



Conduct of Engineering Request for Variance or Alternate Method

Assigned by SMPO or SMPOR: [X] Alternate Method [] Variance

Tracking number VAR- 2016-006

1.0 Affected Document(s)

Form with checkboxes for Engineering Processes, Standards, and Training, and fields for document title and revision.

Section/Para: ADMIN-2, 1.0, N (Material Compatibility), 9 – Hydrogen, Deuterium, and Tritium Service.

Specific Requirement(s) as Written in the Document(s) Systems in hydrogen, deuterium, or tritium service shall follow ASME B31.12.

2.0 Request

Brief descriptive title: Addition of ASME B31.3-2014 as the code of record for hydrogen, deuterium, or tritium services.

NCR required (work has occurred)? [] Yes [X] No If Yes, NCR Number

TA-Bldg-(Room) and/or Project Affected LANL System/Component Affected hydrogen, deuterium, or tritium services

Proposal Permit the application of ASME B31.3 Process Piping for other types of pressure systems addressed in ASME B31.12 Hydrogen Piping and Pipelines.

Justification/Compensatory Measures

Justification

The current version of ASME B31.12 is not as mature as ASME B31.3. B31.12 applies to industrial piping and pipelines, and references ASME B31.3 as explained in the following paragraphs:

The Foreword of ASME B31.12 states the following:

“The first edition of the B31.12 Code applies to design, construction, operation, and maintenance requirements for piping, pipelines, and distribution systems in hydrogen service. Typical applications are power generation, process plants, refining, transportation, distribution, and automotive filling stations. This Code is composed of Part GR, General Requirements, including common requirements referenced by all other parts; Part IP, Industrial Piping; and Part PL, Pipelines, including distribution systems. These Parts incorporate information specific to hydrogen service and either reference or incorporate applicable parts of ASME B31.3, Process Piping; ASME B31.1, Power Piping; ASME B31.8, Gas Transmission and Distribution Piping Systems; ASME B31.8S, Managing System Integrity of Gas Pipelines; and Section VIII, Division 3 of the ASME Boiler and Pressure Vessel Code, where appropriate.”

The Scope of ASME B31.12 states the following:

GR-1.1 SCOPE

This Code is applicable to piping in gaseous and liquid hydrogen service and to pipelines in gaseous hydrogen service. This Code is applicable up to and including the joint connecting the piping to associated pressure vessels and equipment but not to the vessels and equipment themselves. It is applicable to the location and type of support elements but not to the structure to which the support elements are attached. The design for pressure and temperature shall be in accordance with the requirements of Part IP for industrial piping and Part PL for pipelines.

ASME B31.12 was initially issued March 31, 2009 and contains a listing of applications that are under development including commercial, residential and nonmetallic systems. The B31.12-2014 edition still has not been updated. The foreword shows those items that are still in development (unchanged from 2009) as follow:

The Foreword of ASME B31.12 states the following:

*“Material performance factors have been included to account for the adverse effects of hydrogen gas on the mechanical properties of carbon and low alloy steels operating within the hydrogen embrittlement range. Many materials included in B31.3 have been omitted from B31.12’s tables due to their unsuitability for hydrogen service. Rules have been added for conversion or retrofit of existing pipeline and distribution systems from natural gas or petroleum to hydrogen service. Parts covering **commercial, residential, and nonmetallic systems will be added in future editions.** Material performance factors will be reevaluated as materials research data is developed and understanding of hydrogen embrittlement of carbon and low alloy steels increases.”*

There is a need to use non-metallic materials in hydrogen pressure systems for example Teflon™ lined stainless braided hoses where radiation deterioration is not a concern. ASME B31.3 does address flammables and nonmetallic. This is shown by the following citations from the ASME B31.3-2014:

300.1.1 Content and Coverage

- (b) This Code applies to piping for all fluids, including
 - (1) raw, intermediate, and finished **chemicals**

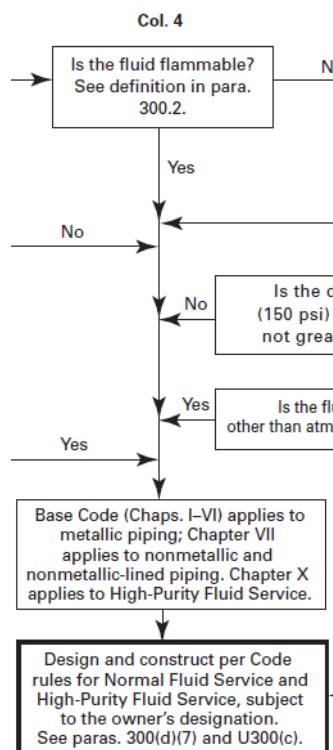
300.2 Definitions

flammable: for the purposes of this Code, describes a fluid that under ambient or expected operating conditions is a vapor or produces vapors that can be ignited and continue to burn in air. The term thus may apply, depending on service conditions, to fluids defined for other purposes as flammable or combustible.

Chapter VII, Nonmetallic Piping and Piping Lined With Nonmetals, A300 GENERAL STATEMENTS

- (a) Chapter VII pertains to nonmetallic piping and to piping lined with nonmetals.

APPENDIX M, GUIDE TO CLASSIFYING FLUID SERVICES, Fig. M300 (full copy attached)



ASME B31.12-2014 under some conditions specifically requires the use of ASME B31.3. Some of the citations of the B31.12 references to B31.3 are shown below:

IP-1.1.2 Exclusions

(b) Elevated temperature fluid service is excluded. Refer to ASME B31.3, Chapters I through VI for applicable requirements.

(c) A high pressure fluid service is a fluid service for which the owner specifies the use of **ASME B31.3**, Chapter IX for piping design and construction. High pressure is considered herein to be pressure in excess of that allowed by the ASME B16.5 Class 2500 rating for the specified design temperature and material group. However, there are no specified pressure limitations for the application of these rules. When piping is designated by the owner as being in high pressure fluid service, it shall meet the requirements of **ASME B31.3**, Chapter IX for materials and components, design, fabrication, assembly, erection, inspection, examination, and testing.

IP-3.8.4 Expansion Joints

(a) The design of metallic bellows-type expansion joints shall be in accordance with **ASME B31.3**, Appendix X.

IP-6.2.6 Fixtures

(3) Piping layout, anchors, restraints, guides, and supports for all types of expansion joints shall be designed in accordance with Appendix X, para. X301.2 of **ASME B31.3**.

IP-10.10.2 Flexibility Analysis

A flexibility analysis of the piping system shall have been made in accordance with the requirements of ASME B31.3, para. 319.4.2(b), if applicable, or (c) and (d).

Application of the B31.12 by LANS is voluntary because 10CFR851, *Worker Safety and Health Program*, Appendix A, Part 4, Pressure Safety, paragraph (b) does not require B31.12. This is likely because the B31.12 was first issued in 2008 after the release of the CFR and was not included in the mandatory list as shown below:

(b) Contractors must ensure that all pressure vessels, boilers, air receivers, and supporting piping systems conform to:

(1) The applicable American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (2004); sections I through section XII including applicable Code Cases (incorporated by reference, see § 851.27)

(2) The applicable ASME B31 (Code for Pressure Piping) standards as indicated below; and or as indicated in paragraph (b)(3) of this section:

(i) B31.1—2001—Power Piping, and B31.1a—2002—Addenda to ASME B31.1—2001 (incorporated by reference, see § 851.27);

(ii) B31.2—1968—Fuel Gas Piping (incorporated by reference, see § 851.27);

(iii) B31.3—2002—Process Piping (incorporated by reference, see § 851.27);

(iv) B31.4—2002—Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids (incorporated by reference, see § 851.27);

(v) B31.5—2001—Refrigeration Piping and Heat Transfer Components, and B31.5a—2004, Addenda to ASME B31.5—2001 (incorporated by reference, see § 851.27);

(vi) B31.8—2003—Gas Transmission and Distribution Piping Systems (incorporated by reference, see § 851.27);

(vii) B31.8S—2001—Managing System Integrity of Gas Pipelines (incorporated by reference, see § 851.27);

(viii) B31.9—1996—Building Services Piping (incorporated by reference, see § 851.27);

(ix) B31.11—2002—Slurry Transportation Piping Systems (incorporated by reference, see § 851.27); and

(x) B31G—1991—Manual for Determining Remaining Strength of Corroded Pipelines (incorporated by reference, see § 851.27).

Compensatory Measures

In order meet the need of hydrogen, deuterium, or tritium pressure systems, the requirements of ASME B31.12 will be applied for items that fit within the scope of the code.

For those hydrogen, deuterium, or tritium pressure systems that need to use non-metallic materials the ASME B31.3 will be applied until B31.12 issues rules for the non-metallic materials.

Attachments:

ASME B31.3 Appendix M

Duration of Request: TBD ASME B31.12 Updates	Start Date: 11/24/15	End Date: TBD ASME B31.12 Updates	<input type="checkbox"/> Lifetime	
Requestor Ari Ben Swartz	Z Number 235211	Organization ES-EPD	Signature Signed below	Date
USQD/USID required (Nucl. High/Mod Hazard)? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		If Yes, USQD/USID Number		
Design Authority Representative Lawrence Kenneth Goen	Z Number 106351	Organization ES-DO	Signature Signed below	Date
LANL Owing Manager (FOD or Programmatic) Lawrence Kenneth Goen	Z Number 106351	Organization ES-DO	Signature Signed below	Date

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

<input type="checkbox"/> Decline <input checked="" type="checkbox"/> Accept <input type="checkbox"/> Accept Labwide <input type="checkbox"/> with Modification:			
POC Ari Ben Swartz	Z Number 235211	Signature Signature on File	Date 11/24/2015

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

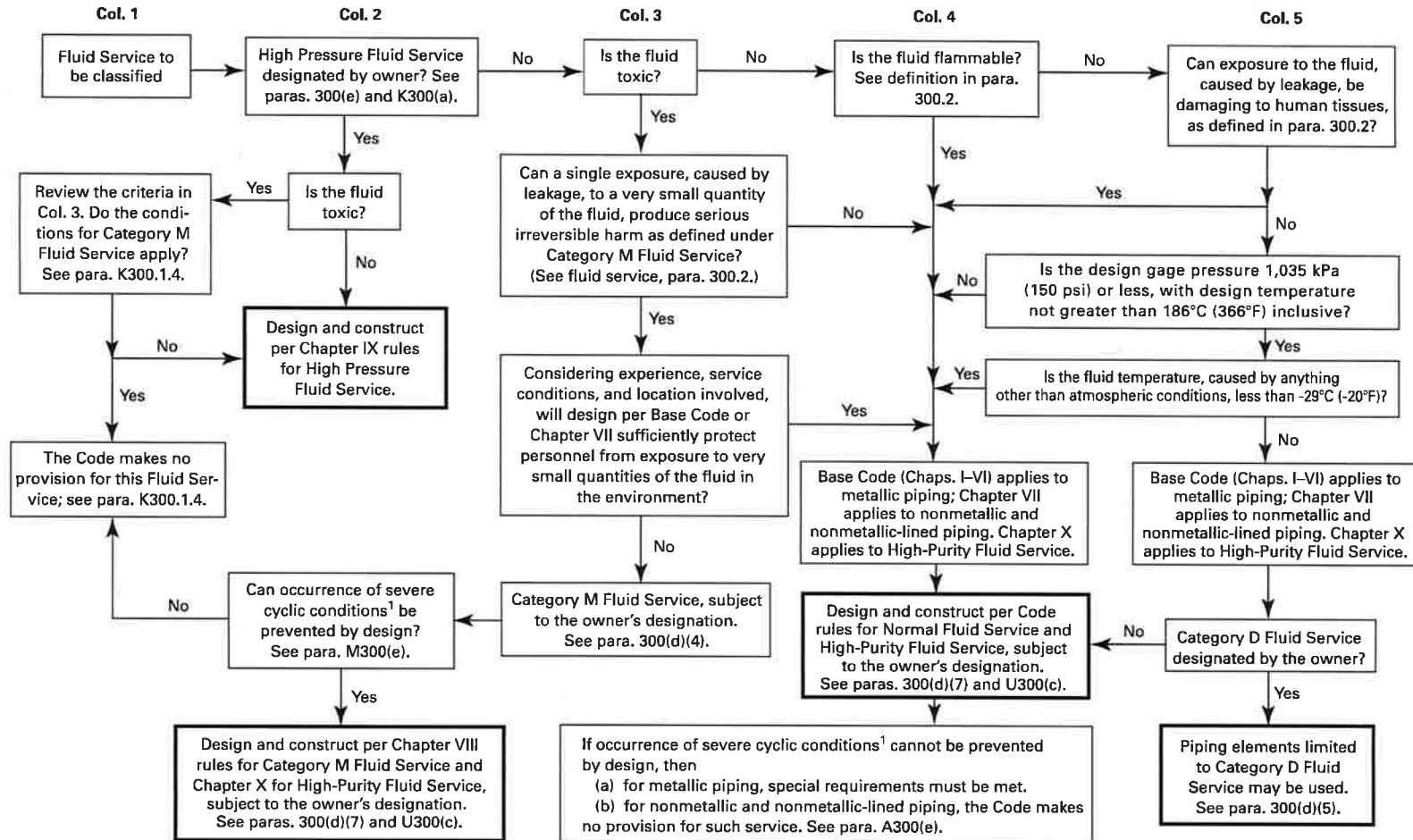
<input checked="" type="checkbox"/> Accepted <input type="checkbox"/> Accepted with comments <input type="checkbox"/> Declined			
Comments: The proposal is consistent with provisions where 31.12 does not cover certain aspects and points to 31.3. B31-12 will be monitored for updates, & this alternate method revisited at such time B31.12 addresses these materials.			
Safety or Security Management Program Owner Lawrence Kenneth Goen	Z Number 106351	Signature Signature on file	Date 11-30-15

APPENDIX M

GUIDE TO CLASSIFYING FLUID SERVICES

See Fig. M300.

Fig. M300 Guide to Classifying Fluid Services



GENERAL NOTES:

(a) See paras. 300(b)(1), 300(d)(4) and (5), and 300(e) for decisions the owner must make. Other decisions are the designer's responsibility; see para. 300(b)(2).

(b) The term "fluid service" is defined in para. 300.2.

NOTE:

(1) Severe cyclic conditions are defined in para. 300.2. Requirements are found in Chapter II, Parts 3 and 4, and in paras. 323.4.2 and 241.4.3.