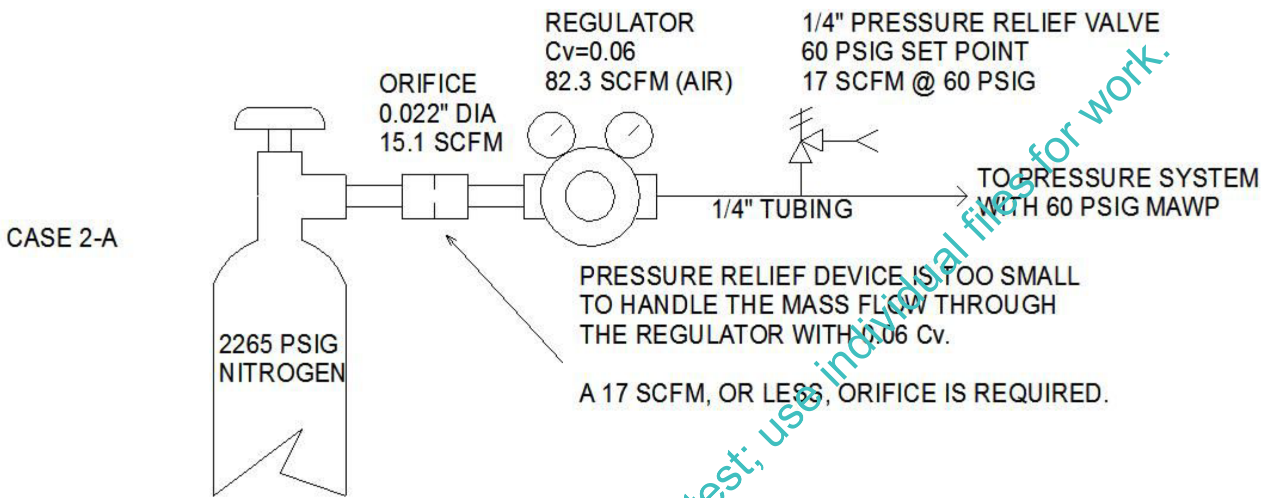
For valve selection, refer to the capacity data for Kunkle Relief Models 264 through 267 (ASME Section VIII, Air/Gas and Steam, National Board Certified). Valve inlet sizes: ½”, ¾”, 1”. Refer to Kunkle catalog at: http://www.kunklevalve.com/catalog/_264.pdf

The capacity data sheet provides the following flows as a function of the setpoints:

Set Pressure (psig)	Flow (Air) (scfm)
50	108
75	150

Interpolating for a set pressure of 60 psig yields a flow of 124.8 scfm -- which is greater than the required flow of 82.3 scfm.

CASE 2-A



Case 2-A

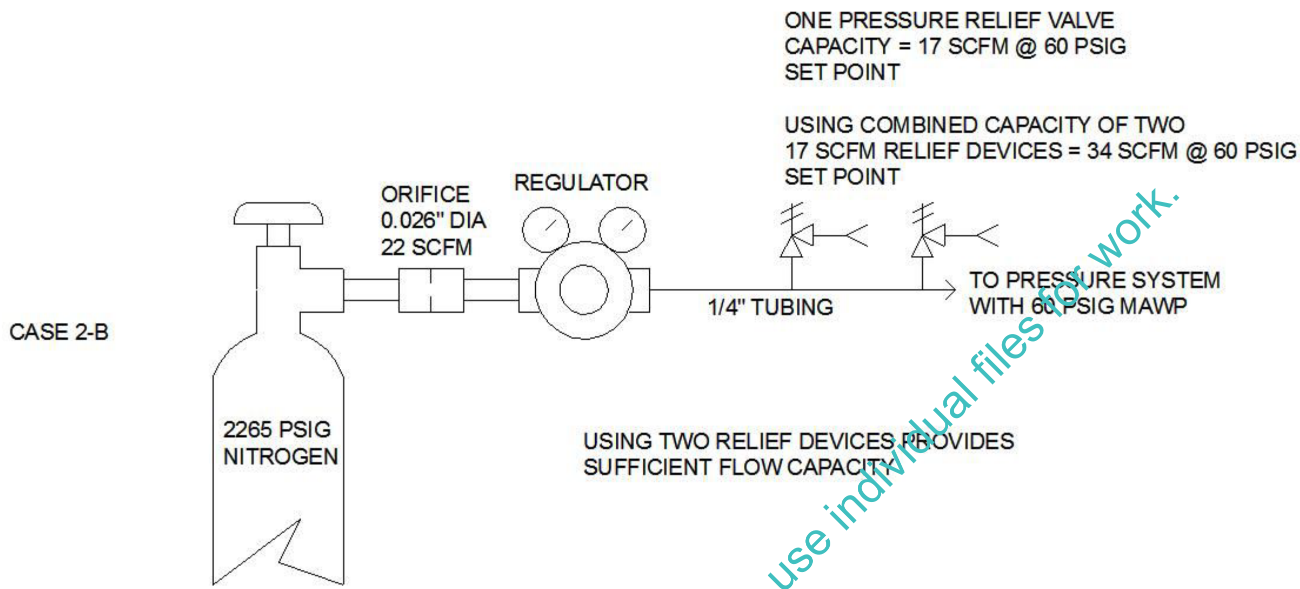
Regulator downstream pipe size: ¼ inch

82.3 scfm is too much for a ¼ inch relief valve; consequently, a restriction orifice will be added upstream of the regulator.

Assume that a ¼ inch Circle Seal model D500-M relief valve is available. The capacity data sheet for that valve indicates a flow of 17 scfm (air) at a setpoint of 60 psig (size 2M at 10% accumulation). Refer to Circle Seal catalog at:
http://www.circlesealcontrols.com/products/relief_valves/500/500-series_2007-10_lo.pdf

From the ARES calculation (page 12), the flow, $Q_{air\_nitrogen}$ = 15.1 scfm for an orifice diameter of 0.022 inch, the orifice flow of 15.1 scfm is within the relief valve capacity of 17 scfm.

CASE 2-B



<u>Case 2-B</u>

Regulator downstream pipe size: ¼ inch

Assume that a flow of 18 scfm (air) is required to meet the demands of the downstream system.

From the ARES calculation (page 12), the flow, an orifice diameter of 0.026 allows a flow, $Q_{air\_nitrogen}$ = 22.0 scfm.

ASME B31.3, Section 322.6.3, references ASME Section VIII, UG-134, which allows multiple pressure relief valves.

Using two Circle Seal model D500-M (1/4” inlet at 10% accumulation) provides a total flow of 34 scfm (air) at a setpoint of 60 psig, which exceeds the orifice flow of 22.0 scfm.

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RECORD OF REVISIONS

Rev	Date	Description	POC	RM
0	9/17/2014	Initial issue. Revision of material formerly in Section I	Ari Ben Swartz,	Larry Goen,

		Rev. 3 Article 12.0.	*ES-EPD*	*ES-DO*

Contact the Standards POC for upkeep, interpretation, and variance issues.

Chapter 17	**Pressure Safety POC and Committee**

This document is online at http://engstandards.lanl.gov

Procurement, Fabrication, and Assembly

A. General

1. Vessels must be code-fabricated and code-stamped; however, if required design features prevent code compliance, then follow the Non-Code Vessels section of this document.
   a. LANL Master Specification 43 4113 *Gas and Liquid Pressure Vessels* must be used for design/build procurements of pressure vessels. This specification is applicable both to new acquisitions and to modification or repair work to existing pressure vessels.
2. In addition to meeting and citing all other applicable procurement requirements in this document, procured pressure systems and components must shall the following where applicable, and documentation must be received with documentation from the manufacturer (ideally) or supplier showing proof of compliance. Documentation must be maintained in the pressure system documentation package.
   a. Applicable ASME code inspection and testing documentation.
   b. Cleanliness level oxygen/oxidizer components must be 175A or cleaner as specified in this document and ASTM G93.
   c. Welding specification, including inspection, and testing, where applicable.
   d. Operating conditions
   e. Loadings (snow, wind, seismic, etc.) as found in ESM Chapter 5.
   f. Purchased systems and custom systems must be built to the most applicable ASME code

B. Procurement Review (ASM Form 410)[1]

1. If the CSPO or designee determines that his/her review of proposed procurements is necessary to ensure that requestors/TSMEs are aware of and properly execute this chapter's requirements, then LANL ASM Form 3041.00.0410 "Goods or Services Requiring Internal Review & Approval" shall contain such requirements at CPSO discretion.

2. Requestors of relief devices will normally be expected to provide all the information in attached Form ADMIN-3-FM01, Relief Device Procurement Pre-approval. *For relief devices, the CPSO review should check such things as:*

   a. *the pressure system is in the database*

   b. *the relief device flow is greater than the regulator flow,*

   c. *the relief inlet size is equal to or larger than the connection to the system,*

   d. *the set pressure is less than or equal to the system MAWP, and*

   e. *bench stock relief devices are purchased as ASME-stamped valves.*

3. For pressure vessel procurements, purchase must require (a) NBIC numbering and registration and (b) manufacturer's data reports (see Section ADMIN-2 for other pressure vessel requirements).

C. Fabrication of New System

1. Appendix M contains the Pressure System Owner Checklist to assist the System Owner, PSO, Owner's Inspector, and Examiner fabricate a new system and identify the required inspections and evaluations.

2. Special requirement exist to use thermoplastics with flammable materials, see ASME B31.3 A323.4.2(a)(1).

3. PVC or CPVC shall not be used in compressed air or other compressed gas services, see ASME B31.3 A323.4.2(a)(3).

[1] Procurement review was successfully used at SRS for decades to ensure that new systems meet pressure safety program requirements, and maintenance of existing systems maintains configuration control of certified systems. Form 410 (3041.00.0410) can be found at https://asmdocs.lanl.gov/docs/Forms%20%20General/Forms/AllItems.aspx, directly here. Rev 18, 6/20/14, stated: Pressure Vessels & Systems:
- Power Boilers
- Heating Boilers
- Commercial Water Heaters
- ASME Section VIII Stamped pressure vessels
- Non-ASME-code-stamped pressure vessels
- Manufactured pressure systems other than ASME code stamped boilers and heaters
- Leased LANL-operated air compressors with tanks greater than 6 inches in diameter
- DOT vessels intended for permanent installation in a pressure system
- Relief Devices: safety relief valves, relief valves, and rupture discs

D. Rupture Disk Procurement

1. Where reverse buckling rupture disks must be procured, procure only rupture disks that have a damage ratio ≤ 1.0.

E. Relief Valve Pre-Testing

1. Prior to installation, new pressure relief valves must be independently tested to ensure the set point is correct as specified when ordered[2]. Such testing is not required if:[3]

   a. PRV setpoint adjustment is sealed by supplier and seal is unbroken, or tamper-proof and supplier meets the code of construction requirements.

   b. The supplier is on the LANL qualified suppliers list (IESL, internal: here)[4] or approved by the CPSO.

      1) *Guidance: CPSO approval listing is posted at ES-Division Pressure Protection Program homepage (internal here).*

   c. If testing is required, it must be performed in accordance with this document, and the applicable portions of ASME PTC-25, and then sealed.

F. Rental Pressure Systems

1. Rental pressure systems must be maintained in accordance with the applicable laws and national consensus codes and standards by the vendor owner.[5] Documentation must be made available upon request.

2. Rental pressure systems must be verified maintained by the owner.

G. ASME Code-Stamped Boilers and Vessels

1. See Section ASME of this chapter.

2. Controls, safety devices, and gas train shall comply with CSD-1 *Controls and Safety Devices for Automatically Fired Boilers*.

3. Boilers with fuel input rating greater than or equal to 12,500,000 Btu/hr fall within the scope of NFPA 85, *Boiler and Combustion Systems Hazard Code*.

H. Non-Code Vessels

1. Procurements of non-code stamped vessels must be reviewed by CPSO.[6]

   a. Vessel MAWP and over pressure protection is sufficient to achieve code equivalent protection from over pressurization.

   b. Design, and inspection documentation is readily available (weld inspection, pressure tests, etc.).

---

[2] This requirement became effective Sept 2010
[3] Contact MSS division for relief device testing capabilities. API recommended practice; experience of need at NASA, SRS, Y-12; and commercial nuclear practice.
[4] If the supplier is on the IESL, they have a quality pedigree for ML-1/2 nuclear safety and are therefore a trusted supplier; however, any PRV used for nuclear safety may warrant verification of setpoint and other attributes nevertheless.
[5] Captured by LANL ASM Form 410 (3041.00.0410) Goods and Services Requiring Internal Review and Approval, also see this topic higher in this Section.
[6] Ibid.

c. Have calculations and documentation generated indicating the minimum wall thickness requirements to justify the MAWP.

2. For on-site fabrication, calculations (weld, MAWP, wall thickness, etc.) must also be submitted to the CPSO prior to fabrication.

I. Flexible Hoses and Flexible Tubing Procurement

1. Flexible hoses must not be procured without end connectors attached by the manufacturer.
2. Flexible hoses must be procured from the manufacturer with the MAWP stamped, or etched, or tagged on the hose or end connectors indicating the maximum allowable working pressure of the assembly.
3. Flexible hoses must not be assembled or repaired, except by manufacturer.

J. Tagging and Labeling

1. Tag/label all piping and components as shown on the system schematic. Follow ESM Chapter 1, Section 200.

K. Welding, Brazing, and Soldering

1. Welding, brazing, or soldering on pressure systems, piping, and components that are within the scope of this program must comply with the applicable ASME BPV or B31 codes. Proof of ASME compliance must be accomplished by documenting the following:
   a. Welder qualifications as defined by the applicable code and ESM Chapter 13.
   b. Welding procedure specifications (WPS) as defined by the applicable code and ESM Chapter 13.
   c. Inspection, examination, and testing, (e.g. radiography, dye penetrant, or pressure qualification test) as defined by the applicable code of construction, to include other requirements defined in ESM Chapter 13.
2. Welding procedures and personnel must be certified for the application that they are performing through the LANL welding program, as defined by ESM Chapter 13. See also LANL Master Specification Sections 01 4444 and 01 4455 on welding.
3. Fabrication shops that do not possess an ASME "U" authorization, regardless of individual personal training, qualifications, and certifications, must not be considered equivalent to Code-certified shops and hence must only perform non-Code welding.
4. Welding on pressure systems or components must be inspected as mandated in the applicable ASME BPV or B31 codes by a certified inspector as defined in ESM Chapter 13.
5. Welding/brazing qualifications must conform to the ASME Section IX, "Welding and Brazing Qualifications," and the requirements of ESM Chapter 13.
6. On-site welding must be performed by welders that are currently certified, having completed testing and qualification in accordance with ESM Chapter 13, GWS 1-05, *Welder Performance Qualification/Certification*.

7. When welded joints (e.g., orbital, butt welding) are used, all welds must have examination records as required by "Inspection, Examination, and Testing" Chapter VI of ASME B31.3 or ASME B31.1 as appropriate, and must be traceable by one of the two following methods:
   a. A weld number referenced on the system drawing or sketch and pertinent information for each weld (weld map).
   b. A stamp traceable to the welder along with examination records.
8. Welding inspection, examination, and testing records must be maintained in the pressure system documentation package.

L. Piping and Tubing

1. Bending of tubing/piping must be performed such that there is no wrinkling, stretching, or ovaling of the tubing. Use of tubing mandrels for thin walled tubing is mandatory.
2. Sand, beads, or other abrasive material must not be used to accomplish uniform bends for pressure system tubing/piping.
3. Tubing that is anchored to beams of dissimilar material properties in temperature varying environments (e.g., stainless steel tubing braced to a carbon steel I-beam on the exterior of a building) must have the flexibility needed for thermal expansion/contraction.
4. Use of tube cutting wheels is discouraged (but not prohibited) for stainless steel tubing.
5. Tubing must be prepped by interior and exterior reaming prior to fitting makeup. The end face of the tubing must be flat as possible and without sharp edges after reaming.
6. For such installations, follow LANL Master Spec Sections 40 0511 and 40 0527.

M. Cleaning

1. Components, piping and tubing specified for oxygen or oxidizer service must be cleaned as specified in this document, prior to assembly, and must be assembled in a manner that maintains cleanliness.
2. Pressure systems must be considered for cleanliness requirements. All components must be cleaned to an acceptable level which removes contaminants that could lead to system failure or contamination.

N. Alignment

1. Twisting or distortion of piping or components, to bring into alignment, which introduces strain in the equipment, is strictly prohibited.
2. For flanges, faces and bolt holes must be aligned per B31.3, paragraph 335.
3. Prior to assembling any joints to be cold sprung, supports and anchors must be examined to ensure that required movement is allowed by the supports, and that undesired movement is controlled.

O. Flanged joint assemblies:[7]

1. Flanges must be replaced whenever any damage has been caused to the sealing surface that prevents the gasket from sealing. Excessive torque beyond torque specifications to achieve a leak free seal is strictly prohibited.
2. Torque up of flange bolts must be that which is defined by calculation or as determined by industry torque-table values, and must be defined in assembly instructions.
3. Bolted flanges must be re-torqued no less than 24 hours after initial torque following assembly, and prior to any leak checks or pressure verification tests.[8]
4. Nuts must have full thread engagement on the bolts or studs. One to two exposed threads is the preferable amount that defines full thread engagement. The minimum acceptable engagement is the outer edge of the nut being not less than flush with the end of the bolt or stud.[9]

P. Threaded Joints

1. Threaded fittings must be lubricated with lubricant that is compatible with the system fluid (e.g., halocarbon, hydrocarbon, fluorocarbon, etc.) prior to assembly to prevent galling and friction welding.

Q. Tubing Joints

1. Flareless and compression tubing joints must be assembled per the manufacturer's instructions. Where the manufacturer specifies a specific number of turns for the nut, these must be counted from the point at which the nut becomes finger tight.
2. For Swagelok installations, follow LANL Master Spec Sections 40 0511 and 40 0527.
3. Flared tubing must be visually inspected for surface pits, and splits prior to assembly. Use of a "Go, No-Go" gauge for flare sizing is highly recommended.
4. Flared tubing with imperfections in the flare must be rejected.

R. Oxygen and Oxidizing media components cleanliness requirements10

1. General requirement

   a. This section is applicable to both liquid oxygen (LOX) and gaseous oxygen (GOX) systems and other similar oxidizing agents (e.g. N_2O_4, HNO_3, etc.)

   b. Oxygen systems shall be designed (including materials selection), tested, cleaned, and assembled in accordance with ASTM G128 and other referenced ASTM standards. The design, testing, cleaning, and assembly shall be documented as an oxygen hazards analysis and shall be approved by the CPSO. The system shall be evaluated to reduce the likely hood of fire.

   c. If no oxygen hazards analysis is performed then components installed into oxygen or oxidizer fluid systems must be cleaned to a level equal to or better

[7] Ibid.
[8] Accommodate material relaxation. Industry good practice.
[9] LANL ASME B31.3 Process Piping Guide ESM Chapter 17 Section REF-3
[10] ASTM G 93

than 175A as defined in ASTM G93 para. 11.4.3, where the nonvolatile residue remaining after cleaning is less than 1 mg/ft^2, and the particulate count is less than the following where "X" is the size of the particles counted:

Number of Particles Allowed	Size Range (µm/100 mL)*
0	X > 175
1	100 < X < 175
5	50 ≤ X < 175
20	X < 50
5	Fibers

**100 mL refers to the amount of solvent fluid (e.g. de-ionized water, isopropyl alcohol, HFE 7100, etc) that is used to flow through, or around the components (or tubing and fittings) to collect the particulate and non-volatile residue (or total carbon) samples described in ASTM G93.*

d. *Oxygen/oxidizer pressure systems must be disassembled for cleaning. Each component must be cleaned prior to assembly. Non-volatile cleaning agents may remain in trapped spaces, which could react with oxygen. Cleaning solutions may degrade non-metals in an assembly. Caustic and acid cleaning solutions may cause crevice corrosion in assemblies.*

e. *Any method of cleaning may be utilized provided that cleaning method meets, or exceeds the requirements as defined in ASTM G93 for level 175A.*[11] *Components may be cleaned by the manufacturer.*

f. Components must be maintained clean during the assembly/construction process.

g. Oxygen-compatible lubricants should be applied after component cleaning

h. Components cleaned for oxygen service must not be left in the open, unprotected. Care should be taken to avoid contamination of particulate and oil deposits on surfaces that will be in direct oxygen service.

i. Components cleaned for oxygen service must be handled with clean gloves or handling devices to maintain oil-free cleanliness of component.

2. If no oxygen hazards analysis is performed, then the following cleaning procedures are required:

a. The cleaning method used must incorporate three cleaning steps as defined in ASTM G93 as follows:

1) Precleaning – removal of gross contaminants

[11] Refer to ASTM A 380 which describes cleaning, descaling, and passivation of stainless steel parts, equipment and systems.

2) Intermediate cleaning – use of alkaline salts, detergents, acids, or caustics to remove solvent residues and residual contaminants.

3) Final cleaning- removal of minute contaminants, in a clean room environment. Includes drying/purging and packaging to protect components from re-contamination.

b. Cleanliness verification must be documented and maintained in the pressure system documentation package.

3. If no oxygen hazards analysis is prepared the following packaging is required:

a. All packaging used to for cleaned components must be as clean as, or cleaner than the clean level specified for the component. Packaging must be clearly marked in accordance with ASTM G93 para 12.2, "Package Marking."

b. Cleaned components that are not bagged/wrapped must be plugged/capped with plugs/caps that are as clean or cleaner than 175A.

4. If no oxygen hazards analysis is prepared the following assembly is required:

a. Where applicable, all components cleaned for oxygen service must be handled with clean, lint free gloves to prevent contamination to the fluid surfaces of the component.

b. Components must be maintained clean to the maximum extent possible during the assembly process.

c. Care must be taken to minimize the potential for contamination

d. Only use of oxygen compatible grease is authorized for thread lubrication. A listing of tested materials is available in ASTM G63.

e. PTFE tape is authorized for NPT fittings cleaned for oxygen service. Ensure that the tape is applied so that it does not extend into the flow path[12].

f. Ensure all tubing has been pre-fabricated, properly de-burred and cleaned prior to assembly.

g. Ensure all weld slag has been removed from interior of lines.

h. After assembly and before wetting the system with oxygen, purge the system using clean, dry gaseous nitrogen to remove assembly generated contaminants through the system or to a benign location.

FORMS

Form ADMIN-3-FM01, Relief Device Procurement Pre-approval

[12] ASTM G93

ADMIN-3-FM01 Relief Device Procurement Pre-approval

Form must be signed and approved by a Certified DCPSO in order to procure (per ASM Form 410).
(data for example only, delete when using form)

PSS #	TA	Bldg	Valve	Regulator / RFO	Max Flow	Relief Device	Set Press.	System MAWP	Relief Flow	Relief Inlet	Sys. Conn.
Tag #			Valve tag # off of P&ID	Model # of Regulator or RFO	SCFM of air Or BTUH/GPM	Make & Model #			Flow in SCFM, BTUH, or GPM	Pipe Size	Pipe Size
5933	53	4	PCV1 RFO 0.030"	Norgren R72G-3AK-NCG Swagelok SS-4-A-08179-SC11	0.76 Approx. 21 SCFM @ 2265 psig	0542-A01-KM0035	35 psig	35 psig	53.2	1/4"	½"
5940	53	4	PCV1 RFO 0.030"	Norgren R72G-3AK-NCG Swagelok SS-4-A-08179-SC11	0.76 Approx. 21 SCFM @ 2265 psig	0542-A01-KM0035	35 psig	35 psig	53.2	1/4"	1/4"
2201	53	4	None	None	Compressor 2 stage 250 psig; 150 scfm	Kunkle (part number omitted in this example)	250 psig	250 psig	175	1/2"	3/4"
2011	53	1	None	None	Boiler rating 230,000 BTU/Hr	Kunkle (part number omitted in this example)	250 psig	250 psig	300,000	1/2"	1/2"

DCPSO: ______________________________ Z #: ___________ Signature: ___________________________________ Date: _________________

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RECORD OF REVISIONS

Rev	Date	Description	POC	RM
0	9/17/14	Initial issue; revision of material formerly in Section I, rev. 3.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*
1	11/18/15	Clarified testing for all systems (1.0.B.2.3). In 2.0, added articles on multi-walled and cryo vessels and piping.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*

Contact the Standards POC for upkeep, interpretation, and variance issues.

Chapter 17	**Pressure Safety POC and Committee**

This document is online at http://engstandards.lanl.gov

1.0 Inspection and Testing

A. Inspection/Examination

NOTE: It is the responsibility of the designer, the manufacturer, the fabricator, and the erector, as applicable, to prepare the records as required for inspections and testing that are defined by the most applicable ASME code.[1]

1. Pressure systems must be examined as defined by the applicable ASME code prior to service.
2. Examination activities to verify the quality of the work must be performed by persons other than those who performed the activity being examined. Such persons must not report directly to the immediate supervisors responsible for the work being examined.
3. The designer of a pressure system or component must define the examination requirements to meet or exceed those required by the applicable ASME code. Examination documents must be maintained in the pressure system documentation package. Examination methods must be specified in the engineering design, and must define type, extent and acceptance requirements for the following methods, as instructed by the ASME Code:
    a. Visual inspection
    b. Magnetic particle examination
    c. Liquid penetrant examination
    d. Radiographic examination
    e. Ultrasonic examination

[1] Example: ASME B31.3 Paragraph 346.

f. In-process weld examination

4. The designer must identify the minimum requirements of examination as defined by the code.

   a. The manufacturer, fabricator or builder must perform examinations as required by the design documents and applicable code.

   b. The fabrication, repair, or alteration documentation must have evidence of the examination; evidence must be maintained in the pressure system documentation package.

   c. Where in-process weld examinations are substituted for RT or UT as allowed by ASME B31.3 Paragraph 341.4.3(3)(c), the in-process examination must be documented with the appropriate information as required by ASME B31.3, Paragraph 344.5 and this documentation must be maintained with the pressure system documentation package.

   d. The Initial Service Leak Test specified in ASME B31.3 para. 345.7 may be applied for ASME B31.3 Category D fluids in low volume piping systems built from rigid tubing and listed tubing fittings or CPSO-approved alternative fittings with non-welded connections.

B. Testing

NOTE: The following testing criteria references B31.3 requirements; however, use the most applicable B31 code requirements in the event of conflict.[2]

1. Pressure systems must be pressure tested prior to service as defined in the applicable ASME code.

2. Pressure systems must be tested as defined by the code of record. *For existing systems, LANL Master Spec Section 22 0813 may need to be adapted for this purpose.*

3. Piping systems must undergo an initial leak check, and initial pressure qualification test as defined in B31.3 Chapter VI, Paragraph 345 (Testing) prior to being placed in service (or as defined in B31.1 Chapter VI). Test may be either pneumatic or hydrostatic, and must conform to the following:

   a. A written procedure must be generated to instruct the test. Tests must be recorded and maintained in the pressure system documentation package.

   b. The pressure of the leak test must be gradually increased in no less than three graduations, checking for leaks between each graduation.

   c. All joints, including welds and bonds, are to be left un-insulated, and exposed for examination during leak testing (pressure qualification test).

   d. Pneumatic pressure qualification tests must be conducted from a remote location with positive control of personnel access. After the test is completed, the system pressure must be reduced to MAWP, at which time personnel may then access the system.

[2] B31.3-based requirements are presented because the majority of LANL piping systems fall within the scope of B31.3 as defined in B31.3, paragraph 300.1.1

e. Test pressure for the pressure qualification test of pressure systems must not be less than 150% the design pressure for hydrostatic tests, and 110% for pneumatic tests as defined in ASME B31.3 Para's 345.4 and 345.5.

f. Hydrostatic tests must be performed with water. If water is not suitable (could freeze, or cause adverse effects to piping or process), another suitable non-toxic liquid may be used.

g. Test instrumentation used to meet the requirements of this document and codes must be calibrated by the manufacturer or LANL Calibration Lab.

h. The pressure of the qualification test must be maintained for at least 10 minutes.

i. Test procedures and results must be maintained in the system documentation package.

4. A modified initial service leak test of LANL legacy systems is allowed.

   a. The initial service leak test shall be conducted at normal system operational pressure.

   b. The entire system shall be inspected for leak tightness at the normal system operational pressure. However, it is not required for portions of the system that are inaccessible to be inspected. Removal of external insulation is not required. Evidence of leakage in the insulation shall be cause for failure.

   c. The leak test shall be for a minimum of 10 minutes.

   d. Leak testing shall not be performed when metal temperatures are near the ductile-brittle transition temperature, as that may lead to brittle fracture.

   e. Testing methods and results may be documented in multiple formats, but must be referenced and readily available for review. This information shall be considered a record and shall be included in the pressure system certification package.

5. The pneumatic or pneumatic/hydrostatic leak test in accordance with ASME B31.3 para. 345.5 may be applied to LANL systems for all ASME B31.3 fluid services except High Pressure. Pressure testing may not be done with reactive gas, flammable gas, Category M fluids, or radioactive gas, but testing with an inert substitute gas is allowed. Test volume is limited to approximately 2 cubic feet of volume not including the gas supply system.[3]

6. Application of ASME B31.3 345.5.2 Pressure Relief Device "A pressure relief device shall be provided, having a set pressure not higher than the test pressure plus the lesser of 345 kPa (50 psi) or 10% of the test pressure when design pressure is less than the piping component MAWP.

   a. The owner or owner's representative must have approved a pneumatic or hydrostatic-pneumatic test in accordance with B31.3.

   b. The pressure system supplying the test gas shall have adequate relief protection to ensure the piping component MAWP is not exceeded.

   c. If the first and second requirements above are satisfied then a relief device is not required if the test pressure is not above the MAWP of the piping components.

[3] VAR-2012-014.1

Example: The tubing MAWP is 2199 psig. The pressure testing supply gas has an adequately supplied relief valve set at 200 psig. The design pressure is 100 psig. No additional relief protection is required.

7. Rad Liquid Waste: The Owner has elected to treat RLW as B31.3 Normal Fluid Service and testing must be done accordingly; paragraph 345.1 (a) is not applicable.

2.0 Inspection and Testing Intervals

All inspection and testing intervals shall be fixed. All inspection and test intervals are granted a grace period of 90 days for performance of the requirement.

A. Vessel Inspections

1. Use the following tables for determining the inspection intervals for pressure vessels.[4]
2. Perform vessel inspections per ESM Chapter 17 ADMIN-4-1, Pressure Vessel Inspection and Test, using CPSO-approved organization *(e.g., AET-6).*

Table ADMIN-4-1 Pressure Vessels Exempt from Mandatory Periodic Test/Inspection[5]

Vessels listed as exempt from the scope of ASME Section VIII, Division 1 – 2007 with 2009 addendum shown others are similar. Use most current version of ASME Section VIII, Division 1 for latest exempt vessel list.

U-1(c)(2) Based on the Committee's consideration, the following classes of vessels are not included in the scope of this Division; however, any pressure vessel which meets all the applicable requirements of this Division may be stamped with the Code U Symbol:

(a) those within the scope of other Sections;

(b) fired process tubular heaters;

(c) pressure containers which are integral parts or components of rotating or reciprocating mechanical devices, such as pumps, compressors, turbines, generators, engines, and hydraulic or pneumatic cylinders where the primary design considerations and/or stresses are derived from the functional requirements of the device;

(d) except as covered in U-1(f), structures whose primary function is the transport of fluids from one location to another within a system of which it is an integral part, that is, piping systems;

(e) piping components, such as pipe, flanges, bolting, gaskets, valves, expansion joints, fittings, and the pressure containing parts of other components, such as strainers and devices which serve such purposes as mixing, separating, snubbing, distributing, and metering or controlling flow, provided that pressure containing parts of such components are generally recognized as piping components or accessories;

(f) a vessel for containing water[6] under pressure, including those containing air the compression of which serves only as a cushion, when none of the following limitations are exceeded:

[4] Bases for frequencies documented in EM Ref-59. *(EMRef is a Standards Program system for maintaining references/bases)*
[5] Based on API 510-2006, *Pressure Vessel Inspection Code: Inspection, Rating, Repair, and Alteration*, App A on exempted systems, with Section VIII Div 1 (pp 2-3, 2007) wording substituted for API's paraphrasing. PSO may choose to require inspection regardless of any exemption.

(1) a design pressure of 300 psi (2 MPa);

(2) a design temperature of 210°F (99°C);

(g) a hot water supply storage tank heated by steam or any other indirect means when none of the following limitations is exceeded:

(1) a heat input of 200,000 Btu/hr (58.6 kW);

(2) a water temperature of 210°F (99°C);

(3) a nominal water containing capacity of 120 gal (450 L);

(h) vessels not exceeding the design pressure…at the top of the vessel, limitations below, with no limitation on size [see UG-28(f), 9-1(c)]:

(1) vessels having an internal or external pressure not exceeding 15 psi (100 kPa);

(2) combination units having an internal or external pressure in each chamber not exceeding 15 psi (100 kPa) and differential pressure on the common elements not exceeding 15 psi (100 kPa) [see UG-19(a)];

(i) vessels having an inside diameter, width, height, or cross section diagonal not exceeding 6 in. (152 mm), with no limitation on length of vessel or pressure;

(j) pressure vessels for human occupancy.[7]

Table ADMIN-4-2 Inspection Frequencies for Non-Exempt Pressure Vessels

Service	External + wall thickness (e.g., ultrasonic)	Internal
Corrosive	3	5
Non-corrosive	5[8]	10[9]

[6] The water may contain additives provided the flash point of the aqueous solution at atmospheric pressure is 185°F or higher. The flash point must be determined by the methods specified in ASTM D 93 or in ASTM D 56, whichever is appropriate

[7] Requirements for pressure vessels for human occupancy are covered by ASME PVHO-1

[8] The requirement for wall thickness measurement of vessels in non-corrosive service may be waived if inspection data indicates that no wall thinning is occurring.

[9] Except where API 510 or NBIC allows on-stream [external and wall thickness] in lieu of internal inspection (excerpt below from API 510-2006 Para 6.5.2.1): At the discretion of the inspector, an [external and wall thickness] inspection may be substituted for the internal inspection in the following situations:

a. When size or configuration makes vessel entry for internal inspection physically impossible.
b. When vessel entry for internal inspection is physically possible and **all** of the following conditions are met:
   1. The general corrosion rate of a vessel is known to be less than 0.005 in. (0.125 mm) per year.
   2. The vessel remaining life is greater than 10 years.
   3. The corrosive character of the contents, including the effect of trace components, has been established by at least five years of the same or similar service.
   4. No questionable condition is discovered during the External inspection.
   5. The operating temperature of the steel vessel shell does not exceed the lower temperature limits for the creep-rupture range of the vessel material.
   6. The vessel is not subject to environmental cracking or hydrogen damage from the fluid being handled.
   7. The vessel does not have a non-integrally bonded liner such as strip lining or plate lining.

3. Boilers: One exception to the above inspection intervals is boilers. Boilers must be inspected according to New Mexico Administrative Code (NMAC) 14.9.4.25, "Inspection Methods and Frequency." A certificate of inspection may be issued with an external inspection; however, an internal inspection must be made within six months of the external inspection.[10]
    a. When the construction does not permit an internal inspection, one external inspection annually is required.
    b. Annual internal inspection is required for high-pressure boilers and high pressure steam generators.
    c. Every 24 months an external and internal inspection must be performed on the following:
        1) Direct fire steam jacketed kettles
        2) Low-pressure steam boilers
        3) Low-pressure hot water heating boilers
4. Multiple-Walled Vessels
    a. For multiple-walled (greater than two) vessels and double-walled vessels that are not in cryogenic service, an engineering evaluation is required to support the inspection test and requirements. The engineering evaluation shall be performed by the system engineer with a PSO Duty Area B.
    b. The inspection and testing requirements shall be reviewed and approved by the CPSO and the Pressure Safety Committee, and the test/inspection performed by a CPSO-approved organization.
5. Cryogenic Vessels[11]

    Note: Cryogenic vessels are a unique case of pressure vessels and the inspection and testing requirements are different than single walled vessels.

    a. If the history of the vessel is known to be cryogenic service throughout, then a periodic inspection or test of the internal vessel is not required.
    b. An external inspection of the vacuum jacket must be performed to verify the annulus maintains vacuum in accordance with Table ADMIN-4-2.
    c. *When a cryogenic vessel is taken out of service for modification or maintenance, then accessible areas should be examined by a competent engineer or, preferably, a qualified vessel inspector, and a record made of the results of the inspection.*

[10] At the date of release of this document, LANL is not considered exempt from this state regulation. See ESM Ch 1 Section Z10 Codes and Standards subsection.

[11] As discussed in AIGA, *Periodic Inspection of Static Cryogenic Vessels*, 046/08

B. Relief Devices

1. Testing of pressure relief valve set points can be performed with the valve installed in the system or by bench test. The PSO must be present for in-place set point verifications, and flow tests. In-place testing must be performed using a PSO approved procedure[12].

2. Any relief valve that has been modified, (e.g. spring replacement, orifice exchange, welding, etc.) except for set point adjustments, must be flow tested to verify capacity and operation. Flow tests must be documented and maintained in the pressure system documentation package.[13]

3. Regardless if the relief valve is ASME Code stamped (UV) or not, where in-place set-point testing of relief valves is the preferred method of testing, the system must be provided with a traceable calibrated gage. Tolerance on set-point verifications must be +/- 2 psi for a set pressure less than 70 psi. For set points greater than 70 psi, the tolerance must be +/- 3% of the stamped set point as defined by ASME BPV Section VIII, Div 1, Part UG-126(d).

   a. ASME (UV) stamped valves that require disassembly to change the set point (i.e., spring replacement) must be performed by an organization accredited by the National Board, holding a "VR" stamp, to disassemble the valve and change the set point (conversely, UV valves than don't require such disassembly don't require a VR stamp organization).

   b. Adjustments of set point pressure on relief valves (regardless of UV stamp) must be performed by a CPSO-approved/designated relief device testing facility.

4. All tested valves (regardless of UV stamp) must have, affixed by the testing organization, a "Test Only" tag as described by NBIC Part 3 (*Section 5.9.4*) with a minimum of the following information:

   a. Test report number (unique identification number)

   b. Name of testing organization, LANL test shop identification, or in-place flow procedure document number.

   c. MAWP

   d. Set pressure

   e. Date of test

      1) Due date of next test (as defined in this document)

5. *Guidance: LANL O&M Criterion and preventative maintenance procedures (PMIs) related to pressure relief devices are available at this internal link.*

   PMI 419-A, Pressure Relief Valve Testing

   a. Criterion 403 "Boilers"

      1) PMI documents: 403-A: Low- and High-Pressure Steam Boiler and Low-Temperature Water Heating Boiler Inspection, Testing, and Maintenance; 403-A.001: Hot Water Boiler Startup After Lay-Up; 403-

[12] See ASME PTC-25 for relief device testing requirements.
[13] See ASME Section VIII, Division 1, Part UG-131.

A.002: Hot Water Boilers Water Treatment; 403-A.003: Hot Water Boiler Weekly Preventive Maintenance; 403-A.004: Hot Water Boiler Weekly Log Sheet (Deleted - Do Not Use - Refer to 403.A.010); 403-A.005: Hot Water Boiler Monthly Preventive Maintenance (In Service Only); 403-A.006: Hot Water Boiler Annual Fireside/Waterside Inspection and Maintenance; 403-A.007: Steam Boiler Startup After Lay-Up; 403-A.008: Steam Boiler Water Corrosion and Scale Inhibitor Treatment; 403-A.009: Steam Boiler Weekly Preventive Maintenance; 403-A.010: Steam Boiler Weekly Log Sheet; 403-A.011: Steam Boiler Monthly Preventive Maintenance (In Service Only); 403-A.012: Steam Boiler Annual Waterside and Fireside Inspection and Maintenance (In Service Only); 403-A.013: Steam Boilers Summer Lay-Up; 403-A.014: Hot Water Boiler Summer Lay-Up

b. *Criterion 419 "Inspection and Testing of Pressure Vessels and Pressure Relief Valves"*

1) *PMI documents: 419-A: Boiler Relief Valve Testing; 419-A.001: Pressure Relief Device Removal, Transport, and Reinstallation Checklist; 419-A.002: Test Summary Report Form; 419-55-0000-A: 55-0000 Specialty Gas Systems; 419-55-0000-A.001: 55-0000 Specialty Gas Systems - Annual*

6. Pressure relief valves (regardless of ASME Code stamp) that are removed from the system and sent to either a VR holder or CPSO-authorized testing organization must be tested using the following fluid media as defined by NBIC/NB-23 Part 2 (*2.5.7*):

Fluid System	Fluid medium used to test valve
high pressure boilers	steam
high temperature hot-water boilers	steam
low pressure steam heating boilers	steam
programmatic and process steam service	steam*
all other valves marked for steam service	steam
hot water heating boiler	air or water
hot water heater temperature and pressure relief valves	air or water (replacement is preferred)
air and gas service	air or nitrogen
liquid service	water

*air is suitable provided the manufacturers steam to air correction factor is used

7. Table ADMIN-4-3 indicates pressure relief device test (set point verification) and replacement intervals.

Table ADMIN-4-3 Relief Device Maintenance Intervals

Fluid Service/Type (alphabetical for PRVs; rupture disks at bottom)	Test Frequency (Years)[14]	Reuse or Replace Device	Reused Device Treatment
Corrosive or Harsh Service When harsh internal or external environment, corrosives, glutinous, acidic, or reactive fluids, rust likely, or otherwise damaging environs	2	Reuse or Replace	Clean and Test
Dewar vessel service (except for O_2)	5	Reuse or Replace	Test
Inert gas or non-corrosive liquids (including dry air kerosene, non-acidic oils, etc.)	5	Reuse or Replace	Test
Natural Gas, LP, and Propane	5	Reuse or Replace	Test
Oxygen (Dewar or gas)	3	Reuse or Replace	Test and reclean
Refrigerant (*Henry, Superior, etc.*)	5	Reuse or Replace	Test
Steam (ASME BPV Section I / power boilers)	1	Reuse or Replace	Test
Steam (ASME Sec IV/VIII)	2	Reuse or Replace	Test
Steam Pilot Relief Valve	2	Reuse or Replace	Complete disassembly and test
Water – Domestic Water Heater	5	Replace	N/A
Water if treated and other liquids non-reactive-to-valve and not listed elsewhere in table	5	Reuse or Replace	Clean and Test

[14] The Pressure System Owner must petition the CPSO for longer test and inspection intervals if historical data has been collected which supports that change. Conversely, if trend data indicates that inspection intervals should be reduced, the PSO should initiate an appropriate change in the CMMS in conjunction with system owner/engineer.

Fluid Service/Type (alphabetical for PRVs; rupture disks at bottom)	Test Frequency (Years)[14]	Reuse or Replace Device	Reused Device Treatment
Water in ASME Section IV heating boilers	2	Reuse or Replace	Test
Rupture Disk Reverse Buckling: If Damage Ratio is less than or equal to 1.0	N/A	Replace as required	N/A
Rupture Disk Reverse Buckling: If Damage Ratio is greater than 1.0**	2	Replace	Replace
Rupture Disk Flat/Forward Buckling in plugging service	2 yr inspection after installation	Establish inspection interval based on results of inspection.	Reuse or Replace based on results of inspection
Rupture Disk Flat/Forward Buckling in lethal service	N/A	Evaluate discharge for safety	N/A
Rupture Disk Flat/Forward Buckling and Bent/Breaking pins (non-plugging and non-lethal service)	N/A	Replace as required	N/A

NOTES:

** If installation direction cannot be verified or the damage ratio is ≥ 1.0, disk must be replaced every 2 years.

Basis for table is EMRef-58 (EMRef is a Standards Program system for maintaining references/bases)

C. Piping

1. Piping inspection and maintenance priority shall be based on Attachment ADMIN-1-6, Risk Based Certification Processing and Maintenance (Guidance)
2. *Guidance: Evaluation of piping systems may apply B31.G, Manual for Determining Remaining Strength of Corroded Pipelines, the original code of record, or API 579-1/ASME FFS-1, Fitness-For-Service.*
3. Other evaluation processes may be approved by the CPSO.

D. Flex hoses

1. Flex hoses shall be inspected for flaws during system reviews by the PSO, and those found unacceptable shall be removed from service.
2. The inspection and acceptance evaluation process shall be based on the manufacturer's requirements and the PSO subjective evaluation of the flex hose to safely perform its function. See Section ASME (Attachment ASME-4-2).

3. Flex hose inspection guidance is provided in Attachment ADMIN-4-2, Hose Assembly Inspection Guidance.

E. Pressure Regulators

1. Attachment ADMIN-4-3 contains pressure regulator maintenance guidance.

3.0 DOT, IM, and UM Portable Tanks

A. General Information[15]

1. Refilling of an expired DOT portable vessel is prohibited
2. Expired DOT vessels which still contain the contents may be used until the contents are gone, provided that no pressure source is connected to the vessel. Removal of contents must be by gravity or vapor pressure only.
3. If the vessel is to be used as a permanent installation and not maintained in accordance with 49CFR, the vessel must be reviewed according to ASME Section VIII, and the DOT stamp must be obliterated.

B. Special Instructions for DOT-4L Cryogenic Cylinders[16]

WARNING: A cylinder used for CO_2 service must not be used for other gas products, especially oxygen or nitrous oxide.

1. Follow the manufacturer's instructions for service and maintenance
2. Excessive loss of product or excessive build-up of pressure is an indication of possible loss of vacuum in the vacuum jacket. Follow the manufacturer's instructions for troubleshooting.
3. If frost spots appear in a non-uniform manner, or are in miscellaneous areas the cylinder may have internal damage and will need to be removed from service until repaired (call cylinder manufacturer for details.)
4. Relief devices must be maintained as defined in this document
5. Where manufacturer recommends checking the set point of relief devices in place, the method must be performed as defined in this document.
6. Solidified contents in cylinders (CO_2) must be re-liquefied per the manufacturer's instructions.

C. Inspection Frequencies

1. Records of DOT, IM, and UM vessel inspection and certification reports must be made available upon request.
2. Owners of DOT, IM, and UM vessels must maintain their DOT vessels certified within the inspection interval frequency.
3. DOT or mobile pressure systems must be retested per 49 CFR or ASME Section XII.
4. DOT, IM, or UM vessels that are not permanently installed in a pressure system must comply with the retest frequencies in CFR Title 49, 180.209. The following table displays the inspection frequencies and retest pressure for cylinders, <u>but does not contain</u>

[15] Chart Industries, Inc., "Liquid Cylinder" Users Manual P/N 10642912 Date:12/00
[16] Ibid

all the requirements of the CFR. The system owner is advised to carefully review the applicable sections.

Table ADMIN-4-4 Cylinder Inspection Frequencies and Retest Pressures

Specification to which cylinder was made	Minimum retest pressure (psig)	Retest period (years)
DOT-3	3000 psig	5
DOT-3A, 3AA	5/3 times service pressure, except non-corrosive service *	5, 10, or 12 *
DOT-3AL	5/3 times service pressure	5 or 12 *
DOT-3AX, 3AAX	5/3 times service pressure	5
3B, 3BN	2 times service pressure	5 or 10 *
3C	Retest not required	Retest not required
3D	5/3 times service pressure	5
3E	Retest Not Required	Retest not required
3HT	5/3 times service pressure	3 *
3T	5/3 times service pressure	5
4	700 psig	10
4A	5/3 Times service pressure *	5 or 10 *
4AA480	2 times service pressure	5 or 10 *
4B, 4BA, 4BW, 4B-240ET	2 times service pressure except non-corrosive*	5, 10, or 12 *
4C	Retest not required	Retest not required
4D, 4DA, 4DS	2 times service pressure	5
DOT-4E	2 times service pressure except non-corrosive*	5
4L	Retest not required	Retest not required
8, 8AL	-	10 or 20*
DOT-9	400 psig (maximum 600)	5
25	500 psig	5
26 (for filling over 450 psig)	5/3 times service pressure	5
26 (for filling at 450 psig)	2 times service pressure	5
33	800 psig	5
38	500 psig	5
Special Permit Cylinder	See current special permit.	See current special permit
Foreign Cylinder (see CFR Title 49 section 173.301(j) for restrictions on use).	As marked on the cylinder, but not less than 5/3 of any service or working pressure marking.	5
*See CFR Title 49 Section 173.34(e) for specific instructions for types of vessels.		

5. The following table defines the NBIC inspection frequencies for DOT, IM, and UM portable tanks and vessels. Portable vessels must be maintained within their inspection due dates.[17]

Table ADMIN-4-5 Portable Tank and Vessel Inspection Frequencies (DOT, IM, and UM)

Specification	Periodic Inspection and Test	Intermediate Periodic Inspection and Test
UM or UN Portable Tanks once placed in service	5 years	2-1/2 years
DOT 51 Portable Tanks	5 years	-
DOT 56 or DOT 57 Portable Tanks (the first periodic inspection and test is required 4 years after being placed into service and each 2-1/2 years thereafter.)	2-1/2 years	-
DOT 60 Portable Tanks (the first periodic inspection and test is required 4 years after being placed into service and the per the schedule to the right)	For the first 12 years of service, every 2 years.	After 12 years of service, yearly.
Retesting is not required on a rubber lined tank, except before relining. For IM and UN Portable Tanks, periodic inspection and test must include at least an internal and external of the portable tank and fittings, taking into account the hazardous material intended to be transported.		

4.0 Mobile Pressure Systems and Transport Tanks

A. Definitions

1. LANL owned mobile pressure vessels and tanks [to include Category 406 (4 psi)] are subject to the requirements of this document which are included within the scope of ASME Section XII. These systems and vessels include, but are not limited, to the following:

   a. Portable tanks for transporting cryogenic fluids (greater than 120 gallons), not part of a Road-Tank vehicle.

   b. Rail Tanks

   c. Cargo Tanks – Intended primarily for the carriage of liquids or gases and includes appurtenances, reinforcements, fittings, and closures. Is permanently attached to or forms a part of a motor vehicle, or is not permanently attached to a

[17] NBIC Part-2 Table S6.14, Inspection Intervals

motor vehicle but which by reason of its size, construction, or attachment to a motor vehicle is loaded or unloaded without being removed from the motor vehicle. Is not fabricated under a specification for cylinders, portable tanks, tank cars, or multi-unit tank car tanks.

2. Pressure vessel designs within the scope of Section XII are as follows:
   a. Full vacuum to 3000 psig
   b. Temperature range is between -452°F to 650°F
   c. Thickness of shells and heads does not exceed 1.5 inches.

B. Procurement

1. Transport tanks must be procured with the ASME (T) stamp symbol.
2. Mobile pressure systems and transport tanks that do not bear the ASME stamp symbol must be evaluated as equivalent through engineering calculations.

C. Pressure Relief Devices

1. Must comply with the tolerances and capacities as defined by ASME Section VIII, and must be installed as defined in ASME Section XII, paragraph TR-130.
2. Must be tracked in the CMMS (*AssetSuite, formerly "PassPort"*) database and meet re-test/replace intervals as defined by this document.
3. Must be code stamped relief devices (TV) or (TD). ASME Section VIII stamped components are authorized to be used on (T) stamped vessels provided the requirements of Section XII are met as defined in ASME Section XII, Article TG-120.2.
4. When all components of a pressure system have a design pressure equal to or greater than the system pressure, there is no requirement for a pressure relief device. Consequently, there is no requirement for pressure relief documentation, calculations, maintenance of the pressure relief device, or inclusion of the relieve device into CMMS or the PSCS database as a maintenance item.
5. PRVs during leak testing*:* Application of the required relief device in accordance with ASME B31.3 345.5.2 shall be done as follows:
   a. First the owner or owner's representative must have approved a pneumatic or hydrostatic-pneumatic leak test in accordance with B31.3 345.1(b).
   b. Second, the pressure system supplying the test gas shall have adequate relief protection to ensure the piping component MAWP is not exceeded.
   c. If the first and second requirements above are satisfied, then a relief device is not required if the test pressure is not above the MAWP of the piping components.

   For example, if using TP304, ASTM A312, 4-inch schedule 40 pipe, the nominal thickness is 0.237 inch with the B31.3 Appendix A value.

   $t = PD/(2*(SEW+PY)$ [304.1.2 equation 3a]

   rearranged: $P = 2tSEW/(D-2Yt)$

   $S = 20{,}000$ psi

   $E = 1$

   $W = 1$

Y = 0.4

D = 4.5 (outside diameter)

T = 0.237 (nominal not subtracting the production tolerances)

P = 2*(0.237)*1*1*20,000/(4.5-2*0.4*0.237))

P = 2199.3 psig nominal

Assume an adequately sized relief device is installed to limit the pressure to less than 2199 psig + 10% (220 psig), or 2419 psig for the supply pressure for the leak test. So, if the system design pressure is 100 psig and the pneumatic leak test pressure is 110 psig, then because 110 psig << 2199.3 psig, no additional relief device is required.

D. Piping, Valves, and Fittings

1. Each connection must be clearly labeled to indicate its function
2. Piping, valves and fittings must be grouped and protected from damage.
3. Must comply with ASME B31.3 as defined by ASME Section XII.

E. Pressure System Documentation Package

1. The manufacturer's data report (T-1A, B, or C) and/or partial data report must be maintained in the pressure system documentation package.
2. Relief valve calculations, recall date, and set pressure must be documented and maintained in the pressure system documentation package.
3. Repairs and alterations must be documented and maintained in the pressure system documentation package.
4. Records of inspections must be maintained in the pressure system documentation package as defined in ASME Section XII, Article TP-6.

F. Repairs and Alterations

1. Must be performed by an institution holding the (TR) stamp.
2. Repairs and alterations must be performed in accordance with NBIC/NB-23
3. Must be performed as defined in ASME Section XII Part TP

G. Tests and Inspections

1. Testing and Inspection must be performed as defined in ASME Section XII, Articles TP-4, and TP-5.

5.0 ATTACHMENTS

ADMIN-4-1 Pressure Vessel Inspection and Test Procedure

ADMIN-4-2 Hose Assembly Inspection Guidance

ADMIN-4-3 Pressure Regulator Maintenance Guidance

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RECORD OF REVISIONS

Rev	Date	Description	POC	RM
0	9/17/2014	Initial issue as ADMIN-4-1. Previously in Chapter 17 as ITM-342-1701 r0, 8/3/2009. Minor admin updates.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*
0.1	2/29/16	Fixed table of content errors.	Ari Ben Swartz, *ES-EPS*	Larry Goen, *ES-DO*

Contact the Standards POC for upkeep, interpretation, and variance issues.

Chapter 17	**Pressure Safety POC and Committee**

This document is online at http://engstandards.lanl.gov

1.0 PURPOSE

This procedure provides instructions to establish a method for inspection and testing of pressure vessels in accordance with applicable drawings, specifications, codes, standards, and policies that fall within the scope of ESM Chapter 17 Pressure Safety, Section ADMIN-4, which sets maximum inspection intervals and defines excluded vessels. These inspection intervals may be adjusted downward by the fitness for service evaluation for any specific vessel based on the findings of the inspection.

Section I frequency requirements at time of writing:

Inspection Frequencies for Non-Exempt Pressure Vessels

Service	***External + wall thickness (e.g, ultrasonic)***	***Internal***
Corrosive	*3*	*3*
Non-corrosive	*5*	*10*

This procedure may be used for vessels and tanks rated below Chapter 17 pressure, size, and service limits.

Sections **5.1** through **5.9** of this procedure may be performed independently or omitted, as necessary.

2.0 APPLICABILITY

2.1 Applicability

This document applies to qualified pressure vessel inspection personnel performing inspections and tests at LANL.

3.0 PRECAUTIONS AND LIMITATIONS

A. Ground fault circuit interrupters (GFCIs) shall be used on all electrically-driven equipment (110 VAC only).

B. Barricades and/or flagging, if used, shall be installed in accordance with LANL policy.

C. Low-voltage safety lights and air-driven tools shall be used inside the vessel as required by the Job Hazard Analysis (JHA) or safety work permit.

D. Inspection and testing of pressure vessels shall be conducted by code-qualified inspectors (i.e., those who have passed the API or National Board of Boiler and Pressure Vessel Inspectors examination).

E. Discovery of a non-code stamped pressure vessel with request for continued use shall be reviewed/approved as safe for continued operation by the Chief Pressure Safety Officer (CPSO).

F. Pneumatic testing shall be limited to pressure vessels where testing with a liquid is impractical or when the equipment cannot be exposed to liquids and shall be approved by the CPSO.

G. Hydrostatic testing shall be performed when inspection discloses unusual, hard to evaluate forms of deterioration that may affect the safety of the vessel. Hydro testing also shall be performed as requested by Operations or Engineering or by the Inspector to confirm suspected leaks and following repairs or alterations.

I. Pressure vessel(s) shall be evaluated for any condition that may affect the remaining life of the vessel. The remaining life may be adjusted based on conditions such as corrosion, erosion in local areas, fatigue, creep, operating and ambient temperatures, effects of hydrogen attack and embrittlement, and stress-corrosion cracking.

J. The maximum period between internal inspections or a complete in-service evaluation of pressure-retaining items shall not exceed the inspection frequency per ESM Chapter 17 Section ADMIN-4.

K. Pressure vessels that have been out of service for one year or more and are past due on an inspection shall be inspected prior to being placed into service.

L. External ultrasonic thickness measurement may be performed in lieu of internal inspections if the internal inspection is impractical or presents excessive hazards to the Inspector. In such cases, the next ultrasonic measurement interval shall be determined the same as for the internal inspection interval described in Item **3.J**, above.

M. Each new, structurally repaired, or altered pressure vessel shall be inspected and tested before use.

N. Pressure vessels within the scope of the ASME Code shall be code stamped in accordance with the applicable section of the ASME code, unless a Code Equivalency determination is made in accordance with ESM Chapter 17 Section GEN.

O. Pressure vessels shall **NOT** have any leakage. Any evidence of leakage shall be thoroughly investigated prior to acceptance of the vessel.

P. Pressure vessels, appurtenances, associated piping and connections shall be rejected for abrasion, dents, distortion, cuts, gouges, or other significant defects that may affect the vessel integrity.

Q. Measurements of pressure vessel wall thickness shall **NOT** be less than the minimum allowable thickness identified by Engineering.

R. Where this procedure conflicts with LANL-adopted national code requirements, those codes shall take precedence.

S. Performance steps in Section **5**, *Performance Activities*, do **NOT** have to be performed in a step-by-step manner; however, all applicable steps within a topic shall be performed unless otherwise documented on the applicable DMAPS inspection report.

4.0 PREREQUISITE ACTIONS

4.1 Planning and Coordination

NDE Supervisor/Designee

[1] Obtain work authorization from the owner/user or operating organization. Inspections within nuclear facilities shall be scheduled on the Plan-of-the-Day.

[2] Conduct pre-job briefing(s) prior to pressure vessel inspection and testing that includes a pre-inspection review of applicable safety and operations documents, including the most current Job Hazard Analysis (JHA) and associated permits (including confined space entry permits for internal inspections), tagouts, special hazard controls or barriers, etc.

Inspector

[3] Obtain and review the inspection folder for the vessel to be inspected (*should be in the EDMS)*. This should contain the U-1 or U-1A data sheet from the manufacturer or NBIC. If not, coordinate with owner to purchase from NBIC.[1]

[4] Obtain current copies of the documents identified in Section **4.2**, *Performance Documents*, as necessary.

4.2 Performance Documents

- DMAPS pressure vessel inspection checklist and record of wall thickness measurements
- Section VIII, Div. 1, *ASME Boiler and Pressure Vessel Code*, latest edition
- NBIC ANSI/NB-23, *National Boiler Inspection Code*, latest edition.
- U1 or U1A report of vessel to be inspected (5.1).
- Service history and cycle history of vessel to be inspected. (5.1 [5])

[1] Approx $20/per. Without data sheet, assumptions would need to be made that could require rerating of the vessel

4.3 Special Tools, Test Equipment, Parts and Supplies

- air-driven tools
- barricades and/or warning devices, as needed
- borescope
- inspection mirrors
- calibrated pressure gauge
- calibrated thermometer (for hydrostatic and pneumatic testing)
- GFCIs (for electrical equipment)
- hydro test equipment
- low voltage safety lights
- non-sparking hammer
- ultrasonic thickness gauge
- wire brush
- oxygen meter (if required for vessel entry)

4.4 Approvals and Notifications

NDE Supervisor/Designee

[1] Obtain permission from the equipment owner, Building Manager/Shift Manager or designee to begin inspection, as appropriate.

[2] Obtain approval for discharging fluid from systems hydrostatically tested, as necessary. See also LANL Master Spec 01 3545, Water Discharge Requirements

NOTE *Where beryllium or radiological hazards may exist, the FOD IH Office or RADCON Office, respectively, will evaluate the hazard conditions(existing and anticipated) and specific work activities to make a BWP or RWP determination (none required, use existing, generate new).*

[3] **IF** any of the following beryllium conditions exist:

- Performing work in beryllium areas
- Moving equipment that may expose previously inaccessible surfaces that may be contaminated with beryllium,

THEN contact with the FOD IH Office.

[4] IF any of the following radiological conditions exist:

- Performing work in radiological areas, Radiological Buffer Areas, and areas posted to contact RADCON prior to working above 8 feet
- Moving equipment that may expose previously inaccessible surfaces that may be contaminated with radiological material
- Disturbing surfaces in/identified as Fixed Contamination Areas
- Disturbing surfaces of yellow-tagged material and suspect older items,

THEN contact the FOD RADCON Office for an RWP.

[5] Obtain appropriate review of the JHA and BWP(s) or RWP(s) to ensure there are no conflicts or new hazards introduced by the BWP or RWP PPE requirements and controls.

[6] Document the BWP or RWP number(s) and the SME review.

5.0 PERFORMANCE ACTIVITIES

NOTE 1 *Performance activity sub-sections may be performed independently or omitted, as required.*
NOTE 2 *All non-conformances are to be documented by a Nonconformance Report (NCR) or by affixing reject tags.*

5.1 Vessel Inspection Prior to Service

Inspector (alternatively, may be performed by CPSO or delegate)

[1] Check for the presence of nameplate and other manufacturer's markings/stamps.
[2] Inspect (visually) vessel, connecting piping, and structural supports for damage and obvious defects such as dents, bulges, etc.
[3] Verify that any modifications (welded brackets, etc.) were performed under appropriate qualification stamp (this requires the original manufacture document U1 or U1A forms as a baseline).

NOTE *Pressure relief device shall be set* ***NO*** *higher than the Maximum Allowable Working Pressure (MAWP) of the pressure vessel.*

[4] Ensure required pressure relief device(s) are inspected in accordance with PMI below.
  [a] **IF** testing is required, **THEN** ensure pressure relief device is removed and tested in accordance with PMI below.
  [b] Ensure reinstallation of pressure relief device, as necessary.
[5] **If not already completed, e**stablish an inspection folder in EDMS or DMAPS for each to include manufacturer's data report, inspection reports, and other pertinent information (e.g., service media history and pressure and temperature cycle history; this may dictate specific examination requirements for example hydrogen embrittlement)
[6] Obtain and affix proper equipment identification tag to vessel and pressure relief device.

The MSS Document "Inspections and Testing of Pressure Vessels and Pressure Relief Valves" is O&M Criterion 419 (internal only).

Work instructions 40-25-040 "Pressurized Tank Relief Valve Testing", 40-25-041 Pressure Vessel Relief Valve Testing

5.2 Site-Fabricated Vessel Inspection Prior to Service

NOTE: *Such vessels are generally not allowed at LANL; contact CPSO before undertaking.*

Inspector

[1] Ensure the required nondestructive testing is performed by qualified personnel and recorded as required.
[2] Inspect vessel after installation or prior to service in accordance with Section 5.**1**, *Vessel Inspection Prior to Service.*
[3] Perform the hydrostatic (Section 5.**8**) or pneumatic (Section 5.**9**) pressure test, as required.

5.3 External Inspection

Inspector

[1] Initiate DMAPS Checklist by recording all available requested information.

[2] Review any previous vessel inspection reports to identify areas of concern and to determine if previously identified deficiencies have been corrected.

[3] Contact the vessel owner/user, as necessary, to determine and consider the service history of the vessel and other vessels in the same service since the last inspection.

[4] Check for the presence of nameplate and other manufacturer's markings/stamps.

[5] Check insulation coverings, supports, or settings for evidence of leakage.

[a] *If external coverings such as insulation or corrosion-resistant coatings are in good condition and no reason exists to suspect any unsafe condition underneath the coverings, removal is not necessary for inspection. However, it is advisable to remove small portions of the coverings (e.g., UT ports) in order to investigate the condition of the coverings and vessel surface.*

NOTE *Due to significant time requirements, Step 5***.3[6]** *may be performed concurrently with the remainder of this section.*

[6] **IF** evidence of leakage (including in the past) is found, **THEN** perform the following in any order.

- Reject vessel pending further inspection
- Inform vessel owner of observation(s)
- Investigate leakage source completely until the source is established/known.

[7] Check structural attachments and supports (e.g., legs, saddles, skirts, hangers) for the following:

- Freedom for expansion and contraction, as applicable
- Anchor bolts and nuts for corrosion or defects
- Distortion
- Protective coating for evidence of blisters, peeling, or corrosion
- Excessive cracks or settlement on concrete pads, piers, or saddles
- Rot deterioration of wood support structures
- Cracks or other defects in weld areas
- Electrical grounding, for corrosion and other defects.

[8] Inspect vessel connections as follows:

[a] Examine manholes, reinforcing plates, nozzles, or other connections for cracks, deformation, or other defects.

[b] Inspect bolts and nuts for corrosion and other defects.

[c] Examine accessible flange faces for distortion and evidence of leakage.

[9] Check the surface of the vessel (shell, heads) for the following conditions:

- External corrosion[2]

[2] Cosmetic (non-failing) anomalies:

- Surface corrosion where no pitting corrosion or significant loss of vessel wall material is observed
- Protective coatings that are scratched or peeled

Significant anomalies that to be reported (may require corrective action):

- Protective coatings bubbled or blistered
- Protective coatings that have disbanded and exhibit corrosion beneath

- Dents
- Distortion[3]
- Erosion
- Cuts or gouges[4]
- Cracks, blisters, or bulges, on shell and head surfaces
- Weld areas for cracks and other defects.[5]

[10] Examine inlet and outlet piping and fittings for the following:
- Provisions for expansion
- Provisions for adequate support
- Evidence of leakage
- Proper alignment of connections
- Evidence of corrosion, erosion, cracking or other detrimental conditions.

[11] Verify proper operation and condition of vessel instrumentation, pressure gauges, controls, sight glasses, and blow-down drains.

[12] Inspect stop valve stems, hand wheels, and extension rods for excessive wear and damage.

NOTE *All pressure vessels are required to have a means of overpressure protection*[6]

[13] Check overpressure protection devices for the following:
- Proper type
- Proper size
- Leaks, corrosion, or damage
- Connecting bolts intact
- Deposits or material buildup
- Overdue test (PRVs) or expiration of service life (burst discs)
- Vent and/or drain lines are clear of obstructions and discharge to a safe location (when practical)
- Relief valves are directed or shielded so personnel in normal working areas will not be impinged by discharge
- Seals for adjustments are intact and show no evidence of tampering
- Set pressure is no higher than MAWP of pressure vessel, EXCEPT for rupture disks rated at temperatures above 300°F.

[14] Verify installed pressure relieving device(s) are within required inspection/testing/calibration frequency.

[15] Perform UT thickness testing of components per Section 5.4 and complete corrosion rate and DMAPS remaining life calculation form.[7]

- Surface areas in which a representative sample area (approx 1 sq ft) exhibits ~1/6 or greater of the area rusted

[3] Evaluate to API 579
[4] Ibid.
[5] Magnetic particle and liquid penetrant may be used to supplement visual inspection by an ASNT-qualified individual
[6] Excepting Code Case 2211 and UG-140
[7] Required to determine next inspection interval; not less than ½ of the remaining life of the vessel

5.4 Thickness Measurement

Inspector

[1] When thickness measurement is required or **IF** it is determined that an internal inspection is impractical, cannot be performed, or would present excessive hazards to the Inspector[8], **THEN** perform external thickness measurements as follows:

[a] Perform external thickness measurements to include those areas where pitting and corrosion are evident or expected, **AND** document in DMAPS

Note: External thickness measurement is not valid for laminated vessels.

NOTE *An NCR shall be prepared if minimum allowable thickness data cannot be determined from manufacturer's data or documentation by Engineering.*

[2] **IF** thickness measurements are performed, **THEN** compare the measurements obtained to the minimum allowable wall thickness as identified in the manufacturer's data report or as determined by Engineering.

5.5 Internal Inspections, Preparing for

Inspector

[1] Obtain authorization **AND** coordinate scheduling of pressure vessel inspections and associated outages with the appropriate equipment owner(s).

[2] Ensure external inspection has been performed in accordance with Section **4.3**, *Vessel External Surface Inspection.*

[3] Ensure the required lockout/tagout permits are in effect; the vessel has been adequately shut down; and is isolated by closed, tagged, and locked stop valves, or by blanked off pipelines prior to entry.

[4] Ensure the removal of fuses, locking of controls, and blocking of movable parts on rotating type vessels or vessels with movable internal parts.

[a] Ensure such controls and movable parts are included in any lockout/tagout permits.

WARNING

Failure to purge vessel or adequately remove surface residue can cause death or serious injury due to asphyxiation or inhalation of toxic gases or vapors.

[5] Ensure the vessel has been drained, ventilated, and cleaned prior to internal inspection.

[6] Ensure applicable confined space entry permits are in place in accordance with confined space entry program.

[7] Ensure the internal atmosphere (oxygen content, etc.) has been analyzed by Industrial Hygiene and that IH has deemed the vessel safe for entry.

[8] Remove the inspection plugs and covers, as necessary, to allow a thorough examination of internal surfaces.

[9] Use adequate lighting to ensure visibility.

[10] Ensure adequate surface preparation so residue will not interfere with determining the true condition of the base metal.

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[8] This is where ESM Chapter 17 Section I allows given when API 510 or NBIC allows on-stream [external and wall thickness] in lieu of internal.

5.6 Internal Surface Inspection

Inspector

[1] Examine internal surface conditions that could adversely affect the safety and dependability of the vessel, such as:

- Pitting
- Distortion
- Corrosion
- Grooving
- Erosion
- Dents
- Cuts or gouges
- Blistering
- Cracking
- Flaking
- Heat affects

NOTE *Where there is evidence of leakage or defects/deterioration are suspected, insulation or lining may require removal to the extent necessary to make a complete investigation.*

[2] Examine appurtenances, such as baffles, screens, and hangers for loose parts, loose or broken bolts, and excessive corrosion.

[3] Examine rotating equipment such as agitators or pump impellers for:

- Evidence of abrasion
- Scoring
- Misalignment
- Cracked mountings.

[4] Check any stays and braces for:

- Looseness
- Corrosion
- Cracks
- Breakage
- Bowing
- Leakage at upset and fastened ends.

[5] Examine manholes and other openings that are flanged or screwed into the vessel for cracks, corrosion, deformation, or evidence of leakage and check bolts and nuts for corrosion or defects. **IF** the pressure vessel is equipped with quick-actuating closures, **THEN** inspect for excessive wear/distortion **AND** ensure the proper function of the holding and locking elements.

[6] Examine all openings to external attachments such as gauge glasses, safety valves, and pressure or temperature controls to assure freedom from obstructions.

[7] Examine coils, tubes, and tube sheets for corrosion, erosion, scale, and other deposits.

[8] Examine rolled, flared, beaded, or sealed tube ends.

[9] Inspect the tube sheet for cracks in the ligaments between tube holes.

[10] Inspect visibly accessible gasket seating surfaces for cleanliness, leakage, and surface defects such as pitting or grooving.

[11] Check protective linings for cracks, tears, and other signs of deterioration. Vessels with special lining will require the use of special instruments to evaluate the lining. For example, glass-lined vessels will require high potential voltage equipment.

[12] Inspect external heating or cooling jackets and coils for defects and/or distortion resulting from over pressurization.

[13] Inspect cathodic protection (anode and cathode, if present) for evidence of excessive deterioration.

[14] Check gaskets and sealing surfaces for evidence of leakage and continued serviceability.

[15] Ensure adequate preparation of the surface and perform thickness measurements (or other non-destructive evaluations) to include those areas where pitting and corrosion are expected or evident, **AND** document measurements in DMAPS.

NOTE *An NCR shall be prepared if minimum allowable thickness data cannot be determined from manufacturer's data or documentation by Engineering.*

[16] **IF** thickness measurements are performed, **THEN** compare the measurements obtained to the minimum allowable wall thickness as identified in the manufacturer's data report or as determined by Engineering.

5.7 Repairs and/or Alteration Inspection

NOTE *Repair of vessels is generally not allowed at LANL; contact CPSO before undertaking.*

Inspector

NOTE 1 *The following steps may be performed in any order.*

[1] Ensure all applicable (completed) repair forms (R-1, R-2, R-3, etc.) and other pertinent information is present in equipment file(s).

[2] Inspect vessel after installation or prior to service in accordance with Section 5.**1**, *Vessel Inspection Prior to Service*.

[3] Perform or witness the hydrostatic (Section 5.**8**) or pneumatic (Section 5.**9**) pressure test, as required.

5.8 Hydrostatic Testing

NOTE 1 *Hydrostatic testing is usually required for post-fabrication, alteration, and repairs prior to the "R" or "U" stamp being applied. Hydrostatic testing is **NOT** normally required for in-service inspections. When hydrostatic testing is performed during in-service inspections, the original test pressure shall **NOT** be exceeded.*

NOTE 2 *Use Appendix A, Pressure Test Record, or equivalent.*

Inspector

[1] Ensure the pressure gauges used by the Inspector have current calibration stickers.

[2] Remove all persons not directly involved from the immediate test area.

NOTE *The designated test pressure for new construction, repair, and alterations is specified in the design documents. For in-service inspections, it is a pressure designated by the Inspector which does not exceed the MAWP stamped on the vessel. (NBIC NB-23 Vol 3, 4.4.1 allows 150% of MAWP)*

[3] Determine (establish) test pressure.

[4] Remove pressure relief valves or non-reclosing relief device from the vessel or test boundary where the test pressure will exceed the set pressure of the valve, **OR** hold down each valve disk by means of an appropriate test clamp and pressurize both sides of non-reclosing relief devices. Install temporary, higher-rated devices where practical.
[5] Install the calibrated test gauge so it is visible to the Inspector at all times.
[6] Ensure the skillet blanks or test plugs or clamps are appropriate for use and are free of obvious defects.
[7] Ensure the metal temperature for the hydrostatic test is between 60°F and 120°F inclusive or other temperature range as specified by Engineering.
[8] Fill and vent system as necessary to remove as much air from the vessel as practical.
[9] Pressurize the vessel, raising the pressure in the vessel gradually until the designated test pressure is achieved.
[10] Maintain this test pressure for ten minutes prior to inspection (NBIC NB-23 Vol 3, 4.4.1) then, if testing above MAWP, reduce to MAWP while making a full and thorough inspection for leaks.

NOTE *Engineering is to be contacted when structural distortion of the vessels is observed.*

[11] **IF** there is evidence of structural distortion, **THEN** reject the vessel.
[12] **IF** there is leakage in the vessel, **THEN** perform the following as appropriate:
- Ensure minor repair is performed **AND RETURN TO** Step 5**.8[1]**
- Contact Engineering for evaluation
- Reject the vessel.

[13] **WHEN** the test is completed, **THEN** vent the test pressure to atmosphere. Return relief devices to normal configuration.

5.9 Pneumatic Testing

WARNING
Stringent control of test pressure is required when using air or gas as a test medium to prevent over pressurization and potential injury/death.

NOTE 1 *Justification for using pneumatic testing instead of hydrostatic testing **SHALL** be reviewed and approved by the CPSO.*
NOTE 2 *Use Appendix A, Pressure Test Record*

Inspector
[1] Determine (establish) the test pressure.
[2] Ensure the pneumatic test pressure does **NOT** exceed the established test pressure of the vessel, unless otherwise specified in the Engineering design documents.[9]
[3] Remove from the immediate area all persons **NOT** directly involved in the test.
[4] Ensure the test area is properly flagged, barricaded, or otherwise controlled in accordance with LANL procedures to prevent unauthorized personnel entry.
[5] Install the calibrated test gauge so it is visible to the Inspector at all times.
[6] Ensure that the test gauge has a current calibration sticker.

[9] NBIC NB-23 Vol 3 4.4.1 "The test pressure shall be the minimum required to verify leak tightness integrity for the repair, but shall not exceed the maximum pneumatic test pressure of the original code of construction."

NOTE *A pressure relief valve or non-reclosing relief device may be installed in the test medium supply line to ensure that this limit is not exceeded.*

[7] Verify that the pressure is continually monitored to ensure that pressure never exceeds the designated test pressure of the vessel.
[8] Remove relief devices from the vessel to be tested, where the test pressure will exceed the set pressure of the device, **OR** hold down each valve disk by an appropriate test clamp and equalize pressure on non-reclosing relief devices.
[9] Pressurize the vessel, raising the pressure in the vessel gradually until not more than ½ of the test pressure is achieved.
[10] Increase the test pressure SLOWLY in steps of approximately 1/10 of the test pressure until the required test pressure has been reached.
[11] Reduce the pressure to the maximum operating pressure before proceeding with the inspection (see ASME Section VIII Div 1 UG-100). Hold the pressure for a sufficient period of time to permit inspection of the vessel.
[12] Check the pressure gauge periodically for indications of leakage.
[13] Apply a soap solution to accessible welds, screwed pipe joints, flanges, etc., where leakage is suspected.

NOTE *Engineering is to be contacted when structural distortion of the vessels is observed.*

[14] **IF** there is evidence of structural distortion, **THEN** reject the vessel.
[15] **IF** there is leakage vessel, **THEN** perform the following, as appropriate:

- Ensure minor repair is performed **AND RETURN TO** Step 5**.9[1]**
- Contact Engineering for evaluation
- Reject the vessel.

[16] Ensure personnel are clear **AND** vent the test medium to approved discharge vicinity/atmosphere.

6.0 POST-PERFORMANCE ACTIVITIES

6.1 Results

Inspector

[1] Complete DMAPS entry.
[2] Complete and forward Work Order and inspection checklist to the reports and data specialist.
[3] Include sketches or photographs with the inspection reports when necessary to depict more complex defects.
[4] Transmit a copy of the inspection report for accepted vessel to the owner and FOD PSO.
Define the when the next inspection is required based on the fitness for service evaluation. (see NBIC NB-23 5.3.7.1 10. & 19)
[5] Attach appropriate status tag to the equipment and contact equipment owner/user, as applicable.
[6] Generate non-conformance report, as necessary, for rejected vessels.
[7] Forward inspection documentation for rejected vessels to NDE team supervision for review/approval.

[8] Provide the owner/user with the completed inspection report and/or reject report, as necessary, **AND** file a copy of each in the work package. *Should also send a copy to the FOD PSO for the equipment files*.
Folder shall be kept in EDMS or PSCS as a Maintenance History Report with an appropriate numbering system (e.g. ,MHR-TABLDG-XXXX) and revised whenever inspection, test, or maintenance is accomplished

Supervisor/Designee

[9] Complete shop floor paperwork using biennial inspection frequency as a “default” frequency for accepted vessels, until the actual frequency determination is determined by DMAPS fitness for service feature or engineering.

NOTE *The following step may be performed at any time and independent of this procedure.*

[10] Perform the following actions upon receipt of the DMAPS determination of next inspection due date:

- **[a]** Ensure that CMMS is updated to reflect the next inspection due date.
- **[b]** Ensure the Inspector updates the equipment status tag in the field to reflect the next inspection due date, if applicable.
- **[c]** Place documentation of the determination in any central equipment file.

7.0 RESPONSIBILITIES

AET-6 or successor is performing organization; should responsible organizations change, applies to successor organizations. Performance may be subcontracted by AET-6, or by owners with AET-6 permission. Use by other LANL groups is allowed with permission of CPSO.

Other organization responsibilities as noted throughout.

8.0 IMPLEMENTATION

As noted throughout.

9.0 TRAINING

Lead inspectors shall be NBIC or API vessel inspection certified. NDE personnel working under their supervision shall be certified under ASNT SNT-TC-1A.

10.0 EXCEPTION OR VARIANCE

To obtain an exception or variance to this document, follow ESM Chapter 1 Section Z10 variance and exception process for procedures (e.g., CPSO may grant via email).

The requesting organization must maintain the official copy of record of the approved correspondence granting the exception or variance.

11.0 DOCUMENTS AND RECORDS

Records generated as a result of this procedure shall be maintained in accordance with LANL records policies.

AET-6 NDE Team

- DMAPS checklists and data
- Manufacturer's Data Report for Pressure Vessels if available, or engineering evaluation of minimum required wall thicknesses
- Non-conformance Reports (NCR)

12.0 DEFINITIONS AND ACRONYMS

12.1 Definitions and Acronyms

API	American Petroleum Institute
CMMS	Computerized Maintenance Management System (e.g., PassPort or Asset Suite)
CPSO	Chief Pressure Safety Officer
PSO	Pressure Safety Officer

For others see Chapter 17 (*Section GEN-1 Definitions*) and/or LANL *Definition of Terms* and *Acronyms and Names*.

13.0 HISTORY

This document supersedes any conflicting requirements in O&M Criterion 419 but the Criterion will remain in force and effect for each nuclear and high-hazard facility until that facility completes the Unreviewed Safety Question (USQ) or Unreviewed Safety Issue (USI) review determinations.

14.0 REFERENCES

- ANSI/NB-23, *National Board Inspection Code*
- American Society of Mechanical Engineers (ASME) Boiler & Pressure Vessel Code, Section VIII, Division 1
- API 510, *Pressure Vessel Inspection Code: Maintenance Inspection, Rating, Repair, and Alteration*
- API 579, *Fitness for Service*

15.0 FORMS

A. Pressure Test Record (Sample)

16.0 CONTACT

Chief Pressure Safety Officer (*in ES-EPD*)

Telephone: (505) 606-2279 or 667-4657
Fax: (505) 606-0581
Location: TA-00, Building 0726, Room 200
E-mail: TBD
Website: Pressure Protection Program

FORM ADMIN-4-1-FM01

Pressure Test Record

SAMPLE from Chapter 17 Section REF-3 B31.3 Guide. Edit Word file with that Guide to suit but capture all data required for ASME Section VIII compliance.

TEST NUMBER:	PROJECT NO.:	PAGE 1 OF
PROJECT NAME:		
TEST INFORMATION		
SYSTEM DESCRIPTION:		
DESCRIPTION OF TEST BOUNDARIES: (Attach Sketch Showing Boundaries as Required. P&ID Recommended)		
DESIGN TEMPERATURE:	DESIGN PRESSURE:	
TEST METHOD: ☐ HYDROSTATIC ☐ PNEUMATIC:		
TEST FLUID:	APPLICABLE CODE:	
TEST REQUIREMENTS		
REQUIRED TEST PRESSURE:	TEST FLUID TEMPERATURE:	
REQUIRED TEST DURATION:	AMBIENT TEMPERATURE:	
GAUGE PRESSURE CALCULATION (See Section 4.2.4)		
ELEVATION DIFFERENCE BETWEEN GAUGE AND HIGH POINT:		
X CONVERSION FACTOR:		
PLUS REQUIRED TEST PRESSURE:		
EQUALS REQUIRED GAUGE PRESSURE:		
TEST RESULTS		

TEST DATE:	START TIME:	☐ AM ☐ PM	
	FINISH TIME:	☐ AM ☐ PM	
ACTUAL GAUGE PRESSURE:			
TEST EQUIPMENT			
TYPE:	RANGE:	CAL. DATE:	CAL. DUE:
REMARKS:			
TEST ACCEPTANCE			
CODE EXAMINER:		DATE:	
CODE INSPECTOR:		DATE:	

Hose Assembly Inspection (Guidance)

(convoluted, elastomeric, or braided)

RECORD OF REVISIONS

Rev	Date	Description	POC	RM
0	9/17/2014	Initial issue.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*

Contact the Standards POC for upkeep, interpretation, and variance issues.

Chapter 17	**Pressure Safety POC and Committee**

This document is online at http://engstandards.lanl.gov

Reference: RMA Hose Handbook IP-2 [1987] and National Propane Gas Association Flyers 114-91 & 134-81

All hoses should be visually, externally inspected prior to each use and thoroughly inspected prior to 12 months. All hose should be hydrostatically tested to 1.5 times Maximum Operating Pressure for 3 to 5 minutes every 12 months to verify the hose assembly's integrity. Hose prior to inspection must be cleaned, depressurized, and laid straight.

Inspection tasks

1. Look for cuts, gouges or worn spots in the hose cover that expose reinforcement braid.
2. Inspect for soft spots, bulges in cover, sections of crushed flat areas or kinked sections.
3. Carefully examine the first 18" of hose adjacent to both end couplings for damage such as kinks, soft spots, and bulges, cover cracks, permanent deformation, alignment, variations from the original form.
4. Check couplings for any slippage between the ferrule or hose and fitting body. Identify any indication of coupling motion.
5. Should the spring system protrude through the end fitting, the spring system is not working and the assembly has been damaged.
6. Check the coupling for worn threads, loose clamps or bands, worn gaskets or seal rings, worn or broken handles cam arms and pins.
7. Shake the assembly by hand. No component should rattle.
8. Inspect the hose cover for blisters and corrosion

If any of the above conditions are found, take hose out of service (tag or lock) and replace.

ADMIN-4-2 Hose Assembly Inspection Guidance

General Instructions for Hose Hydrostatic Testing

An inspection and hydrostatic test should be performed prior to each 30 hours of service or six months, whichever is sooner. The assembly must be clean prior to test.

A visual inspection as described previously should be completed.

Basic Instructions:

1. Lay the assembly straight.
2. Fill the assembly with water.
3. Raise one end and run water through to purge the assembly of air.
4. Cap and pressurize the assembly to 1.5 times Maximum Operating Pressure.
5. Maintain pressure for 10 minutes.
6. Any indication of leakage is cause for failure.
7. Drain and flush with alcohol to remove traces of water.
8. Allow drying if alcohol is not compatible with product.

Safety Warning:

Before conducting any pressure test on hose, provisions must be made to ensure the safety of personnel performing the test and to prevent any damage to property. Only trained personnel using proper tools and procedures should conduct pressure tests.

1. Air or other compressed gasses should not be used for pressure test.
2. All air should be removed from the hose prior to test by bleeding the air through an outlet valve at the raised end of the hose.
3. Test only one hose at a time.
4. Restrain the hose being pressurized. Crushing the hose should be avoided. Place firmly anchored steel bars or straps on each side and supported above the hose at about 10-ft intervals to limit whipping should a failure occur. It is normal, and you should allow for, the hose to move due to the pressurization.
5. A failure may occur that ejects one or both fittings. Retaining walls or sandbags should limit this motion.
6. Personnel must be protected or removed from the test area. Hose whip or an ejected fitting could cause injury during a failure.

Proper Hose Storage

1. Hose assemblies are made of material resistant to aggressive chemical attack consistent with the intended application. There is no shelf life. The product does not age. An accumulation of microbes has been observed due to thermal cycling in humid environments. This accumulation has proved very difficult to remove. Store hose assemblies in a clean, dry place where temperature cycles infrequently through a range no greater than –30 to 125 °F. The outer cover becomes stiff at cold extremes and may crack when flexed. Warm before flexing.
2. Avoid physical damage during storage by storing in a straight rigid tube or in a gentle coil that spirals in a radius larger than the minimum bend radius. Never stack material that will crush the hose.
3. Protect the assemblies from boring insects and gnawing rodents.
4. Good housekeeping that prevents exposure to process or foreign solids and fluids will reduce the required cleaning when the hose goes into service.

Pressure Regulator Maintenance (Guidance)

RECORD OF REVISIONS

Rev	Date	Description	POC	RM
0	09/17/2014	Initial issue.	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*

Contact the Standards POC for upkeep, interpretation, and variance issues.

Chapter 17	**Pressure Safety POC and Committee**

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Regulator maintenance is an important part of maximizing your system's performance and extending the service life of system components. A maintenance schedule is the frequency at which recommended maintenance operations should be performed. Adherence to a maintenance schedule should result in minimizing downtime due to regulator failure as well as enhancing safety in the work area. Regulator service defines the gas service in which the regulator is installed in terms of its corrosive nature. There are three categories: noncorrosive, mildly corrosive, and corrosive. Establishing the category a regulator fits into can be difficult.

Recommended Schedule - This schedule should be used as a general guide. Be sure to follow the manufacturer instructions supplied with your regulator.

Service	Function Test[5]	Inert Purge	Leak Check[5]	Creep Test	Overhaul	Replacement[1,2]
Noncorrosive	prior to use	NA	monthly	annually	5 yrs	10 yrs
Mildly Corrosive[4]	prior to use	at shutdown	1-2x/month	6 months	3-4 yrs	6-7 yrs
Corrosive[4]	prior to use	at shutdown	2x/month	3 months	1-2 yrs[3]	3-4 yrs[3]

[1]More frequent overhaul or replacement may be required for regulators installed in a corrosive ambient environment.
[2]If diaphragms are neoprene or other elastomer, they may dry out and require more frequent replacement.
[3]If regulators are not properly installed and used, or a poor grad of gas is used, or purging is not properly done, overhaul and/or replacement may be required more frequently.
[4]For regulators used in toxic or corrosive gas applications, ensure proper precautions are followed as recommended by the manufacturer; e.g., don't use a self-venting regulator with ambient discharge.
[5]Leak testing is required when bottles are changed, maintenance is performed, or system configuration is changed.

In addition, a pressure regulator should also be checked after cylinder changes or system maintenance. The user is solely responsible for determining the frequency of maintenance based on the application, that the recommended checks can be safely performed, and that the recommended checks are adequate to ensure proper and safe operation of the user's system. **A regulator that does not comply with the recommended checks or malfunctions in any manner must be immediately removed from service. Do not attempt to repair the regulator.**

Glossary

Creep	A gradual increase in outlet pressure above the setpoint and occurs two ways: Changes to the motion of the regulator springs when gas flow is stopped Foreign material becomes lodged between the poppet and seat preventing tight shutoff Gas
Drop	a change in outlet pressure from a no flow to a flowing condition while the inlet pressure remains constant.
Inlet Pressure	The pressure measured immediately at the regulator entry.
Outlet Pressure	The pressure sensed at the regulator's outlet port.
Rise	An increase of outlet pressure as the inlet pressure decreases

<u>Maintenance Checks</u>

Function Test

1. Check the regulator function. Confirm delivery pressure increases when the adjusting knob is turned clockwise and decreases when turned counter-clockwise. To decrease delivery pressure the system must be flowing or vent the downstream system.

2. Check flow shutoff. Confirm after flow is stopped, that delivery pressure does not exceed the regulator's maximum outlet pressure.

Inert Purge

1. To increase regulator life use an inert gas to purge regulators that are used with corrosive or reactive materials after each use. Depending on the type of regulator for an effective purge, it may be necessary to fully reduce and re-pressurize the regulator body.

Leak Test

1. Check for regulator seat leak. Leak test methods should be appropriate for the system leak integrity requirements. Suggested method: Fully close the regulator by turning the adjusting knob counter clockwise until the stop is reached. Apply pressure to the regulator inlet. Close the upstream supply valve. Monitor the pressure between the supply valve and the regulator for 5 minutes. The pressure should not decrease.

2. Check for leaks to atmosphere. There should be no leaks to atmosphere. Leak test methods should be appropriate for the system leak integrity requirements. For example with an inert gas - With a regulator under pressure (both high and low pressure side) check all connections for leaks using a gas bubble leak check solution (Scott Model 46-B Series or Snoop®). If a leak is detected, shut down the gas source, reduce pressure to atmospheric, and tighten or redo the leaking connection.

Creep Test

1. Regulator creep is a phenomenon in which delivery pressure rises above a set point. Creep can occur in two ways. The first is due to changes in the motion of the regulator springs when gas flow is stopped. When flow has stopped, the springs must move to a new position of equilibrium, causing a slight increase in delivery pressure. This type of creep may be thought of as the opposite of droop. The second and more insidious type of regulator creep is caused by foreign material being lodged between the poppet and seat, thus preventing tight shut-off.

2. The result is that inlet and delivery pressure can equalize across the regulator, exposing all tubing and instrumentation to the inlet pressure. Regulator creep as a result of seat failure due to foreign material is the single most common cause of regulator failure. In order to prevent costly damage to the gas delivery system and the instrumentation it serves, care must be taken to ensure that regulator connections are capped to protect against ingress of dirt or foreign material. Tubing should also be flushed or blown clean to remove any foreign matter. A pressure relief valve should be installed downstream of the regulator as additional protection against creep.

3. To creep test, isolate the downstream side of the regulator by closing the regulator outlet valve, instrument valve or process isolation valve. Close the regulator by turning the adjustment knob counterclockwise until it reaches stop or rotates freely. Slowly turn on the gas supply. When the regulator inlet gauge registers full cylinder delivery pressure, shut off the gas supply. Turn the regulator adjusting knob clockwise until delivery pressure gauge reads approximately half of scale [e.g.,. 50 psi (3 bar) on a 100 psi (7 bar) gauge]. Close the regulator by turning the adjustment knob counterclockwise until it rotates freely or reaches the stop. Note the reading on delivery pressure gauge. Wait 15 minutes and recheck the setting on delivery pressure gauge. **If any rise in delivery pressure is detected during this time, the regulator is defective. Remove and replace.**

Proper Inactive Regulator Mode

A regulator should not be used as a shutoff valve. Close the supply valve or cylinder valve when equipment is not operating or is unattended, and vent and back out the regulator to the no flow condition.

A corrosive or reactive material is to be removed from a regulator by purging with an inert, during periods of in-operation.

A regulator is not to be left at a preset when a gas cylinder supply valve is opened. It should be at the no-flow condition.

Regulators should not be allowed to flow unrestricted to atmospheric pressure for any extended period of time. Such operation could result in excessive wear and improper regulator operation.