Los Alamos NATIONAL LABORATORY EST. 1943

Conduct of Engineering
Request for Variance or Alternate Method

Assigned by SMPO or SMPOR: ☒ Alternate Method ☐ Variance Tracking number **VAR- 2015-032.0**

1.0 Affected Document(s)

☐ Engineering Processes (e.g., P 341) ☒ Engineering Standards (e.g., P 342) ☐ Engineering Training & Qualification (e.g., P 343) If against P documents themselves, revision:	Subordinate (Functional Series) document if applicable (ESM Chapter, Master Spec, AP, etc.): Document Title/Number: Engineering Standards Manual STD-342-100, Chapter 17, Pressure Safety Revision 0, 9/17/2014

Section/Para: Specified below

Specific Requirement(s) as Written in the Document(s)

1.1 This form was submitted in accordance with ESM Chapter 17, *Pressure Safety,* Section GEN, Paragraph E

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

1.2 ESM Chapter 17, Section ADMIN-2 Design, Documentation, and Records, Section Q *Piping Components,* item 2:

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.

1.3 ASME B 31.3,

300(c)(3) General Statements:

"(3) Engineering requirements of this Code, while considered necessary and adequate for safe design, generally employ a simplified approach to the subject. A designer capable of applying a more rigorous analysis shall have the latitude to do so; however, the approach must be documented in the engineering design and its validity accepted by the owner. The approach used shall provide details of design, construction, examination, inspection, and testing for the design conditions of para. 301, with calculations consistent with the design criteria of this code."

1.4 ASME B 31.3,

301.2.1 Design Pressure, General:

"(a) The design pressure of each component in a piping system shall be not less than the pressure at the most severe condition of coincident internal or external pressure and temperature (minimum or maximum) expected during service, except as provided in para. 302.2.4."

1.5 ASME B 31.3,

304.7.2 Pressure Design of Other Components, Unlisted Components

"Pressure design of unlisted components to which the rules elsewhere in para. 304 do not apply shall be based on calculations consistent with the design criteria of this Code. These calculations shall be substantiated by one or more of the means stated in paras. 304.7.2(a), (b), (c), and (d), considering applicable dynamic, thermal, and cyclic effects in paras. 301.4 through 301.10, as well as thermal shock. Calculations and documentation showing compliance with paras. 304.7.2(a), (b), (c), or (d), and (e) shall be available for the owner's approval.

(a) Extensive successful service experience under comparable conditions with similarly proportioned components of the same or like material.
(b) Experimental stress analysis, such as described in the BPV Code, Section VIII, Division 2, Annex 5.F.
(c) Proof test in accordance with either ASME B16.9, MSS SP-97, or Section VIII, Division 1, UG-101.
(d) Detailed stress analysis (e.g., finite element method) with results evaluated as described in Section VIII, Division 2, Part 5. The basic allowable stress from Table A-1 shall be used in place of the allowable stress, S, in Division 2 where applicable. At design temperatures in the creep range, additional considerations beyond the scope of Division 2 may be necessary.
(e) For any of the above, the designer may interpolate between sizes, wall thicknesses, and pressure classes, and may determine analogies among related materials."

2.0 Request

Brief descriptive title: Approval for use of Conflat (CF) flanged fittings in pressure systems under certain applications and conditions based upon analysis, testing, and successful service experience.	
NCR required (work has occurred)? ☐ Yes ☒ No	If Yes, NCR Number
TA-BLDG-(Room) and/or Project Affected: Lab-wide	System/Component Affected: New and modified pressure systems as applicable

Background

Applications exist at LANL where piping systems are required to be operated under both vacuum and pressure. Upon extensive research, it has been determined that there are not any reputable manufacturers who can provide components that are rated for vacuum service, and are either ASME B31.3 listed or have a published maximum allowable working (positive) pressure.

Proposal

This Alternate Method is being submitted for approval to use Conflat (CF) flanged fittings as unlisted components in new and modified pressure / vacuum systems under the following applications / conditions based upon analysis, testing, and successful service:

1. Applies only to 1-1/3" and 2-3/4" (outside diameter) stainless steel, rotatable and non-rotatable Conflat flanged fittings with copper gaskets.
2. Applies only to systems that require operation both under vacuum and pressure conditions where listed fittings from a reputable manufacturer that have a published MAWP and are rated for vacuum cannot be obtained.
3. The system design pressure / maximum allowable working pressure will be 50 psig for both 1-1/3" and 2-3/4" fittings.
4. Applies only to applications that are non-cyclic and which are operated within the temperature range of 60-120F.
5. Applies only to applications without dynamic loads, and when the piping system is supported at intervals specified in LANL Engineering Standards or MSS standards.
6. Applies only to fittings which are procured with 1-1/3" and 2-3/4" Conflat flanges attached (i.e. elbows, tees, adapters) and/or to Conflat flange stainless steel weld fittings which are attached to fittings.
7. This alternate method does not apply to valves procured with Conflat flanges. There are other features on valves (i.e. bellows, packing) that are not associated with the Conflat flanged connection that must be analyzed separately. (Refer to alternate method VAR-2013-086.0, *Alternate Method for Continued Operation of TWTS Inlet Header with the Current Installed Valves and Conflat (CF) Flanges)*
8. Conflat fittings must be made with high-tensile strength nut/bolt fastener combinations with torque values of 7 ft-lb for 1-1/3" fittings and 12 ft-lb for 2-3/4" fittings. Regular nuts and bolts are not suitable for CF flange applications. Bolts/nut materials, gaskets, and fitting make-up must be in accordance with Conflat fitting manufacturer specifications and requirements.
(Reference http://www.lesker.com/newweb/flanges/flanges_technicalnotes_conflat_1.cfm)

The evaluations presented in this Alternate Method include a combination of analyses, pressure tests and demonstrated successful service that meet the intent of ASME B31.3 300(c)(3) and 304.7.2.

This request is related to, and includes common reference documents to alternate method VAR-2013-086, *Alternate Method for Continued Operation of TWTS Inlet Header with Current installed Valves and Conflat Flanges.* VAR-2013-086 applies only to specific valves with Conflat fittings at WETF under the conditions stated in the alternate method.

Justification/Compensatory Measures:

1. A finite element stress analysis *Analysis of Conflat Flange Sets Subjected to Internal Pressures* per ASME Section VIII, Division I, Appendix 2 concluded that 2-3/4" OD 304 SS Conflat flanges with copper gaskets can withstand an internal pressure of 285 psig at room temperature. (Attachment 1)
2. A test report Indiana University *Leak Testing of Conflat-type Flanges Under Internal Pressure* concluded that 2-3/4" and 1-1/3" OD 304 SS Conflat flanges with copper gaskets pressurized to approximately 200 psig yielded no significant leak rated after cold cycling (2-6 cycles) between room temperature and <100K. (Attachment 2)
3. LANL W-7 test report *Proof and Leak Test of WETF Sensor Chamber Dwg 104Y-234083-14* (Attachment 3) documents that 2-3/4" OD Conflat (CF) flanges that were part of the WETF Sensor Chamber were pressure and leak tested on October 9, 2009 to a pressure of 250 psia (238.8 psig) for 8 minutes. The pressure in the WETF Sensor Chamber was then reduced to 225 psia and helium leak tested. The observed leak rate was less than 1x10-3 std cc/sec.
4. A piping header section in the WETF Tritium Waste Treatment System with 2-3/4" Conflat flanged fittings connected to Varian vacuum valves models L6591-301 and L8679-301 was pressure tested to 75 psig with a leak rate of less than 1x10-3 std cc/sec per WETF record WETF-02-687-R0, *TWTS Header RE-Route* (Attachment 4).
5. Vacuum valves models L6591-301 and L8679-301 with 2-3/4" Conflat flange connections were independently pressure and leak tested to 93 psia and 102 psia respectively with a leak rate of less than 1x10-3 std cc/sec. (Attachment 5, Group WX-5 Helium Leak Test Reports dated June 6th, 1986). It is noted that these specific two valves are approved for use in Alternate Method *VAR-2013-086, Alternate Method for continued operation of TWTS inlet header with the current installed valves and Conflat fittings* and are not the subject of this variance. These valves are referenced in this alternate method because of the pressure tests performed on these valves with Confat fittings. Valve model L6591-301 is HV-3-W in the WETF MEL and on drawing WETF-DR-TWTS-073.C and valve model L8679-301 is HV-2-W in the WETF MEL and on drawing WETF-DR-TWTS-073.C.
6. A Nupro 24VFBG valve with 2-3/4" Conflat flange connections pressure tested to 76 psig and leak-rate tested at 51 psig with a leak rate of less than 1x10-3 std cc/sec. (Attachment 6, W-7-AD-003U, Issue A, *GTS Proof and Leak Test Data Sheet*, dated 5/6/13.
7. Original Construction Specification for WETF (Attachment 7, *WETF Building Specification, TA-16, Bldg 205*) specified ½" and 1" stainless steel tubing with Conflat flange connections that were to have a design pressure of 50 psig and a test pressure of 75 psig. Although the original pressure test reports cannot be located and are presumed to be lost, WETF Tritium Waste Treatment System piping sections have been in extensive successful service with 2-3/4" and 1-1/3" Conflat flange connections in dual vacuum and pressure service up to 50 psig since 1986 with no record of failures or leakage.

Attachment 1: LANL report *Analysis of Conflat Flange Sets Subjected to Internal Pressures*, John C Ramsey, May 2010

Attachment 2: *Leak Testing of Conflat-type Flanges Under Internal Pressure, Indiana University,* October 2004

Attachment 3: LANL W-7 test report *Proof and Leak Test of WETF Sensor Chamber Dwg 104Y-234083-14,* 10/9/09

Attachment 4: Record WETF-02-687-R0, *TWTS Header RE-Route,* 9/4/02

Attachment 5: Group WX-5 Helium Leak Test Reports dated June 6th, 1986, (2 sheets)

Attachment 6: W-7-AD-003U, Issue A, *GTS Proof and Leak Test Data Sheet*, dated 5/6/13)

Attachment 7: *WETF Building Specification, TA-16, Bldg 205* (pertinent excerpt pages only attached)

Attachment 8: Conflat Information

Duration of Request:	Start Date:		End Date:	☒ Lifetime
Requestor Ed Hyde	Z Number 092739	Organization ES-WFO	Signature Signature on file	Date 6/18/15
USQD/USID required (Nucl. High/Mod Hazard)? ☐ Yes ☒ No		If Yes, USQD/USID Number		
Design Authority Representative Robert Swickley, ES-WFO	Z Number 228406	Organization ES-WFO	Signature Signature on file	Date 6/22/15
LANL Owning Manager (FOD or Programmatic) Brian Watkins	Z Number 206831	Organization WFO-FOD	Signature Signature on file	Date 6/25/15

3.0 Safety Management Program Owner (SMPO) Representative (SMPOR/POC)

☐ Decline ☐ Accept ☒ Accept Labwide ☒ with Modification: added web page info.			
POC Ari Swartz	Z Number 235211	Signature Signature on file	Date 6/29/15

4.0 Additional Approval for P341 and APs; P342, ESM, Code, and Regulation Matters; and P343

☒ Accepted ☐ Accepted with comments ☐ Declined			
Comments:			
Safety or Security Management Program Owner Lawrence Goen	Z Number 106351	Signature Signature on file	Date 6/29/15