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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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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]

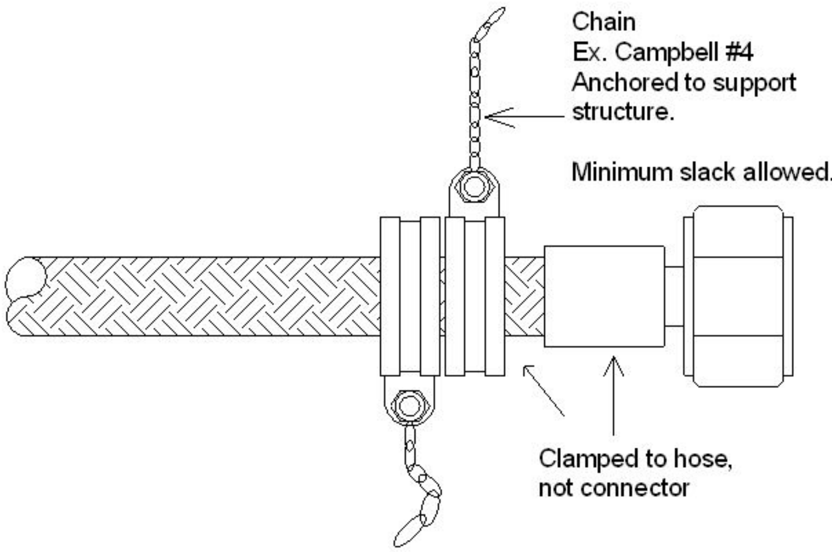
2. Approved alternatives (of those shown below) or restraining devices approved by a designer may be used if the restraining device withstands the thrust challenge posed by both the initial surge thrust and the sustained surge thrust.

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.

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[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

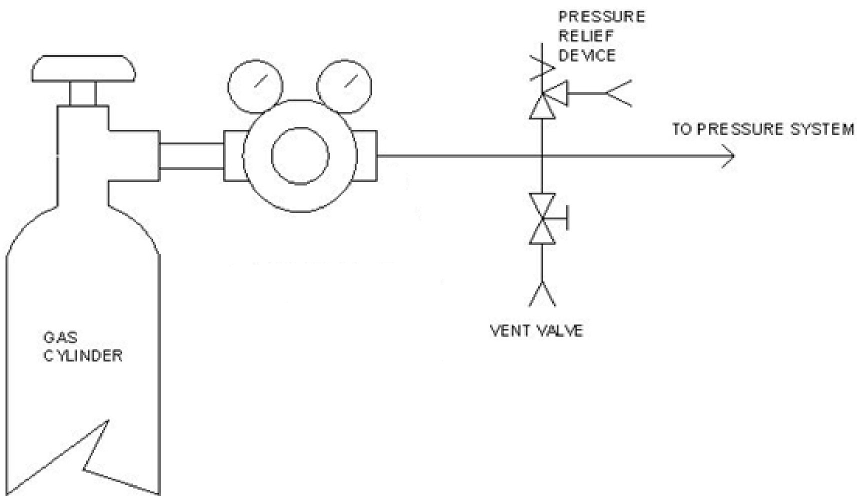
1. The CPSO must make the final determination of fluid category for all systems if there is any question. Determination of fluid category must be determined using ASME B31.3 (e.g., Appendix M, Figure M300).
    a. *The CPSO may evaluate the fluid service of a pressure system on an individual basis to 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

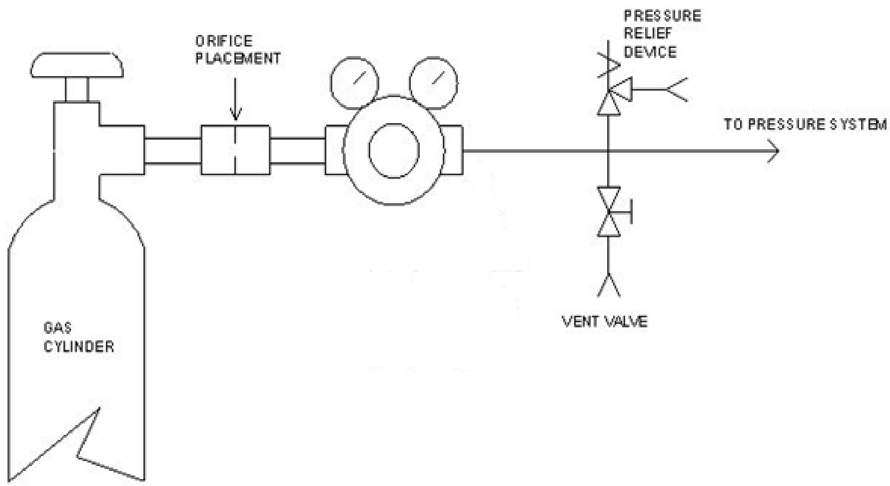
1. Pressure systems utilizing pressurized cylinders as the pressure source must meet all the applicable requirements of this document, including certification.[8]
2. Pressure relief devices incorporated integrally into the design of pressure regulators do not perform a pressure protection function for 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

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[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]

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[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

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[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*

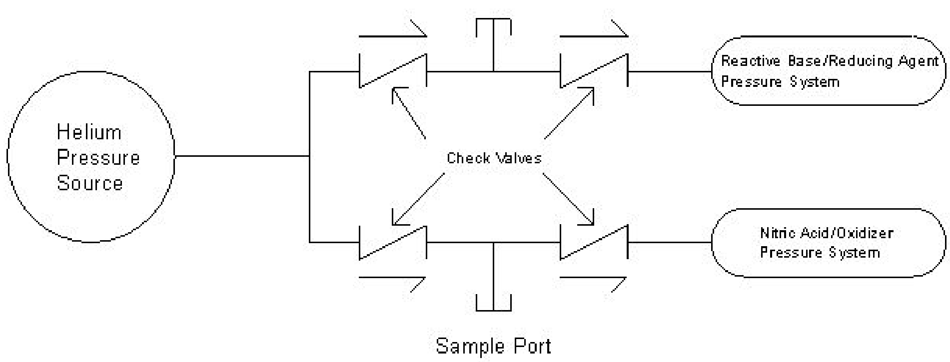
   b. *Where two dissimilar systems must be continuously pressurized from a single pressure source.*

   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)