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THE NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTORS

NATIONAL BOARD SUBCOMMITTEE INSPECTION

MINUTES

Meeting of July 15, 2020
Louisville, KY

These minutes are subject to approval and are for the committee use only. They are not to be duplicated or quoted for other than committee use.

The National Board of Boiler & Pressure Vessel Inspectors
1055 Crupper Avenue
Columbus, Ohio 43229-1183
Phone: (614)888-8320
FAX: (614)847-1828

1. **Call to Order**
   Chairman, Jim Getter, called the meeting to order at 8:10 AM

2. **Introduction of Members and Visitors (Attendance – Attachment Page 1)**
   The members and visitors that were physically present at the meeting went around the room to introduce themselves. Then the members and visitors that were present through WebEx, were called upon one at a time to introduce themselves.

   William Hackworth sat in as an alternate for Paul Welch.

3. **Check for a Quorum**
   With the members present both physically and through WebEx, a quorum was established.

4. **Awards/Special Recognition – None at this meeting**

5. **Announcements**
   Secretary, Jodi Metzmaier gave the announcements to the Subgroup **(Attachment Page 2).**

   It was announced that voice voting was going to be for negatives, abstentions, and not voting only. All other votes would be assumed as approved.

6. **Adoption of the Agenda**
   A motion was made to adopt the agenda. The motion was seconded. The agenda was unanimously approved.

7. **Approval of the Minutes of the January 15, 2020 Meeting**
   A motion was made to approve the minutes from the January 15, 2020 Subgroup meeting. The motion was seconded and **unanimously approved**.

8. **Review of Rosters**
   a. **Membership Nominations**
      - Brent Ray Interest Category of User, has attended the last two meetings and is interested in becoming a member of SG & SC Inspection. **(Resume – Attachment Pages 3-5)**

        Mr. Ray reviewed his resume with the Subcommittee and spoke on why he wanted to become a member and why thinks he would be a good addition to the Subgroup & Subcommittee. A motion was made to approve Mr. Ray as a member of the Subgroup & Subcommittee Inspection. The motion was seconded and **unanimously approved**.

   b. **Membership Reappointments**
      The following Subgroup & Subcommittee Inspection memberships are set to expire prior to the January 2021 meeting:
      1. Mr. Donnie LeSage
      2. Mr. James Roberts
      3. Mr. Jason Safarz

      All 3 of the above listed members stated they would like to continue being members of both Subgroup & Subcommittee Inspection. A motion was made to approve all 3 members for reappointment to both Subgroup and Subcommittee Inspection. The motion was seconded and **unanimously approved.**

   c. **Officer Appointments - None**

9. Open PRD Items Related to Inspection

- NB14-0602B – Improve index in Part 2 relating to pressure relief devices – D. Marek (PM)
  - Update: Work is still being done for this item.
- NB15-0321 – Review testing requirements for inservice testing of pressure relief devices in Part 2, 2.5.7 a) – A. Renaldo (PM)
  - Update: Proposal was balloted to Main Committee and received a few negative votes. Further work is being done to address those comments.

Chairman, Mr. Getter, reviewed the PRD items with the Subcommittee. The committee had no conflicts or questions regarding these items.

10. Interpretations - There are no interpretations for Subcommittee Inspection.

11. Action Items

Item Number: NB16-1402	**NBIC Location: Part 2, New Supplement**	**Attachment Pages 6-10**

General Description: Life extension for high pressure FRP vessels above 20 years

Subgroup: FRP
Task Group: M. Gorman (PM)

July 2020 Meeting Action:
A few of the FRP Task group members joined the meeting to present this item to the Subcommittee. Michael Gorman gave the background information explaining the reasoning behind the proposal. The Subcommittee had many questions for the FRP task group members. The Subcommittee asked them to explain how they addressed the letter balled disapproval comments from the Subcommittee, and what revisions were made based on these comments. Chairman, Jim Getter, has asked the Subcommittee to read through the letter ballot comments/replies from the project manager & recommended we **letter ballot this proposal to Subcommittee**.

The Subcommittee has asked that the NBIC Secretary include the Special Permit from DOT, SP16320 in the letter ballot for the Subcommittee to reference in their review of the revised proposal.

Item Number: 18-6	**NBIC Location: Part 2, S1.4.2.9**	**No Attachment**

General Description: Riveted stay bolt dimensions

Subgroup: Locomotive
Task Group: M. Janssen (PM)

July 2020 Meeting Action:
No Action as there was no one to report on this item.

Item Number: 18-43	**NBIC Location: Part 2, Section 5**	**Attachment Pages 11-13**

General Description: Permanent nameplate removal from pressure vessel being removed from service

Subgroup: Inspection
Task Group: J. Roberts (PM), J. Burgess, J. Calvert, J. Clark, M. Sansone

July 2020 Meeting Action:
Mr. Getter explain that the Subgroup Inspection members unanimously voted to move this item back up to Main Committee with no changes. They want to explain the purpose of the form to the Main committee, and explain that it is a tool and not enforceable. It is for the Owner/User to protect their liability and information for the jurisdiction. A motion was made to move the proposal to Main Committee as is. The motion was seconded and **unanimously approved**.

Item Number: 18-62	NBIC Location: Part 2	Attachment Pages 14-16

General Description: Remote Inspection of Confined Space Requirements

Subgroup: Inspection
Task Group: V. Newton (PM), M. Horbaczewski, B. Wilson, J. Calvert, J. Castle, D. Graf, T. Shernisky

July 2020 Meeting Action:
Mr. Newton presented this item to the Subcommittee along with a proposal. He explained that this item was letter balloted to the Main Committee in January 2020 and received comments. The comments were addressed by the task group and changes were made to the original proposal. A motion was made to approve the proposal as the task group has revised. The motion was seconded and **unanimously approved**.

Item Number: 18-63	NBIC Location: Part 2	No Attachment

General Description: Review inspection requirements for pressure vessels designed for high pressures

Subgroup: Inspection
Task Group: V. Scarcella (PM), J. Mangas, J. Peterson, and J. Castle

July 2020 Meeting Action:
Progress Report: Mr. Getter reported that there was a progress report given at the Subgroup meeting.

TASK GROUP UPDATE: Add B. Ray to the task group.

Item Number: 19-6	NBIC Location: Part 2, 2.3.6.8	Attachment Pages 17-19

General Description: PVHO 2.3.6.8 Add other types of PVHO's

Subgroup: Inspection
Task Group: D. Buechel (PM), R. Smith, S. Reimers, J. Burgess, M. Mooney & D. LeSage

July 2020 Meeting Action:
This item was closed with no action at the subgroup level; however, after further review of the item the subcommittee noticed this was a mistake.

Mr. Buechel reviewed the proposal with the Subcommittee. He made many changes to improve the proposal from the last time if was brought to the subgroup. All of the changes were reviewed and discussed. A motion was made to accept the proposal. The motion was seconded and **unanimously approved**.

Item Number: 19-7	NBIC Location: Part 2	Attachment Page 20

General Description: Pressure Gage Graduation

Subgroup: Inspection
Task Group: V. Newton (PM), D. Buechel, D. Rose, D. Graff, & J. Clark

July 2020 Meeting Action:
This item was letter balloted to Subgroup and Subcommittee Inspection and the ballot passed on 7/14. No action was taken at the Subcommittee meeting, the item will now be presented to Main Committee.

Item Number: 19-22	NBIC Location: Part 2, S2	Attachment Pages 21-26

General Description: Review of MAWP on ~~Return Flue Boilers~~ Cylindrical Components Under Extreme Pressure.

Subgroup: SG Historical
Task Group: M. Wahl (PM), J. Amato, R. Bryce & D. Rose

July 2020 Meeting Action:
Mr. Rose & Mr. Bryce presented this item to the Subcommittee with a proposal that was unanimously approved at the Historical Task Group meeting. The Subcommittee had questions and there was a lot of discussion. A motion was made to approve the proposal. The motion was seconded and **unanimously approved**.

GENERAL DESCRIPTION UPDATE: Change to "Review of MAWP on Cylindrical Components Under Extreme Pressure"

Item Number: 19-46	NBIC Location: Part 2, S5	No Attachment

General Description: Revisions to Yankee dryer supplement in Part 2 (Scope)

Subgroup: Inspection
Task Group: V. Newton (PM), T. Barker, D. Lesage, J. Jessick

July 2020 Meeting Action:
Mr. Newton reported that a progress report was given at the Subgroup Inspection meeting.

Item Number: 19-63	NBIC Location: Part 2, S5.2	No Attachment

General Description: Changes to the Yankee Dryer Supplement (ASSESSMENT OF INSTALLATION)

Subgroup: Inspection
Task Group: V. Newton (PM), T. Barker, D. Lesage, J. Jessick

July 2020 Meeting Action:
Mr. Newton reported that a progress report was given at the Subgroup Inspection meeting.

Item Number: 19-64	NBIC Location: Part 2, S5.2.1	No Attachment

General Description: Changes to the Yankee Dryer Supplement (DETERMINATION OF ALLOWABLE OPERATING PARAMETERS)

Subgroup: Inspection
Task Group: None assigned

July 2020 Meeting Action:
Mr. Newton reported that a progress report was given at the Subgroup Inspection meeting.

Item Number: 19-84	NBIC Location: Part 2, S2.10.7	No Attachment

General Description: Inspecting riveted joints for failure

Subgroup: SG Historical
Task Group: F. Johnson (PM)

July 2020 Meeting Action:
Mr. Rose reported that a progress report was given at the Historical Task Group Meeting.

Item Number: 19-88	NBIC Location: Part 2, 2.2.12.7 c) 2)	No Attachment

General Description: At NBIC Part II propose the following be added to Thermal Fluid Heater

Subgroup: Inspection
Task Group: V. Scarcella (PM), M. Sansone, & T. Bolden

July 2020 Meeting Action:
Mr. Scarcella reported that a progress report was given at the Subgroup Inspection meeting.

Item Number: 19-89	NBIC Location: Part 2, S2.7.3.2	Attachment Page 27

General Description: Longer NDE cycle for historic boilers

Subgroup: SG Historical
Task Group: None assigned

July 2020 Meeting Action:
Mr. Rose and Mr. Getter presented a proposal to the Subcommittee that was unanimously approved at the Historical Task Group meeting. During discussion the Subcommittee made a few changes to the proposal. T. Seime joined the discussion to help the Subcommittee further understand the wording in the proposal and the need for the change. A motion was made to approve the revised proposal. The motion was seconded and **approved with one negative vote**.

Vinny Scarcella had to leave the meeting and nominated Tim Bolden as his Alternate

New Items:

Item Number: 20-5	NBIC Location: Part 2, 4.1 – 4.4	No Attachment

General Description: Add language in NBIC Pt2/Pt3 to minimize CSEs by allowing remote NDE.

Subgroup: Inspection
Task Group: None assigned

July 2020 Meeting Action:
A task group was assigned at the Subgroup Inspection meeting. No further action was taken.

Item Number: 20-9	NBIC Location: All Parts - Glossary	Attachment Page 28

General Description: Request for Revision to NBIC Section 9: Glossary of terms to Define "Verify" & "Witnessing"

Subgroup: Inspection
Task Group: None assigned

July 2020 Meeting Action:
The Subcommittee discussed the changes made to the proposal during the Subgroup Inspection meeting, with regards to the definition of "witness". The Subcommittee agreed the wording should be changed from the original proposal, and a motion was made. The motion was seconded and **unanimously approved**.

Item Number: 20-26	NBIC Location: Part 2, S2	No Attachment

General Description: Concern for Historical Boiler Inspections Nationwide

Subgroup: ~~Inspection~~ Historical
Task Group: None assigned

July 2020 Meeting Action:
A task group was assigned at the Historical Task Group meeting. No further action was taken.

CORRECTION: Change the Subgroup to "Historical"

Item Number: 20-46	NBIC Location: Part 2, 5.3.2	No Attachment

General Description: Updates to Forms NB-5, NB-6, & NB-7

Subgroup: Inspection
Task Group: None assigned

July 2020 Meeting Action:
A task group was assigned at the Subgroup Inspection meeting. No further action was taken.

12. Future Meetings

January 11th – 14th, 2021 – New Orleans, LA
July 12th – 15th, 2021 – Cincinnati, OH

Chairman, Jim Getter, discussed the future meetings with the Subcommittee.

13. Adjournment

A motion was made to adjourn the meeting at 1:44 PM. The motion was seconded and **unanimously approved**.

Respectfully submitted,

Jodi Metzmaier
Subcommittee Inspection Secretary

SC Inspection Attendance

MEMBERS:	In Person	WebEx	Not In Attendance
Darrell Graf	X		
Jim Getter	X		
Tim Barker		X	
Ernest Brantley			X
David Buechel	X		
James Calvert		X	
James Clark		X	
Mark Horbaczewski		X	
Donnie LeSage		X	
John Mangas			X
Venus Newton	X		
Jeffrey Petersen			X
James Roberts		X	
David Rose		X	
Jason Safarz		X	
Matt Sansone	X		
Vincent Scarcella		X	
Thomas Vandini	X		
Paul Welch			X
William Hackworth (Alternate for Paul Welch)		X	

VISITORS:	In Person	WebEx
Joe Morgan	X	
Brent Ray		X
Robert Bryce		X
Jeffrey Castle		X
Tim bolden		X
John Eihusen (TG FRP)		X
Mayur Brijlani (TÜV Austria)		X
Michael Gorman (TG FRP)		X
Norman Newhouse (TG FRP)		X
Gerald Whitlock (HSB)		X
Luis Ponce	X	
Trevor Seime	X	

Announcements

- The National Board will be hosting a reception for all committee members and visitors on Wednesday evening at 5:30pm in the Bluegrass Room
    - Seated dinner
    - Who is coming to the reception?

- Breakfast (7-8 am) and Lunch (11:30 -12:30) will be provided to NBIC Committee members and visitors on Thursday.

- We will take a short break around 9:30-10:00 for task groups to work on items.

- Meetings schedule and meeting rooms layout are on the website under National Board Inspection Code tab → NBIC Committee Information → NBIC Meeting Information

- If the meeting ends early use the extra time to work with your task groups.
    - This can be done through Zoom/WebEx if needed.

- Always submit attachments in word format showing "strike through/underline"
    - Does anyone need to know how to do this?

- Naming format reminder:
    - *Item number - person who made the revision - date update*

- **We will do a voice voting for the negatives, not voting, and abstentions only.**

- As a reminder, anyone who would like to become a member of a group or committee, must submit their resume to Jonathan PRIOR TO the meeting.
    - *nbicsecretary@nationalboard.org*

Brent David Ray

99 Valley Lake Drive, Kenova, WV 25530 ***Cell Phone: (606) 471-9446*** ***bdray@marathonpetroleum.com***

SUMMARY

A dedicated Materials Science Engineer with experience and skills within the petrochemical, refining, and primary metals (carbon-steel, ferrous-alloy and nickel-alloy) industries. A career of varied experience has led to a unique knowledge base and skill set well suited for the petroleum refining industry. A driven individual providing a positive influence to the improvement and advancement of the engineering field.

EXPERIENCE HISTORY

Marathon Petroleum Company

July 2002 to Present

- Corporate Refining Inspection Engineering Specialist *(October 2017 to Present)*
- Corporate Refining Risk-Based Inspection Specialist *(November 2012 – October 2017)*
- Plant Metallurgical/Corrosion/Reliability Engineer, Catlettsburg Refining *(July 2002 – November 2012)*

Special Metals Corporation

(previously INCO Alloys)
November 1996 to July 2002

- Supervising Melting/Casting Engineer for Air Induction Melting & Electro-Slag Remelting Melt Shops
  - *Member Sandia National Labs Liquid Metals Symposium (board member)*
  - *Auditor for the Kentucky Quality Award (1998, 1999, 2000)*
  - *Certified Green Belt 6-Sigma (Engineer & Facilitator)*

Kentucky Electric Steel

October 1991 to November 1996

- Metallurgical Engineer / Statistical Process Control Coordinator / Customer Service Engineer
  - *American Society for Quality – Certified Quality Engineer & Certified Quality Auditor*
  - *Philip Crosby & Associates – Certified Statistical Process Control (Facilitator, Leader, and Trainer)*

College Work Positions

Internships, Student Worker, Technical Aide

- Bechtel, at Ashland Petroleum (Catlettsburg, KY) - Summer 1990 / Winter 1990
- Ashland Petroleum (Catlettsburg, KY) – Summer 1989 / Winter 1989
- South Point Ethanol (South Point, OH) – Summer 1987/Winter 1987/Summer 1988/Winter 1998
- Corps of Engineers (Huntington, WV) – September 1985 to August 1986 / Winter 1986

EDUCATION

BACHELOR OF SCIENCE: Materials Science Engineering (1991)
University of Kentucky (Lexington, KY)

MASTER ASSOCIATE'S CERTIFICATE: Project Management (2007)
The George Washington University (Washington, DC)

Brent David Ray

PROFESSIONAL AFFILIATIONS

- American Petroleum Institute (API)
- American Institute of Steel Technology (AIST)
- National Association of Corrosion Engineers (NACE)
- Society of Manufacturing Reliability Professionals (SMRP)
- American Welding Society (AWS)
- American Society for Materials (ASM)
- Kentucky Society of Professional Engineers (KSPE)
- National Society of Professional Engineers (NSPE)

Specific Memberships and Leadership Roles

- *Member API Sub-Committee Inspection & Mechanical Integrity – Chair (2019-present), Vice-Chairman (2016-19)*
- *Member API RP 581 (Risk-Based Inspection Methodology) – Chairman (2011-2019)*
- *Member API RP 580 (Elements of Risk-Based Inspection Programs) – Chairman (2019-present)*
- *Member API Inspection & Mechanical Integrity Summit Planning/Leadership Committee (2014-present)*
- *Member ASME Post-Construction Code Committees – PCC (Vice-Chair 2020-present), PCC-2, PCC-2 Subgroup on Welded Repairs, PCC-3 (Chair 2019-present)*
- *Member ASME/API Joint Committee on Fitness-for-Service (API 579-1/ASME FFS-1)*

CERTIFICATIONS

- Licensed Professional Engineer – Kentucky (1999 to 2015)
- American Petroleum Institute Certifications
  - *510 (Inspector, Pressure Vessel Code)*
  - *570 (Inspector, Piping Code)*
  - *653 (Inspector, Above Ground Storage Tanks)*
  - *571 (Damage Mechanisms in the Refining Industry)*
  - *577 (Welding Metallurgy)*
  - *580 (Risk-Based Inspection)*
  - *936 (Refractory Inspection)*
  - *TES (Tank Entry Supervisor)*
- National Board (NBIC) – Inspector, Owner-User commission
- Non-Destructive Evaluation Certifications – Level II NDE, RTFI Level 1, Infrared Level 1
- American Welding Society – Certified Welding Engineer
- National Association of Corrosion Engineers – Coating Inspector Program Level 1
- American Society for Quality – Certified Quality Engineer *(expired)* & Certified Quality Auditor *(expired)*

KNOWLEDGE & SKILLS

- Risk-Based Inspection
- Risk-Based Analysis
- Fitness-for-Service
- Reliability Engineering
- Melting/Casting of Nickel-based and Ferrous-based Alloys
- Codes & Standards
- Life-Cycle Studies
- Failure Analysis Review/Application
- Inspection
- Inspection Planning
- Inspection Engineering
- NDE Planning/Execution
- Melting/Casting/Forming of Carbon Steel
- Strong Technical Aptitude
- Strong Writing Skills
- Strong Presentation Skills
- Metallurgical Engineering
- Materials Science Engineering
- Corrosion Engineering
- Damage Mechanisms
- Quality Assurance & Quality Control Engineering
- Project Management
- Leadership
- Computer "savvy"

Brent David Ray

CIVIC INVOLVEMENT

- *Boy Scouts of America*
  - Past, all in TriState Area Council, Huntington, WV (1976 to 2014):
    - Cub Scouts (Cub Scout, Webelos Scout, Assistant Cubmaster & Cubmaster, Pack 605),
    - Boy Scouts (Boy Scout – Life Rank, Assistant Scoutmaster & Scoutmaster Troop 76),
    - District Commissioner, Cardinal District
  - Current, all in Buckeye Council, Charleston, WV (2014 to present):
    - Troop Committee, Assistant Scoutmaster (Buckeye Council, Troop 20, Huntington, WV);
    - Council Merit Badge Counselor (18 various merit badges)
    - Helped counsel at least 10 Eagle Scouts (to date) on their activities and projects
- *26th Street Church of Christ* – assist with church and youth activities as well as mentor college students
- *University of Kentucky, Alumni Band* – participated with since 1991, work with the UK Marching Band and UK Pep Band to provide support for the UK Athletic Bands program including mentoring students, work with the Alumni organization to plan and execute alumni functions and fundraising, served as Vice-President (2012-13), President (2013-14), Board of Directors (2015-present)
- *Various Athletic Organizations* – coached various soccer, basketball, & baseball teams (from 2004 to 2019)
- *Band Booster Organizations* – Spring Valley High School (2013-14), Wayne High School (2014-2019)
- *National Speleological Society* – participate within various groups, including leadership positions, in West Virginia (West Virginia Association of Cave Studies) and Kentucky (ESSO Grotto, CUSS Grotto, James Cavers) from 1993 to present
- *Winter Adventure Weekend (Carter Caves State Resort Park)* – participate in the planning and execution of the yearly event, leading outdoor and caving trips, volunteer position from 1991 to present
- *Kentucky Speleological Survey* – participated in the formation of the group and served as President for several years
- *C-K Alumni Band & Greater Huntington Symphonic Bands* – participate in both groups at various times since 1993, performing at various local concerts and benefits

Item NB16-1402 (NBIC Part 3, Section 6)

Supplement 14
Life Extension of High Pressure Fiber Reinforced Plastic Pressure Vessels

S14.1 Scope

This document may be used to evaluate whether the service life of high pressure fiber reinforced plastic pressure vessels (FRP) can be extended for an additional lifetime. High pressure means vessels with a working pressure from 3,000 psi (20 MPa) to 15,000 psi (103 MPa). For vessels intended for cyclic service, fatigue testing of new vessels is carried out by the vessel manufacturer to be certain that the vessel will not fail in service and such testing is typically required by regulatory authorities. Fatigue design and testing is the starting point for consideration of life extension.

S14.2 General

a) The procedure for in-service testing of high pressure composite pressure vessels, **Supplement 10** herein, is incorporated by reference into this procedure for life extension of high pressure composite pressure vessels. Supplement 10 is based on acoustic emission (AE) testing, specifically modal AE (MAE) testing. The MAE inspection procedure employs detection and analysis techniques similar to those found in seismology and SONAR. Much as with earthquakes, transient acoustical impulses arise in a composite material due to the motion of sources such as the rupture of fibers. These transients propagate as waves through the material and, if properly measured and analyzed by the methods in Supplement 10, the captured waves reveal, for example, how many fibers have ruptured. Similar information about other sources is also determinable, such as the presence and size of delaminations. Delaminations can play a significant role in vessel fatigue life, particularly delaminations near the transition regions and in the heads. The rupture behavior can be used to determine the integrity of the vessel. However, the development of criteria for life extension (LE) requires an understanding of the vessel design and fatigue life.

b) Fatigue testing of out of life vessels is a crucial part of the life extension process. It is used to validate the mechanical behavior of the vessels and to develop the numerical values for the allowables in the MAE pass/fail criteria for the particular design, material and construction.

S 14.3 Life Extension Procedure

a) New vessel fatigue life testing data shall be obtained from the Manufacturer's Design Report (MDR) and the number of cycles in a lifetime shall be determined from the MDR. The type of vessel under consideration for life extension shall have been shown through testing to be capable of sustaining at least three lifetimes of cycles to developed fill pressure followed by a subsequent burst test at a pressure greater than minimum design burst pressure.

b) An evaluation of the service the vessel has seen should take into account any operational conditions that may have differed from those used in the design testing and analysis. Such conditions include for example exposure to more severe weather than expected, more cycles per year, constant high temperature and humidity, chemical attack or any other of a number of

conditions under which operations take place that were not specifically included in testing at manufacture. Any such conditions shall be listed on the attached form. If no such conditions exist, it shall be so noted on the form. The test program delineated herein shall be revised to reflect the modified conditions as documented by the user and submitted for approval to the proper authorities.

c) Data and records for all vessels considered for life extension shall be kept and made readily available to inspectors or examination personnel. This includes an operating log, number of operating cycles since the previous examination, total number of operating cycles, examinations, examination techniques and results, maximum operating pressure and any unexpected pressures, temperatures, temperature cycles, damage events or other significant events that were outside the intended operating parameters or conditions.

d) A life extension test program shall be carried out for each type of vessel under consideration. Type of vessel means the particular manufacturer, materials (fiber and resin), water volume and design. If the type of vessel passes all requirements, then that type shall be eligible for life extension testing. If such a vessel passes the life extension MAE test its lifetime can be extended for one additional lifetime in five-year increments. In order to maintain life extension a vessel must be requalified every five years using the MAE test.

S14.4 Life Extension Test Program

a) The type of vessel under consideration for LE shall be noted. Manufacturer, place of manufacture and manufacturing date shall be recorded. The vessel dimensions shall be recorded. The specific fiber, matrix and winding pattern shall be recorded. If the fiber, matrix and winding pattern are not available from the manufacturer, then a vessel of the type under consideration shall be used to verify the winding pattern (hoop and helical angles and number of plies) through destructive testing.

b) Ten out-of-life vessels of the particular type shall be tested in the manner described herein. MAE techniques shall be applied to every vessel tested. Analysis of the MAE data is described herein. Two strain gages, one in the 0-degree and one in the 90-degree direction, shall be applied to every vessel pressure tested under this program. The purpose of strain gage data is to compute the 0 and 90 modulus values and to confirm that the modulus values of the material do not vary during the fatigue cycling required herein. Strain data shall be recorded and analyzed as described later on.

c) The LE test program proceeds by Steps. If the Step 1 is not successful, then there is no need to proceed to Step 2, and so forth.

S14.5 Life Extension Test Program Steps

S14.5.1 Step 1

Three vessels shall be selected from the ten and pressurized to burst. The vessels shall be inspected for visible damage, i.e., cuts, scrapes, discolored areas, and the vessel appearance shall be documented with photographs. MAE testing shall be done in conjunction with this testing as specified in Supplement

10, except for transducer spacing, pressurization plan and accept/reject criteria values. The values in Supplement 10 are for requalification testing. The transducer spacing shall be determined by the distance at which the 400 kHz component of a suitable pulser source is detectable along the axis of the vessel (essentially across the hoop fibers) and in the perpendicular direction (essentially parallel to the hoop fibers). Detectable means that the resulting signal component has an amplitude with at least a signal to noise ratio of 1.4. Transducer frequency response calibration and energy scale shall be carried out as specified in SUPPLEMENT 10. The pressurization plan shall follow that in ASME Section X Mandatory Appendix 8, i.e., there shall be two pressure cycles to test pressure with holds at test pressure as prescribed therein, however, the time interval between the two cycles may be reduced to one minute. For the purposes of life extension, the fiber fracture energy and BEO (background energy oscillation) values shall be as specified below.

a) No BEO greater than 2 times the quiescent energy (see Supplement 10) shall be observed up to test pressure or during pressure holds.

b) No fiber break event energy shall be greater than $24 \times 10^3 \times U_{FB}$ (see Supplement 10) during the second pressurization cycle.

c) No single event shall have an energy greater than $24 \times 10^5 \times U_{FB}$ during the second pressurization cycle.

Note: The numerical values specified in b) and c) can be adjusted through documented testing and stress analysis methods in order to account for the particular design, material and construction.

d) At least two sensors shall remain on each vessel all the way to burst in order to establish the BEO pressure for this type of vessel.

e) Plots of stress versus strain shall show linear behavior up to 90% of burst pressure.

f) The burst pressures of all three vessels shall be greater than the minimum design burst pressure.

g) If the burst pressure of any one of the three vessels is not greater than the minimum design burst pressure, then these vessels shall not be eligible for life extension and there is no need to proceed with Step 2 below.

Note: It is possible that one or more of the vessels selected had damage not obvious to visual inspection. If during this burst testing phase the MAE test identifies a vessel as damaged, the substitution of three other randomly selected vessels is allowed.

S14.5.2 Step 2

If the vessels pass Step 1, fatigue testing shall be carried out on a minimum of three vessels of the same type being considered for life extension.

a) Prior to testing, the vessels shall be inspected for visible damage, i.e., cuts, scrapes, discolored areas, and the vessel appearance shall be documented with photographs.

b) Prior to fatigue testing, MAE testing as specified in Step 1 shall be done in conjunction with the fatigue testing, hereinafter called the MAE test or MAE testing, in order to determine the suitability of the vessels for fatigue testing, i.e., that they pass the MAE test.

c) Next, the vessels shall be subjected to fatigue cycles. Pressure shall be 100 psi +0, -50% to at least 1.05 x working pressure. Vessels shall survive one and one-half (1.5) additional lifetimes. If they survive then they shall be tested by an MAE test as was done prior to fatigue cycling.

d) Provided they pass the MAE test, they shall be burst tested. At least two sensors shall remain on each vessel all the way to burst in order to establish that the BEO (background energy oscillation) pressure for the fatigued vessels is consistent, i.e., is the same percentage of ultimate, with that of the vessels tested in Step 1.

e) Plots of stress versus strain shall show linear behavior up to 90% of burst pressure.

f) The burst pressures at the end of the fatigue testing shall be greater than or equal to the minimum design burst. If the burst pressure of any one of the three vessels is not greater than the minimum design burst pressure, then these vessels shall not be eligible for life extension.

S14.5.3 Step 3

If the vessels pass Step 2, impact testing shall be carried out on a minimum of three vessels of the same type being considered for life extension.

a) Prior to testing, the vessels shall be inspected for visible damage, i.e., cuts, scrapes, discolored areas, and the vessel appearance shall be documented with photographs. Prior to impact testing, MAE testing shall be done in order to determine the suitability of the vessels for impact testing, i.e., that they pass the MAE test.

b) Two vessels shall be subjected to an ISO 11119.2 drop test and then subjected to the MAE test. If they pass the MAE test, then one vessel shall be burst tested. At least two sensors shall remain on the vessel all the way to burst in order to establish that the BEO (background energy oscillation) pressure for the fatigued vessels is consistent, i.e., is the same percentage of ultimate, with that of the vessels tested in Step 1.

c) Plots of stress versus strain shall show linear behavior up to 90% of burst pressure.

d) If the burst pressure is not greater than the minimum design burst pressure, then these vessels shall not be eligible for life extension.

e) If the first vessel passes the burst test, the other dropped vessel shall be fatigue cycled and subsequently subjected to the MAE test and, if it passes, shall be burst tested under the same conditions as before. If the vessel fails during fatigue cycling, i.e., bursts or leaks, then these vessels shall not be eligible for life extension.

f) If the modulus changes by more than 10%, then these vessels shall not be eligible for life extension. The strain gages should be mounted in a location that is away from the impact zone.

g) The burst pressure at the end of the fatigue testing of the dropped vessel shall be greater than or equal to the minimum design burst. The vessels shall have MAE testing applied during burst testing as before and the BEO shall be consistent with the previously established percent of burst ±10%.

S14.5.4 Step 4

If the vessels pass Step 3, cut testing shall be carried out on a minimum of two vessels of the same type being considered for life extension.

a) Prior to testing, the vessels shall be inspected for visible damage, i.e., cuts, scrapes, discolored areas, and the vessel appearance shall be documented with photographs. Prior to cut testing, MAE testing shall be done in order to determine the suitability of the vessels for cut testing, i.e., that they pass the MAE test.

b) Two vessels shall be subjected to an ISO 11119.2 cut test and then subjected to the MAE test. If they pass, then one shall be burst tested under all the conditions and procedures delineated in Step 2. If the burst pressure is not greater than the minimum design burst pressure, then these vessels shall not be eligible for life extension.

c) If the cut vessel passes, then the other cut vessel shall be fatigue cycled as described in Step 2 and subsequently subjected to the MAE test and then burst tested with at least two MAE sensors remaining on and monitoring the vessel as before. If it does not survive fatigue cycling, then these vessels shall not be eligible for life extension.

d) The burst pressure at the end of the fatigue testing of the cut vessel shall be greater than or equal to the minimum burst pressure specified by ISO 11119.2.

If the vessel type passes Steps 1 to 4, then that type is eligible for life extension. An out of life vessel of the type subjected to the program above may have its life extended for one additional lifetime if it passes the MAE test. The vessel shall pass the MAE test at subsequent five-year intervals or at one-third of the lifetime, whichever is less, in order to continue in service. The vessel shall be labeled as having passed the NBIC life extension test.

1.6 CHANGE OF SERVICE

Supplement 9 of this part provides requirements and guidelines to be followed when a change of service or service type is made to a pressure-retaining item.

Whenever there is a change of service, the Jurisdiction where the pressure-retaining item is to be operated, shall be notified for acceptance, when applicable. Any specific jurisdictional requirements shall be met.

1.7 SCRAPPING PRESSURE RETAINING ITEMS

The owner or user shall deface the code nameplate(s) of any pressure retaining item that is scrapped. The removal or defacement of the Code nameplate(s) should be verified by the Inspector, and the National Board form NB-XXX shall be completed and submitted to the National Board and Jurisdiction, if required.

ADD DEFINITION:

SCRAPPED – Permanent removal from service by owner's or user's procedures.

Scrapping of Pressure Retaining Items

In accordance with provisions of the National Board Inspection Code

1.Submitted to:

Name of Jurisdiction

Address

Phone Number

2. Submitted by:

(Name of Owner/User)

Address

Phone Number

3. Manufactured by:
(name and address)

4. Location of Installation:
(address)

5. Manufacturer's Data Report: ☐ YES ☐ NO

6. Item Registered with National Board: ☐ YES ☐ NO NB Number: _____

7. Item Identification:

Year Built: _____ Mfr. Serial No.: _____

Type: _____ Jurisdiction no.: _____

Dimensions: _____ MAWP: _____

8. Date of removal or defacement of the Code nameplate(s) _____

9. I certify that to the best of my knowledge and belief the statements in this report are correct, and with provisions of the National Board Inspection Code.

Name of Owner or User: _____

Signature: _____ Date: _____

Instructions for Completing the Form NB-XXX, *Scrapping of Pressure Retaining Items Form*

Items 1-9 shall be completed by the owner, user, or "R" Stamp Holder making the request.

1) The name, address, and phone number of the Jurisdiction, Authorized Inspection Agency (when there is no Jurisdiction) the form is being submitted to for approval.
2) Enter the name and address of your company or organization.
3) Enter the name and address of the manufacturer shown on the name plate.
4) Enter the name and address of the location where the pressure-retaining item is installed. If this is the same as number 2, check the box "same as # 4."
5) Manufacturer's Data Report Attached-check the appropriate box.
6) Is the pressure-retaining item registered with the National Board? Check the appropriate box. If yes, provide the National Board Registration Number.
7) Provide as much information as known to help identify the pressure-retaining item.
8) Enter date the removal or defacement of the Code nameplate.
9) Enter the name and signature of the owner, user, or "R" Stamp Holder (and "R" Stamp number if applicable).

Note: Once completed the requester shall file a copy with the Jurisdiction where the pressure retaining item is installed, the National Board (if registered with the National Board), and the owner or user of the vessel if the request was made by an "R" Stamp Holder, and upon request to the Authorized Inspection Agency who witnessed the removal or defacement of the nameplate.

1.4.1 PERSONAL SAFETY REQUIREMENTS FOR ENTERING CONFINED SPACES

a) No pressure-retaining item shall be entered until it has been properly prepared for inspection. The owner or user and Inspector shall jointly determine that pressure-retaining items may be entered safely.

This shall include:

1) Recognized hazards associated with entry into the object have been identified by the owner or user and are brought to the attention of the Inspector, along with acceptable means or methods for eliminating or minimizing each of the hazards;

2) Coordination of entry into the object by the Inspector and owner or user representative(s) working in or near the object;

3) Personal protective equipment required to enter an object shall be used. This may include, among other items, protective outer clothing, gloves, respiratory protection, eye protection, foot protection, and safety harnesses. The Inspector shall have the proper training governing the selection and use of any personal protective clothing and equipment necessary to safely perform each inspection. Particular attention shall be afforded respiratory protection if the testing of the atmosphere of the object reveals any hazards;

4) Completing and posting of confined space entry permits, as applicable; and

5) An effective energy isolation program (lock out and/or tag out) is in place and in effect that will prevent the unexpected energizing, start-up, or release of stored energy.

b) The Inspector shall determine that a safe atmosphere exists before entering the pressure-retaining item. The atmosphere shall be verified by the owner or user as directed by the Inspector.

1) The oxygen content of the breathable atmosphere shall be between 19.5% and 23.5%.

2) If any flammable or combustible materials are present in the atmosphere they shall not exceed 10% of their Lower Explosive Limit (LEL) or Lower Flammable Limit (LFL).

3) The Inspector shall not enter an area if toxic, flammable or inert gases, vapors or dusts are present and above acceptable limits.

c) Remote visual inspection is an acceptable alternative to confined space entry provided the requirements of 4.2.1 c) are met and where allowed by the jurisdiction.

1.4.2 EQUIPMENT OPERATION

The Inspector shall not operate owner or user equipment. Operation shall be conducted only by competent owner or user employees familiar with the equipment and qualified to perform such tasks.

4.1 SCOPE

This section describes acceptable examination and test methods that are available to the Inspector during inspection of pressure-retaining items. This section also describes evaluation of test results and assessment methodologies.

4.2 NONDESTRUCTIVE EXAMINATION METHODS (NDE)

a) Listed below is a variety of nondestructive examination methods that may be employed to assess the condition of pressure-retaining items. The skill, experience, and integrity of the personnel performing these examinations are essential to obtain meaningful results. The Inspector should review the methods and procedures to be employed to ensure compliance with jurisdictional requirements.

b) Generally, some form of surface preparation will be required prior to use of these examination methods. When there is doubt as to the extent of a defect or detrimental condition found in a pressure-retaining item, the Inspector is cautioned to seek competent technical advice and supplemental NDE.

c) Personnel performing examination and test methods shall have proper training and certification, as required by the owner and acceptable to the Inspector and Jurisdiction, if required.

4.2.1 VISUAL

a) Visual examination is the basic method used when conducting an inservice inspection of pressure-retaining items. Additional examination and test methods may be required at the discretion of the Inspector to provide additional information to assess the condition of the pressure-retaining item.

b) Visual examination is an inspection method to ascertain the surface condition of the pressure-retaining item. The Inspector should be aware of recognizing various surface features and comparing these features with damage mechanisms listed in NBIC Part 2, Section 3 that could indicate exposure of the pressure-retaining item to harmful corrosion or elevated temperature service.

c) ~~In some cases the Inspector may have limited or no access while performing an inspection of the pressure-retaining item. Subject to approval of the Jurisdiction, remote camera or fiber optic devices may be considered acceptable methods to view and record the surface condition of the pressure-retaining item.~~Remote Visual Inspection is an acceptable method of visual examination if the process is agreed upon by the owner and acceptable to the Inspector and Jurisdiction.

1) For Remote Visual Inspection, plans are reviewed and approved by the Inspector.
2) The Inspector shall be present at time of data collection.
3) The Inspector will be provided a dedicated monitor that has a resolution at least equal to that obtainable by direct observation, care should be taken to minimize glare on the viewing screen.
4) The Inspector shall have direct communication with the operator of the remote visual camera.
5) For Remote Visual Inspections, the final report is acceptable to the Inspector / Jurisdiction and all raw data is available to the Inspector / Jurisdiction as needed.

6) For Remote Visual Inspections, the inspection procedure shall reference a validated qualification of the equipment, including verification that the equipment is safe for use in the environment it will be operating in. Equipment validation will refer to ASME BPVC Section V. As a minimum the equipment shall meet:

   a. 1/32" (0.8 mm) simulated defect identification
   b. Minimum light intensity of 100 fc (1086 lux)
   c. Not less than 30deg offset to the surface to be examined
   d. Resolution at least equal to that obtainable by direct observation

7) All equipment used must produce results acceptable to the Inspector.

Proposed PVHO Comments to NBIC re 2018 Updates to NBIC 2.3.6.8

2.3.6.8 INSPECTION OF PRESSURE VESSELS FOR HUMAN OCCUPANCY (PVHO's)

A pressure vessel for human occupancy (PVHO), as defined by ASME PVHO-1 is a pressure vessel that encloses a human being or animal within its pressure boundary while it is subject to internal or external pressure that exceeds a 2 psi (14 kPa) differential pressure. PVHOs include, but are not limited to submersibles, diving bells, personal transfer capsules, decompression chambers, recompression chambers, hyperbaric chambers, high altitude chambers and medical hyperbaric oxygenation facilities.

This section provides guidelines for inspection of ~~medical~~ PVHO systems. Due to the many different designs and applications of PVHOs, potential failures of components or safety concerns that are not specifically covered, such as rapid decompression or fire/sparking issues should be considered.

a) General/operational

1) PVHOs should be constructed in accordance with ASME PVHO-1. This code adopts Section VIII and therefore the vessels should bear a "U" or "U2" ASME designator. Inspections may be conducted using ASME PVHO-2 for reference. PVHO-1 also has several Cases that address PHVOs manufactured from non-traditional materials such as various fabrics. PVHOs built under such cases shall have all the documentation required by the Case, but may not necessarily have any related Section VIII forms.

2) Cast and ductile iron fittings are not allowed.

~~3) Due to the human occupancy element, a person should be in attendance to monitor the PVHO when in operation, in the event there is an accident emergency or personnel inside the PVHO require assistance.~~

~~4)~~3) The installation should be such that there is adequate clearance to inspect it properly. In some applications, such as underground tunneling, it may be impossible to perform a complete external inspection.

b) Internal Inspection

1) Where existing openings permit, perform a visual internal inspection of the vessel. Look for any obvious cracks and note areas that are subject to high stress such as welds, welded repairs, head-to-shell transitions, sharp interior corners, and interior surfaces opposite external attachments or supports.
2) The vessel should be fee of corrosion, damage, dents, gouges, or other damage. Special attention should be paid to areas under chamber floors and the interiors of chamber drain fittings.
3) All openings leading to external fittings or controls should be free from obstruction
4) All exhaust inlets should be checked for the presence of fittings that prevent a chamber occupant from inadvertently blocking the opening.
5) The inlets to all chamber pressure gauge lines should be located where they are either protected from possible blockage or fitted with multiple openings.
6) Chamber doors:
    a. Doors should operate freely and smoothly. However, doors designed to move/swing horizontally should not have so little hinge friction that they will move on their own when released.
    b. Doors that close/seal with pressure and which are fitted with "dogs" or other restraints to hold them in place until an initial seal is obtained, shall be ~~fitted~~ provided with features to prevent the door from maintaining a seal in the event the pressure differential on the door is reversed to an extent sufficient to overload the restraints.
    c. Door seals should be supple, free from flat spots, cracking, etc.

Proposed PVHO Comments to NBIC re 2018 Updates to NBIC 2.3.6.8

d. Doors that close/seal against pressure shall have provisions as follow:
    1. Positive protection against pressurization of the vessel unless the restraint mechanism is fully engaged. This includes pressurization by back-up methods as well as primary methods.
    2. Positive protection against release of the restraint mechanism unless pressure in the vessel is fully released

c) External Inspection

1) The Inspector should closely examine the external condition of the pressure vessel for corrosion, ~~damage,~~ dents, gouges or other damage.
2) The lower half and the bottom portions of insulated vessels should receive special focus, as condensation or moisture may gravitate down the vessel shell and soak into the insulation, keeping it moist for long periods of time. Penetration locations in the insulation or fireproofing such as saddle supports, sphere support legs, nozzles, or fittings should be examined closely for potential moisture ingress ~~paths~~. When moisture penetrates the insulation, the insulation may actually work in reverse, holding moisture in the insulation and/or near the vessel shell.
~~**3)** Insulated vessels that are run on an intermittent basis or that have been out of service require close scrutiny. In general, a visual inspection of the vessel's insulated surfaces should be conducted once per year.~~
~~4)~~3) The most common and superior method to inspect for suspected corrosion under insulation (CUI) damage is to completely or partially remove the insulation for visual inspection. The method most commonly utilized to inspect for CUI without insulation removal is by X-ray and isotope radiography (film or digital) or by real time radiography, utilizing imaging scopes and surface profilers. The real time imaging tools will work well if the vessel geometry and insulation thickness allows. Other less common methods to detect CUI include specialized electromagnetic methods (pulsed eddy current and electromagnetic waves) and long-range ultrasonic techniques (guided waves).
~~5)~~4) There are also several methods to detect moisture soaked insulation, which is often the beginning for potential CUI damage. Moisture probe detectors, neutron backscatter, and thermography are tools that can be used for CUI moisture screening. Proper surface treatment (coating) of the vessel external shell and maintaining weather-tight external insulation are the keys to prevention of CUI damage.
~~6)~~5) Couplers and doors that open with pressure:
    a. Couplers and doors should operate freely and smoothly.
    b. Seals should be supple, and free from flat spots, cracking, etc.
    c. That close/seal against pressure shall have provisions as follow:
        1. Positive protection against pressurization of the vessel unless the restraint mechanism is fully engaged. This includes pressurization by back-up methods as well as primary methods
        2. Positive protection against release of the restraint mechanism unless pressure in the vessel is fully released

d) Inspection of parts and appurtenances (e.g., piping systems, pressure gages, bottom drains, etc.)

1) As stated above, cast iron is not allowed on PVHOs and shall be replaced with parts fabricated with other suitable materials, in accordance with ASME Code Section II.
2) If valves or fittings are in place, check to ensure that these are complete and functional.
3) The Inspector shall note the pressure indicated by the gage and compare it with other gages on the same system. If the pressure gage is not mounted on the vessel itself, it should be ascertained that the gage is installed on the system in such a manner that it correctly indicates actual pressure in the vessel. Lines leading to chamber primary depth gauges should connect only to the depth gauge.
4) The Inspector shall verify that ~~the~~ any vessel is provided with a drain opening.
5) The system should have a pressure gage designed for at least the most severe condition of pressure in normal operation. This gage should be clearly visible to the person adjusting the

Proposed PVHO Comments to NBIC re 2018 Updates to NBIC 2.3.6.8

setting of the pressure control valve. The graduation on the pressure gage shall be graduated to not less than 1.5 times the pressure at which the lowest safety/relief valve is set.

6) Provisions should be made to calibrate pressure gages or to have them checked against a standard test gage.
7) ~~Any vents and exhausts~~ The exhausts from the depressurization of PVHOs located inside enclosures should be piped to a location outside the enclosure and located at least 10 ft. (3.0 m) away from any air intake.
8) ~~Low points should be fitted with drains.~~

e) Inspection of view ports / windows

1) Each window should be individually identified and be marked in accordance with PVHO-1.
2) If there are any penetrations through windows, they must be circular and in accordance with PVHO-1 requirements.
3) Windows must be free of crazing, cracks and scratches that exceed “superficial” defects as defined by PVHO-2.
4) Windows and viewports have a maximum interval for seat/seal inspection and refurbishment. Windows have a maximum service life ranging from 10 to 20 years depending on the type of window and service conditions. Documentation should be checked to ensure compliance with PVHO-2 inspection and refurbishment requirements (PVHO-2-2016, Tables 2-4.3-1 and 2-4.3-2) and service life limitations (PVHO-2-2016, Section 2-4.4).

f) Inspection of pressure relief devices

1) Pressure relief devices for chambers only must have a quick opening manual shutoff valve installed between the chamber and the pressure relief device, with a frangible seal in place, within easy access to the operator.
2) The pressure relief device shall be constructed in accordance with ASME Code Section VIII.
3) The discharge from the chamber pressure relief device shall be piped outside to a safe point of discharge as determined by the AHJ (Authority having Jurisdiction). The discharge from other relief devices shall to be piped outside only if they are on systems that carry non-life supporting gases.
4) ~~Rupture disks may be used only if they are in series with a pressure relief valve, or when there is less than 2 ft³ (57 l) of water volume.~~ Rupture disks shall not be used, except in series upstream of pressure relief valves to prevent gas leakage.
5) Verify that the safety valve is periodically tested either manually by raising the disk from the seat or by removing and testing the valve on a test stand.

g) Acceptance criteria

The following forms are required to be available for review ~~completed~~:

1) ASME BPV Forms U-1, U-1A or U-2 as appropriate for vessels built to ASME B&PV Code Section VIII. For vessels built to other rule sets, the equivalent forms shall be available;
2) PVHO-1-2016 Form GR-1 Manufacturer’s Data Report for Pressure Vessels for Human Occupancy;
3) PVHO-1-2016 Forms VP-1 ~~PVHO-2~~ Fabrication Certification for Acrylic Windows (one for each window);
4) PVHO-1-2016 Form VP-2 Design Certification for Acrylic Windows (one for each window);
5) PVHO-2-2016 Form VP-1 Viewport Inspection (one for each window, current within PVHO-2 inspection interval requirements); and
6) For any repaired windows, PVHO-2-2016 Form VP-2 Acrylic Window Repair Certificate for Windows Repaired by the Use (or his Authorized Agent) OR PVHO-2-2016 Form VP-3 Acrylic Window Repair Certificate for Severely Damage Windows

h) All PVHOs under the jurisdiction of the U.S. Coast Guard must also comply with 46 CFR Part 197.

2.3.6.5 INSPECTION OF PRESSURE VESSELS FOR HUMAN OCCUPANCY (PVHO'S)

d) Inspection of parts and appurtenances (e.g., piping systems, pressure gage, bottom drain)

1) As stated above, cast iron is not allowed on PVHOs and shall be replaced with parts fabricated with other suitable materials, in accordance with ASME Code Section II.

2) If valves or fittings are in place, check to ensure that these are complete and functional.

3) The Inspector shall note the pressure indicated by the gage and compare it with other gages on the same system. If the pressure gage is not mounted on the vessel itself, it should be ascertained that the gage is installed on the system in such a manner that it correctly indicates actual pressure in the vessel. Lines leading to chamber primary depth gages should connect only to the depth gage.

4) The Inspector shall verify that the vessel is provided with a drain opening.

5) The system should have a pressure gage designed for ~~at least~~ the most severe condition of ~~coincident~~ pressure in normal operation. This gage should be clearly visible to the person adjusting the setting of the pressure control valve. The graduation on the pressure gage shall be graduated to not less than 1.5 times the pressure at which the lowest safety/relief valve is set.~~MAWP of the vessel.~~

6) Provisions should be made to calibrate pressure gages or to have them checked against a standard test gage.

7) Any vents and exhausts should be piped at least 10 ft. (3.0 m) from any air intake.

8) Low points should be fitted with drains.

Action Item Request Form

CODE REVISIONS OR ADDITIONS

Request for Code revisions or additions shall provide the following:

a) Proposed Revisions or Additions

Item Number: 19-22.

b) Existing Text:

None

Provide a brief explanation of the need for the revision or addition.

No existing text to instruct inspectors on rating return-flue (Scotch Marine) historical boilers. Add section S2.10.3.1 and table for constant values. Update S2.10.6 Nomenclature

c) Background Information

An extensive review of all code and pre-code equations has been made:

1.) ASME equations from 1914-1971 editions are simple but the steps to determine the choice of equations is complex in nature, and examples exist where engineers did not correctly interpret the steps or equations. Design criteria may not match construction on pre-code boilers, and construction may hide details needed for a field inspector to choose the appropriate equation. These equations typically grant the highest calculated MAWP which may or not be appropriate for pre-code boilers with unknown material or non-compliant designs.

2.) The Canadian Interprovincial Regulations define a set of simple equations, but do not consider tensile strength. These equations were first enforced in 1910, then deprecated in favour of ASME wording in the 1920's, presumably in efforts to harmonize aspects of the two standards.

49.—Internally Fired Furnaces or Parts of Boilers (other than Ordinary Fire Tubes) Subjected to Compression.

The furnace plates in plain circular internally fired furnaces, not exceeding 42 inches in diameter if not found sufficiently strong, must be stayed as flat surfaces, allowing in the calculations for such seventy-five per cent. (75%) of the value of the resistance to collapse, as found by the following formula, the pitch of the stays being computed by the rule for flat surfaces, but the pitch shall in no case exceed eight inches on the furnace plate. For furnaces over forty-two inches in diameter, no allowance for value of resistance to collapse shall be made. Care must be taken not to reduce the efficiency of the riveted joint when applying these stays.

$$B = \frac{C \times T^2}{(L_1 + 1)\,Dr}$$

Where—

Dr = Outside diameter of furnace in inches.

T = Thickness of plate in inches.

L_1 = Length of furnace in feet, or length between rings.

C = Constant according to the following circumstances:

B = Working pressure per square inch, which must not exceed that found by the limiting formula, as follows:

50

$$B = \frac{10000 \times T}{Dr}$$

Furnaces with butt joints and rivet holes punched small and reamed out in place.

112500 where the longitudinal seams are double riveted, and fitted with single butt straps.

100000 where the longitudinal seam is single riveted, and fitted with single butt strap.

112500 where the longitudinal seam is single riveted, and fitted with double butt straps, or where seam is welded.

Furnaces with lap joints and rivet holes punched small and reamed out in place.

96000 where the longitudinal seams are double riveted.

87500 where the longitudinal seams are single riveted.

3.) The British Board of Trade rule (circa 1880) is a precursor to the Canadian regulations. The equation is of the same form, but assumed different materials. It is only appropriate for wrought iron boilerplate. It is clear that this equation was heavily researched and heavily enforced because other formulas were “dangerously weak”.

“Circular furnaces with the longitudinal joints welded or made with a butt strap:

$$\frac{\text{90,000} \times \text{the square of the thickness of the plate in inches.}}{(\text{Length in feet} + 1) \times \text{diameter in inches}} = \text{the working}$$

pressure per square inch, provided it does not exceed that found by the following formula:

$$\frac{\text{8,000} \times \text{thickness in inches}}{\text{diameter in inches.}} = \text{Working pressure per square inch.}$$

The second formula limits the crushing stress to 4000 lbs. per sectional square inch.

The length is to be measured between the rings if the furnace is made with rings.

If the longitudinal joints instead of being butted are lap jointed in the ordinary way then 70,000 is to be used instead of 90,000, excepting only where the lap is bevelled and so made as to give the flues the form of a true circle, when 80,000 may be used.

When the material or the workmanship is not of the best quality, the constants given above must be reduced, that is to say, the 90,000 will become 80,000; the 80,000 will become 70,000; the 70,000 will become 60,000; when tke material and the workmanship are not of the best quality, such constants will require to be further reduced, according to circumstances and the judgment of the surveyor, as in the case of old boilers. One of the conditions of best workmanship is that the joints are either

double rivetted with single butt straps, or single rivetted with double butt straps, and the holes drilled after the bending is done and when in place, and the plates afterwards taken apart, the burr on the holes taken off, and the holes slightly countersunk from the outside *

*** The following examples will serve to show the application of the constants for the different cases that may arise:**

Furnaces with butt joints and drilled rivet holes.	**90,000**	**where the longitudinal seams are welded.**
	90,000	**where the longitudinal seams are double rivetted and fitted with single butt straps.**
	80,000	**where the longitudinal seams are single rivetted and fitted with single butt straps.**
	90,000	**where the longitudinal seams are single rivetted and fitted with double butt straps.**
Furnaces with butt joints and punched rivet holes.	**85,000**	**where the longitudinal seams are double rivetted and fitted with single butt straps.**
	75,000	**where the longitudinal seams are single rivetted and fitted with single butt straps.**
	85,000	**where the longitudinal seams are single rivetted and fitted with double butt straps.**
Furnaces with lapped joints and drilled rivet holes.	**80,000**	**where the longitudinal seams are double rivetted and bevelled.**
	75,000	**" " " " " " " and not bevelled.**
	70,000	**" " " " " single " and bevelled.**
	65,000	**" " " " " " and not bevelled.**
Furnaces with lapped joints and punched rivet holes.	**75,000**	**where the longitudinal seams are double rivetted and bevelled.**
	70,000	**" " " " " " " and not bevelled.**
	65,000	**" " " " " single " and bevelled.**
	60,000	**" " " " " " " and not bevelled.**

In the case of upright fire-boxes of donkey or similar boilers, 10 per cent. should be deducted from the constants given above, applicable to the respective classes of work.

4.) Lloyds Rule (circa 1870) is a precursor to the British Board of Trade rules, derived from research by Sir William Fairbairn. It was deemed incorrect by the British Board of Trade for determining collapsing pressure of large cylinders. For the firetube dimensions it was intended for, this equation applied a 4.5:1 factor of safety. Thus, this equation is not a suitable candidate.

5.) Modern ASME equations assume modern materials and welded construction. Compensation for the length of the tube is inappropriate for riveted construction.

6.) Other research and equations, generally from the mid 1800's through early 1900's, were investigated and documented but not evaluated because it is clear that the equations predate any current knowledge or definition of safety factors. Note that in the USA there was no known accepted standard equation for external pressures on cylindrical surfaces. In fact, one extensive study in 1896 did not provide any equation for USA boilers.

This proposal derives an equation based on the Canadian and British Board of Trade regulations. With both forms of the equation, it is possible to derive a new equation that requires material tensile strength. The calculated MAWP results are generally more conservative than ASME equations, which may be acceptable when ASME design criteria may

not be met, and when thickness readings are based from sampling of deteriorated plate, not new construction with uncorroded, new, material.

S2.6.2 ULTRASONIC THICKNESS TESTING

Ultrasonic thickness (UT) testing shall be performed to determine boiler plate thickness. UT testing shall be performed by personnel acceptable to the Jurisdiction and the Inspector. The following requirements shall be met, to the extent possible. Performance and results shall be acceptable to the Inspector and, if required, the Jurisdiction.

a) Equipment, operator, and calibration standards used shall be documented.
b) On initial UT of stayed sections, the plate thickness readings should be taken on a grid not exceeding the maximum staybolt pitch. Additional readings may be taken close to each staybolt to determine if localized thinning has occurred. Particular attention should be given to the joint between the staybolt and the plate.
c) On initial UT of unstayed sections, the plate thickness readings should be taken on a grid not exceeding 12 inch (300mm) centers. Additional readings should be taken if conditions warrant.
d) UT test results shall be documented so location of test results can be checked at subsequent UT tests to determine if material loss has occurred.
e) Recurring UT testing shall be performed by randomly checking 10% of original UT checks. Areas of thinning identified during previous inspections shall be given particular attention. If material loss is determined, additional testing may be requested by the Inspector.
f) Particular attention should be placed upon areas that typically exhibit thinning. These areas include the ogee curve, the mudlegs, the fusible plug, around feedwater inlets, and around the firebox door ring.
g) The owner/operator shall maintain the initial and recurring grid mapped UT readings in conjunction with the calculations in permanent boiler records. Documentation shall be available to the Inspector for review and acceptance.
h) Unstayed plain circular cylindrical components under external pressure shall require readings performed on a grid not exceeding 9 inch centers. Additional readings should be taken if conditions warrant.

S2.10.3.1 Cylindrical Components Under External Pressure

The MAWP of unstayed plain circular cylindrical components not exceeding 42 inches in diameter and under external pressure shall be determined by the strength of the weakest course computed from the minimum thickness of the plate, the tensile strength of the plate, the type of longitudinal joint, outside diameter of the weakest course, and the length of the firetube, using the following formulas:

$$P_1 = \frac{C_1 \times t^2 \times TS}{\left(\frac{f}{12} + 1\right) \times d_o}$$

$$P_2 = \frac{t \times TS}{C_2 \times d_o}$$

$$P = min(P_1, P_2)$$

TABLE S2.10.3.1

CONSTANTS FOR CALCULATED MAWP FOR CYLINDRICAL COMPONENTS UNDER EXTERNAL PRESSURE

Constant Values		
C_1	Longitudinal Joint	
	1-row lap seam	1.85
	2-row lap seam	1.95
	1-row butt strap, single butt strap	2.1
	1-row butt strap, double butt strap	2.2
	2-row butt strap, single butt strap	2.2
	2-row butt strap, double butt strap	2.3
	Forge welded	2.3
C_2		5.0

Example 1: Vertical boiler with an unstayed steel firebox with an outside diameter of 34 inches, height of 24 inches, and a thickness of 0.4 inches calculates as follows, 1-row lap seam is calculated as follows:

$$P_1 = \frac{1.85 \times 0.4^2 \times 55000}{\left(\frac{24}{12} + 1\right) \times 34} = 160\ PSI$$

$$P_2 = \frac{0.4 \times 55000}{5.0 \times 34} = 129\ PSI$$

$$P = min(160, 129) = 129\text{psi}$$

S2.10.6 NOMENCLATURE

p = maximum pitch measured (inches or mm) between straight lines, (horizontal, vertical, or inclined) passing through the centers of staybolts in different rows.

l = the pitch of stays in one row, passing through the center of staybolts, these lines may be horizontal, vertical, or inclined and measured in inches or mm.

w = the distance between two rows of staybolts, inches or mm.

h = the hypotenuse of a square or rectangle, defined as either $\sqrt{2p^2}$ or, $\sqrt{l^2 + w^2}$ inches or mm.

d = minimum diameter of corroded staybolt, inches or mm

R = inside radius of the weakest course of shell or drum, in inches or mm.

TS= ultimate tensile strength of shell plates, psi (MPa)

t = minimum thickness of shell plate in the weakest course, inches or mm.

P = calculated MAWP psi (MPa).

S = maximum allowable stress value, psi (MPa).

d_0 = outside diameter of firetube; if tapered use the largest outside diameter.

f = length of firetube, inches, measured between circumferential joints.

C = 2.1 for welded stays or stays screwed through plates not over 7/16 in. (11 mm) in thickness with ends riveted over.

C = 2.2 for welded stays or stays screwed through plates over 7/16 in. (11 mm) in thickness with ends riveted over.

C = 2.5 for stays screwed through plates and fitted with single nuts outside of plate, or with inside and outside nuts, omitting washers.

C = 2.8 for stays with heads not less than 1.3 times the diameter of the stays screwed through plates, or made a taper fit and having the heads formed on the stays before installing them and not riveted over, said heads being made to have true bearing on the plate.

C = 3.2 for stays fitted with inside and outside nuts and outside washers where the diameter of washers is not less than 0.4p and thickness not less than t.

Note: The ends of stays fitted with nuts shall not be exposed to the direct radiant heat of the fire.

C_1 & C_2 = constants, see Table S2.10.3.1

E = the efficiency of the longitudinal riveted joint.

See Table S2.10.6 for efficiencies (E), which are the average for the different types of riveted joints.

S2.7.3.2 SUBSEQUENT INSPECTIONS

a) Boilers that have completed the initial inspection requirements begin the subsequent inspection intervals. The following inspection intervals should be used unless other requirements are mandated by the Jurisdiction.

1) Interval #1 — One year following initial inspection. Inservice inspection per NBIC Part 2, S2.7.1.
2) Interval #2 — Two years following initial inspection. Visual inspection per NBIC Part 2, S2.5.2.2.
3) Interval #3 — Three years following initial inspection. A pressure test per NBIC Part 2, S2.6.1.
~~4) Interval #4 — Same as interval #1.~~
~~5) Interval #5 — Visual inspection per NBIC Part 2, S2.5.2.2 and UT thickness testing per NBIC Part 2 S2.6.2.~~
~~6) Interval #6 — Same as interval #3.~~

b) After interval #3~~6~~ is completed, the subsequent inspection cycle continues with interval #1.

c) UT thickness testing per NBIC Part 2 S2.6.2 shall be performed at 5 year intervals, or at a shorter interval if deemed necessary by the Jurisdiction.

1) Recurring UT thickness testing may be extended by up to 1 cycle (5 years) where the owner can demonstrate the following:

a. Two prior consecutive NDE reports following this cycle, spanning a minimum of 5 years, showing that current practice permits a longer NDE cycle;

b. Storage and care of the boiler in adherence with the applicable sections of S2.13.1 STORAGE METHODS; and

c. Continued records (ie; visual images and log book records showing correct water treatment) shall be reviewed annually during the extension period indicating no change to boiler condition.

Item 20-9: Request for Revision to NBIC Section 9: Glossary of terms

Parts 1, 2, 3 and 4 9.1

Purpose	Define "Verify" and “Witness” in the NBIC Part 1, 2, 3, and 4 to align with the definition in NB-263, RCI-1, Rules for Commissioned Inspectors
Scope	Add “Verify” and “Witness” to the terms defined in Section 9 of Parts 1, 2, 3 and 4
Background	The need for the definition of "verify" and “witness” was initiated from Interpretation Item 18-03, which addresses which Inspector (i.e. “IS” Commissioned or “R” Endorsement) signs the FFSA Form NB-403 when an “R” Certificate Holder is involved with a repair in that region as well as determine what level of review of the Fitness-for-Service the Inspector is expected to complete.
Proposed Revision	Verify – To determine that a particular action has been performed in accordance with the requirements either by witnessing the action or reviewing records. Witness – To be present at an event and have first-hand knowledge of the action and be able to attest that it occurred.

Submitted by: Terry Hellman

SG INSPECTION APPROVED THE BELOW:

Proposed Change:

9.1 DEFINTIONS

Verify – To determine that a particular action has been performed in accordance with the requirements either by witnessing the action or reviewing records.

Witness – To be physically present, or remotely present as allowed, to confirm an event or condition is true and accurate.