NBIC EXECUTIVE COMMITTEE
TUESDAY, JULY 17, 2012
COLUMBUS, OHIO

MINUTES

1. Call to Order

The meeting was called to order by Mr. Gary Scribner-Chairman at 3:55 P.M.

2. Announcements

The Secretary made the announcements concerning the NBIC meetings and the Wednesday evening outing and a sympathy card was present to the Committee to add condolences for Mr. Mike Schwartzwalder's loss of his daughter Kaley.

3. Adoption of Agenda

There was a motion to adopt the agenda. The Agenda was adopted with a change to 5.1. , Mr. Ball will be providing an update on proposed new Part 4.

4. Approval of the Minutes of July 18, 2011 meeting.

There was a motion to approve the minutes of the last meeting. The motion was unanimously approved.

5. Discussion of NBIC

5.1 Proposed Part 4, Pressure Relief Devices (Attachment 2, pp. 1-8)

Mr. Ball gave a progress report and Mr. Parks presented the results of the letter ballot.
After a lengthy discussion, the Committee voted to table the proposed Part 4 with a voted of 9-Yes and 1- Abstaining (Alton Cox).

5.3 Removal of Accreditation Requirements from NBIC Part 3, Section 1. SC Repairs and Alterations, Action Item NB12-0306.

The Committee voted unanimously to send a letter ballot to the Main Committee, SC PRD and SC Repairs and Alterations on this Action Item.

5.4 Revision to "NR" Accreditation Program.

Mr. Terry Parks gave a report on the progress of the "NR" Rewrite Task Group that met on Monday, July 16, 2012.

6. Strategic Initiatives

Mr. Richard Allison gave a progress report to the Committee.

7. New Business Items

7.1 Global version of the NBIC (Attachment 3)

Mr. Terry Parks gave a report on survey results- see Attachment 3

The Committee voted unanimously to continue to pursue a Global version of the NBIC.

7.2 Design by Analysis-Finite Element Analysis (FEA)

Mr. Mike Richards gave a report on FEA and presented the Committee with an Inspector Checklist for FEA Review Rev 0 from the FEA Task Group. See Attachment 4.

7.3 Remove supplements individually for a fee, when requested.

Mr. Terry Parks presented the survey results. This item was closed in the previous meeting and this was the last action by the Committee for

complete closure of this item with no action.

7.4 Discuss performing SWOT analysis to promote/improve NBIC (strengths, weakness, opportunities, threats)

Mr. Richard Allison reported to the Committee and the Committee agreed to the concept of SWOT analysis and its benefits.

The Committee expressed the desire to meet between the NBIC meetings in Columbus, Ohio at the National Board. The National Board will send an E-mail to Committee members soliciting proposed dates and times.

7.5 Other New Business Items.

There were no New Business Items.

8. Next Meeting

8.1 Mobile, Alabama (January 13-17) at the Renaissance Mobile Riverview Plaza

8.2 January 2014 meetings

San Antonio, TX (Selected by Main Committee during January 2012 meeting)

8.3 Continue July meetings to be held in Columbus, Ohio.

9. Adjournment

The meeting was adjourned at 6:10 P.M.

Attendance List NBIC Executive Committee

Meeting Date: July 16, 2012

Gary Scribner Missouri Division of Fire Safety P.O. Box 844 Jefferson City, MO 65102 Ph: 573-751-8708 Cell:573-230-3160 Fax: 573-526-5971 E-mail: gary.scribner@dfs.mo.gov	Attended: Yes ☑ No ☐ *Initial*	**David Douin** Executive Director The National Board of B&PVI 1055 Crupper Ave. Columbus, OH 43229 Ph; 614-888-8320 Fax: 614-847-1828 E-mail: ddouin@nationalboard.org	Attended: Yes ☑ No ☐ *Initial*
Charles Withers Asst. Executive Director The National Board of B&PVI 1055 Crupper Ave. Columbus, OH 43229 Ph; 614-888-8320 Fax: 614-847-1828 E-mail: ~~ddouin@nationalboard.org~~ cwithers@	Attended: Yes ☐ No ☒ *Initial*	**Don Cook** Principal Safety Engineer Dept. of Industrial Relations Div. of Industrial Safety & Health 1515 Clay Street, Suite 1302 Oakland, CA 94612-1302 Ph: 510-622-3050 Fax: 510-622-3063 E-mail: dcook@dir.ca.gov	Attended: Yes ☑ No ☐ *Initial*
H. Michael Richards Southern Company 42 Inverness Center Pkwy. Birmingham, AL 35242 Ph: 205-992-7111 Fax: 205-992-0361 E-mail: hmrichar@southernco.com	Attended: Yes ☒ No ☐ *Initial*	**George W. Galanes, PE** Manager, Metallurgy and QA Edison Mission Group/Midwest Generation 235 Remington Blvd. Boilingbrook, IL 60440 Ph: 630-771-7927 Fax: 312-788-5218 E-mail: ggalanes@MWGen.com	Attended: Yes ☒ No ☐ *Initial*
Frank Hart Alton Cox alt Director Valve Services, COE Furmanite Worldwide 6330 Dixie Drive Houston, TX 77087 Ph: 713-844-7623 Fax: 713-844-9245 E-mail: fhart@Furmanite.com	Attended: Yes ☐ No ☒ JRM *Initial*	**Brian Morelock** Eastman Chemical Company P.O. Box 511 B54D Kingsport, TN 37660 Ph: 423-229-1205 Fax: 423-229-6099 Email: morelock@eastman.com	Attended: Yes ☒ No ☐ BRM *Initial*
Robert V. Wielgoszinski Hartford Steam Boiler I & I of CT. One State Street Hartford, CT 06103 Ph: 860-722-5064 Fax: 860-722-5705 E-mail: Robert_Wielgoszinski@hsbct.com	Attended: Yes ☑ No ☐ RWW *Initial*	**Terry Parks** The National Board 1055 Crupper Avenue Columbus, OH 43229-1183 Ph: 614-888-8320 Fax: 614-847-1828 E-mail: tparks@nationalboard.org	Attended: Yes ☑ No ☐ TMP *Initial*

Attendance List NBIC Executive Committee

Meeting Date: July 16, 2012

Dick Allison	Attended: Yes ☒ No ☐ RBA *Initial*	Robin Haught	Attended: Yes ☑ No ☐ *Initial*
J. Alton Cox Vice-Chairman SC-PRD for Frank Hart	Attended: Yes ☒ No ☐ *Initial*	James McGimpsey - NB Staff Secretary	Attended: Yes ☒ No ☐ *Initial*
Joseph Ball	Attended: Yes ☒ No ☐ JB *Initial*		Attended: Yes ☐ No ☐ *Initial*
	Attended: Yes ☐ No ☐ *Initial*		Attended: Yes ☐ No ☐ *Initial*

Ballot Comments NB11-0401 INST

Ballot Comments

Name	Document	Comment	Date Created	Is Active
Raymond Snyder		I agree with Venus Newton and others ,I do not agree in this separating these references from Parts1,2or3.	05/25/2012	☑ True
Raymond Snyder		I agree with Venus Newton and others ,I do not agree in this separating these references from Parts1,2or3.	05/25/2012	☑ True
Raymond Snyder		I agree with Venus Newton and others ,I do not agree in this separating these references from Parts1,2or3.	05/25/2012	☑ True
Donald Patten		I think that in removing the PRD information from Part 1 will leave a void. I would assume that a reference for installation of PRD's in Part 1 directing you to Part 4 would be appropriate.	05/23/2012	☑ True
Gary Scribner		I also feel that the basic installation requirements for PRD's should be at least duplicated in section one so that an installer understands the basic requirements for the vessel being installed.	05/23/2012	☑ True
Joseph Ball		Any requirements concerning discharge piping from pressure relief devices were intended to be moved to part 4 so inlet piping, device requirements themselves, and discharge piping are all together in one location.	05/23/2012	☑ True
Geoffrey Halley		While I am in general agreement with a separate PRV section, I wonder if it is wise to separate the vent pipework from the installation section.	05/21/2012	☑ True
Stanley Konopacki		No comments at this time	05/10/2012	☑ True
Michael Richards		No comments.	05/02/2012	☑ True
Joseph Ball		Not a member. Voting to activate ability to respond to comments	05/01/2012	☐ False
Joseph Ball		Dear Mr. Tyndall, I appreciate (and anticipated) some comments like this. Development of a stand alone PRD document was authorized by the executive committee because it represents manufacturing and repair industries that are usually separate from boiler/pressure vessel manufacturing and repair, although other NBIC users (such as Users and Inspectors) probably look at the use of a PRD along with	05/01/2012	☑ True

	the rest of the unit being protected. A final resolution of your comment will ultimately come from the NBIC committee after consideration of the comments received during this balloting. Thank you for your comment and concerns. J. Ball		
Harold Tyndall	I like the ability to go to one part of the NB Code to see what I need. If I am looking at Section I Power Boilers, I want to find all I need to know in once section. If we break out PRDs, what will be next	04/26/2012	☑ True

Ballot Comments NB11-0401 INSP

Name	Document	Comment	Date Created	Is Active
Bob Reetz		I agree with Venus Newton and others. I do not believe that separating all references to PRD's from Parts I and 2 and 3 and creating a new Part 4 will enhance anything. I recommend leaving the references just where they are at present. As an inspector, it just complicates matters to have to jump back and forth between NBIC sections to understand an issue. For these reasons, this action to remove PRD references from each Part of the NBIC does not have my approval.	05/23/2012	☑ True
Jim Riley		Speaking for owner-users we support PRD related items moving to a new Part 4. Our owner-user agencies keep all current NBIC parts in electronic form with all other industry and regulatory codes. Easy access search using PDF format. Inspectors are fluent with electronic access and rely on it for most recent information. Good summary by Joe Ball.	05/23/2012	☑ True
Mark Horbaczewski		However, I agreed with Dave Parish more work has to be done so we are consistent with the other sections. I believe that a new item for business may have to be opened and get committee members to go over these changes thoroughly.	05/23/2012	☑ True
Venus Newton		I don't agree with the whole idea of removing the PRD's	05/23/2012	☑ True

		from Part 2, because now in order to perform a complete inspection of a pressure retaining item a field inspector has yet one more Code book to go to. It's just adding to the confusion of performing an inservice inspection.		
Joseph Ball	56c03783-d093-4c71-858e-b17acdbf5a7c.docx	See attached document	05/23/2012	☑ True
Joseph Ball		Thanks to David Parrish for the detailed review. Material in Supplements was kept in those documents considering the users want the information for these particular types of equipment in one place, and those supplements were written in that fashion. See the attachment for more detailed responses.	05/23/2012	☑ True
Joseph Ball		Please see response to Mr. Parrish. Thank you.	05/23/2012	☐ False
Timothy Barker		I agree with Mr. Parrish's comments. I like the idea but there are many areas that were missed with the changeover and a lot of areas referencing Safety Valves where it should be PRD's.	05/04/2012	☑ True
Dave Parrish	NBIC PART 2 with Part 4 removed dkpComments.docx	There is general agreement within FM Global with the objective to consolidate OPD guidance into a specific part. There is, however, concern about redundancy in each PART and across all four PARTS. Currently, there are some inconsistencies resulting from duplications of text. The proposed PART 4 does reduce some of	05/04/2012	☑ True

	the redundancy and inconsistency, but further effort is needed. Attached is a quick review of proposed PART 2 INSPECTION to demonstrate how improvement can be accomplished.		
John Richardson	The changes appear to be in order.	04/27/2012	☑ True

Ballot Comments NB11-0401 R&A

Name	Document	Comment	Date Created	Is Active
William Vallance		I have no comments	05/23/2012	☑ True
Wayne Jones		No comment	05/23/2012	☑ True
Michael Webb		No adverse comments. My apologies for my delayed response.	05/22/2012	☑ True
Joseph Ball		Voting to access public comments - not a member.	05/01/2012	☐ False
Joseph Ball		5.13.6 and 5.13.6.1 are a combination of VR and NR requirements, although the forms come from the NR program only (there is no VR data report form). I think this was actually missed during the Part 4 draft, but it appears that they might be better staying in Part 3 to stay tied to the rest of the NR program. We are certainly open to suggestions over this question.	05/01/2012	☑ True
George Galanes, PE		I do have a comment. There are some items that were not extracted on this first draft; 5.13.6, 5.13.6.1	05/01/2012	☑ True
Jim Sekely		No Comment Joe No way to submit comments without choosing a voting option - please disregard	04/29/2012	☑ True

COMMITTEE CORRESPONDENCE

COMMITTEE: PRD

TO: PRD

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

FROM: Robin Hough
NBIC Secretary

SUBJECT: Letter Ballot NB11-0401 PRD

DATE: May 24, 2012

Gentlemen:

Letter Ballot NB11-0401 PRD has now closed. The ballot passed. The voting results are:

6	Approved
0	Disapproved
0	Abstain
0	Not Voting
5	Not Returned

This document will now be discussed at NBIC Committee meetings in July.

Thanks,

Robin Hough
NBIC Committee Secretary

Ballot Votes NB11-0401

Name	Email	Votes	Vote Date
Alton Cox	alton@jaltoncox.com	Approve	05/23/12
Frank Hart	fhart@furmanite.com	Approve	05/22/12
Marianne Brodeur	marianne@ivicorp.net	Approve	05/15/12
R. W. Donalson	bdonalson@tycovalves.com	Approve	05/23/12
Raymond McCaffrey	raymond@qualityvalves.com	Approve	05/21/12
Sid Cammeresi	sidneycammeresi@hotmail.com	Approve	05/23/12
Benjamin Anthony	banthony@dlt.state.ri.us	Not Voted	N/A
Denis DeMichael	Denis.B.DeMichael@usa.dupont.com	Not Voted	N/A
Kevin Simmons	ksimmons@tycovalves.com	Not Voted	N/A
Robert Dobbins	robert.dobbins@zurichna.com	Not Voted	N/A
Thakor Patel	tpatel@curtisswright.com	Not Voted	N/A

Ballot Comments

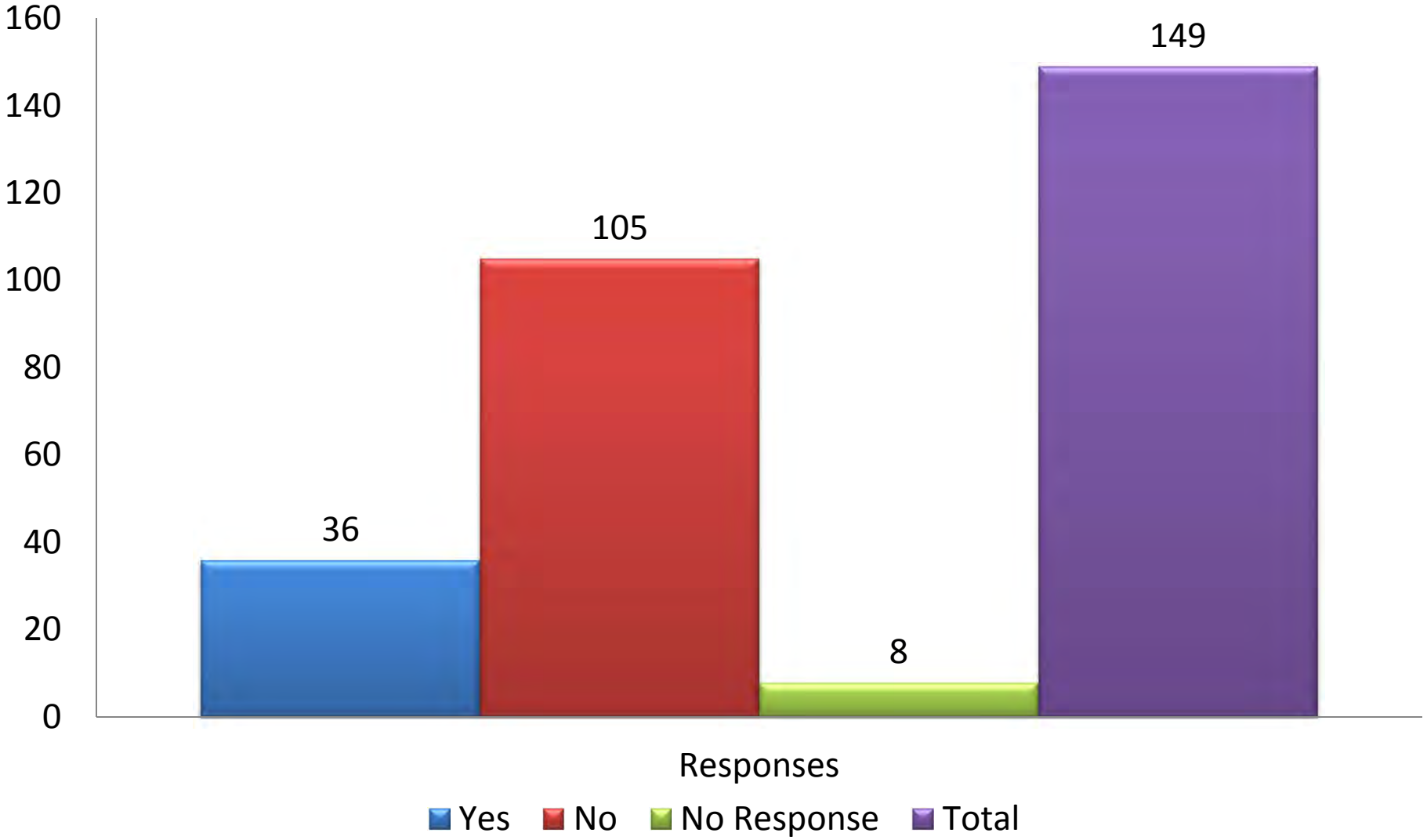
Name	Document	Comment	Date Created
Alton Cox	NBIC Part 4 draft 4-12-1 comments.doc	with comments.	05/23/2012
R. W. Donalson		I approve but would like a chance to review again once the open editorial items have all been addressed.	05/23/2012
Frank Hart		will provide written documents for discussion at meeting.	05/22/2012

ATTACHMENT 3

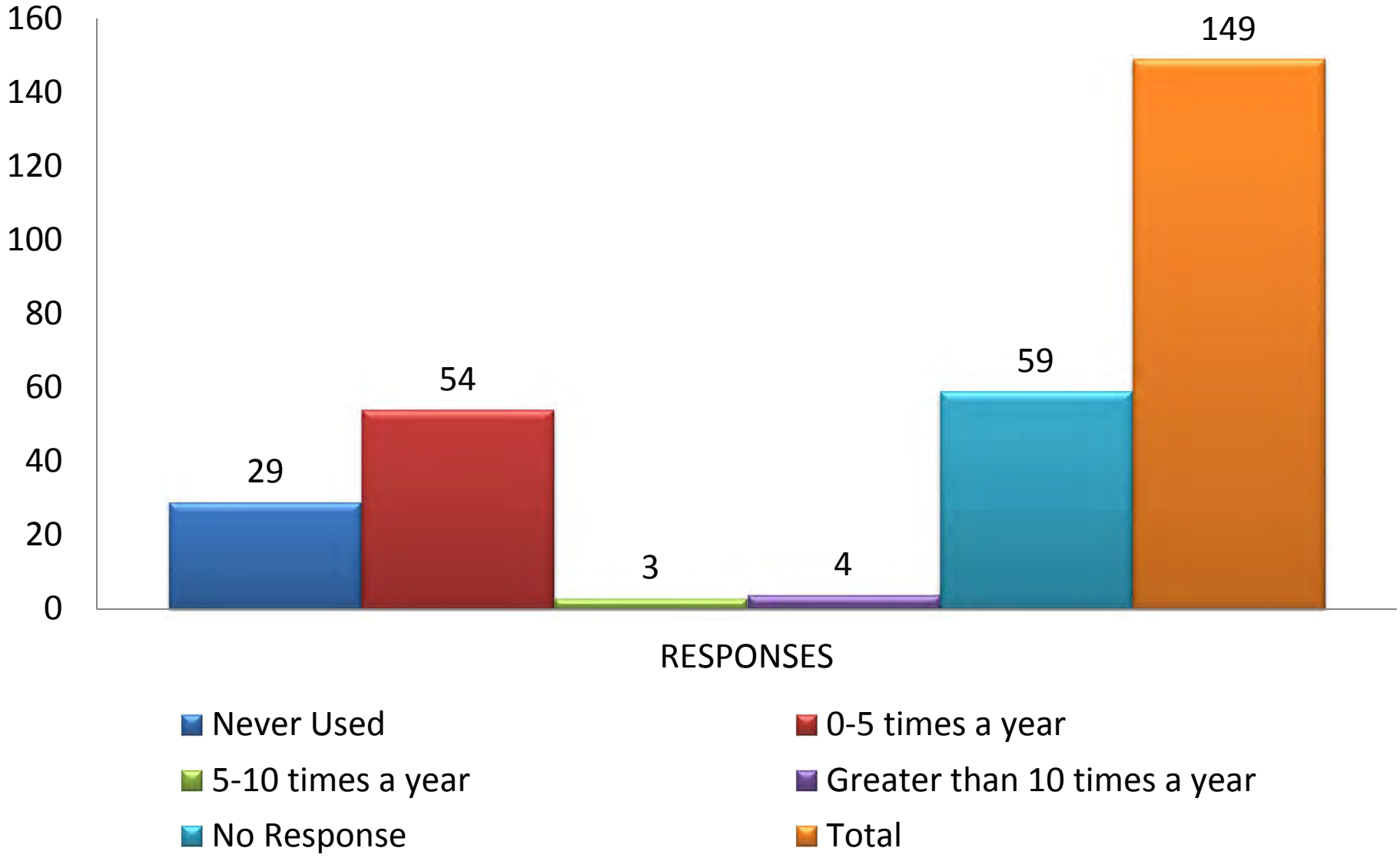
Global NBIC Survey

A survey was conducted of all of the “R” certificate holders outside of the US and Canada to determine the need for a global NBIC that does not reference any code or standard. The survey also included questions on how the NBIC was being used for repairs and alterations to both ASME and Non-ASME PRIs. The results of the survey are herein.

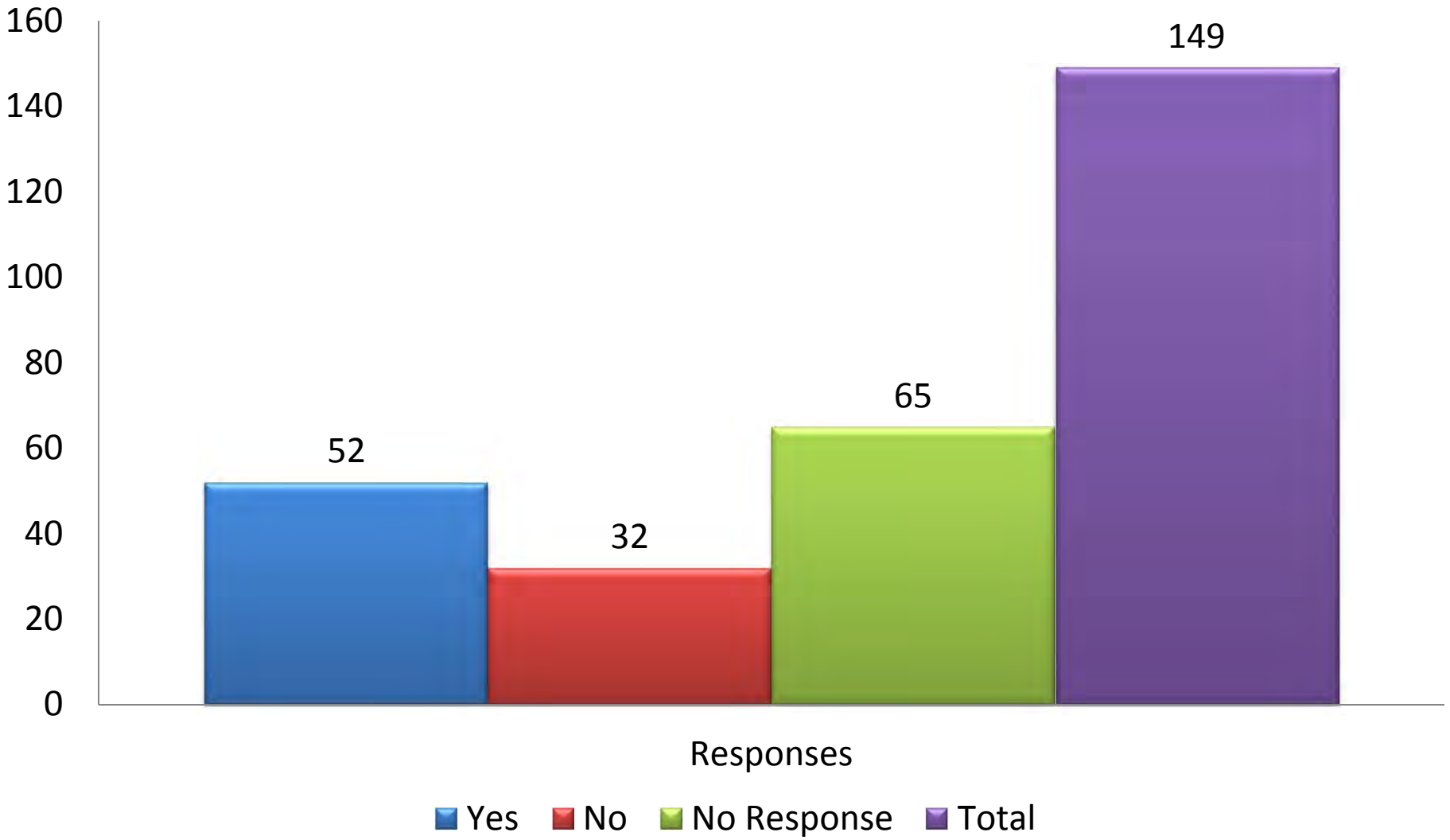
Have you used the National Board Inspection Code (NBIC), Part 3 to perform repairs and alterations to pressure-retaining items not constructed to ASME requirements?



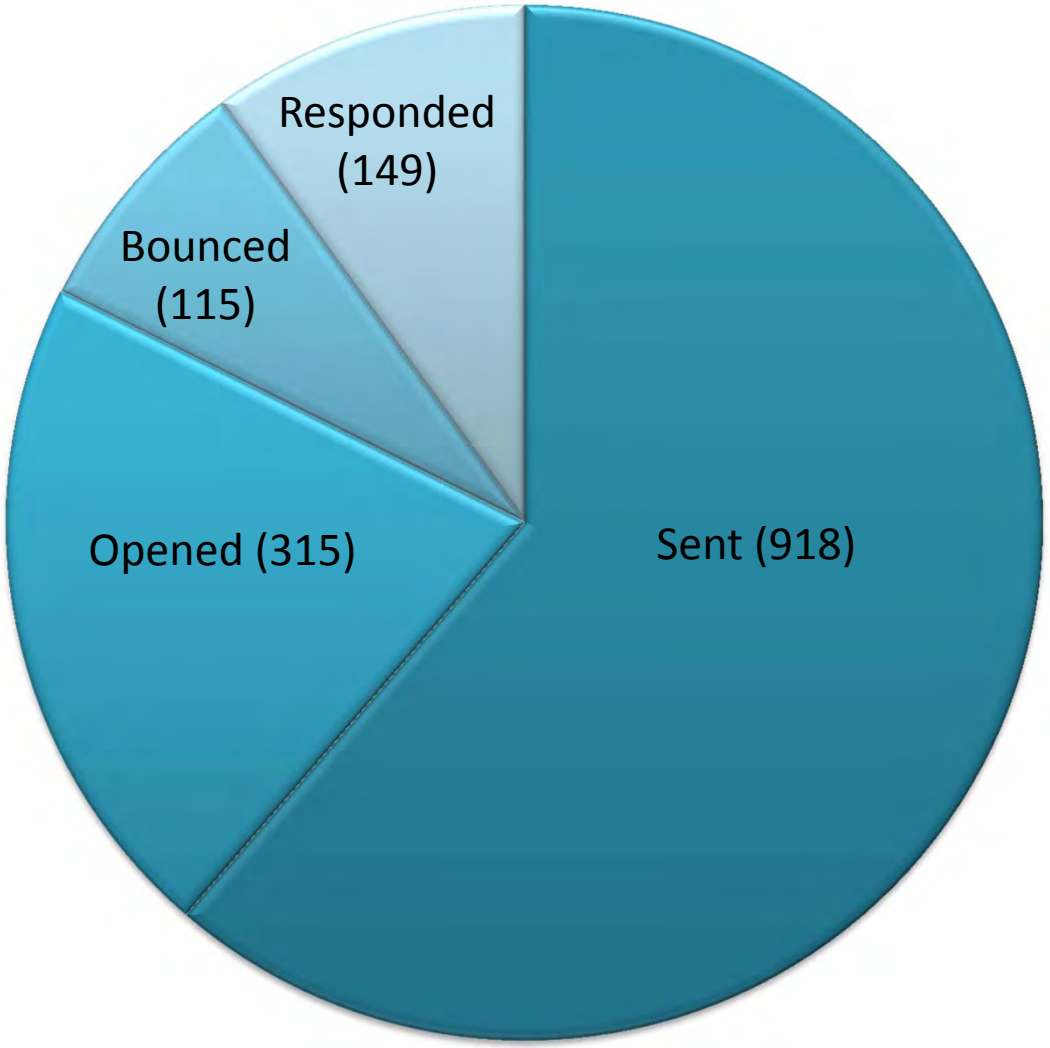
How often does you organization perform repairs or alterations using your "R" Certificate of Authorization?



Would a global standard (without any reference to specific codes or standards) based on the NBIC Part 3, be useful when performing repairs and alterations to pressure equipment?



Global NBIC Survey



Eastman Check List

Supplement X

Inspector Review Requirements for Finite Element Analysis (FEA)

SX-1 Scope:

This Supplement provides requirements and guidelines to be followed when a finite element analysis (FEA) is submitted as part of a repair or alteration package for a pressure retaining item for review by the Authorized Inspector, and the local jurisdiction as required.

SX-2 Pressure Retaining Item Information

- Vessel size,
- Material of construction,
- Vessel type,
- Original Code of Construction
- Repair and Alteration History
- Known degradation, (if available/any),
- Operating conditions (temp., pressure, cyclical, etc,) and
- Other loads (seismic, earthquake, etc.)

SX-3 Finite Element Analysis Report Requirements

- All materials, if necessary a figure showing all regions of different material properties
- All dimensions (or reference to drawings)
- All restraints (mechanical or thermal)
- All loads (mechanical or thermal)
- Geometries to be modeled – for example, corroded, non-corroded, or both is to be run
- Load cases to be run for each geometry (corroded or not corroded)
- Material properties – explicitly defined or by reference. Consider every property.
- Results required for each geometry and load case. Specify whether a plot is sufficient or if only maximum values are needed or if tabular results (of stress classification lines) are necessary.
- Specify that stress contour plots are to be plotted with consistent, meaningful contour bands.

SX-4 Review Process

Review Steps:

Prior to submission of the final FEA report to the Authorized Inspector for review, reviews prior to the final report are recommended. These reviews should include with Owner/User, "R" stamp holder (repair organization), Authorized Inspector, and the jurisdiction as required.

SX-4.1 First Review - Problem setup

- Mesh
- Include any contacts (thermal or mechanical)
- Material properties – include any calculations for properties that are modified for the model. For example, the model density is often modeled
- Stress classification line locations

SX-4.2 Second Review - Preliminary Results

- Deformed plot for every load case
- Stress and temperature for every load case
- Stress classification line results (include average temperature at the stress classification line).

SX-4.3 Third Review - Final Report

SX-5 Final Report Requirements:

The final report should contain a reference to the analysis specification, or contain all of the information that is listed in the Specification section.

The final report should contain all of the information listed in the review packages.

SX-5.1 Summary:

- Name the customer and analysis vendor.
- Reason why the model was created.
- Brief description of the model
  - Geometry
  - Loads
  - Source of material data
  - Type of analysis (heat transfer, stress, or both).
- Brief description of results generated.
- Brief description of results assessment criteria (example, reference ASME Div 2).
- Brief conclusion – for example "This analysis concludes that considering the rules of the Code, for given boundary conditions and loads, the design of the internal cone and cone-to-shell junction is acceptable.

SX-5.2 Analysis method

- State that FEA was used, give the program and version.

- Note whether or not the problem is linear.
- Give an overview of how the analysis is conducted, for example:
  - Calculations are done to simplify radiation boundary conditions so that the problem is linear.
  - thermal loads are applied to fea model and temperatures generated
  - temperatures at select locations are compared to the radiation simplification calculations.
  - mechanical loads are added
  - stress generated
  - stress classification results generated
  - results verified by comparison to something
  - results compared to the code.
- Note if any of the geometry is not included in the stress model

SX-5.3 Structural Description / Mesh / Stress Classification Line Locations

- Reference the geometry source or show a drawing or sketch with dimensions.
- Name all the parts, usually best done with a sketch.
- Note any symmetry
- Give the type of element used for each component.
- Show plots of the mesh.
- Show top and bottom of shells or beam orientations.
- Show cross sections with stress recovery points for beams.
- Describe parts that are connected by node sharing or contact and tell whether the connections are thermal, mechanical, or both.
- Give the stress classification line locations (usually best done with a sketch)

SX-5.4 Material Properties

- List properties used for every component, references to other sources are not sufficient. They must be explicitly listed. Show the values of any properties modified for the sake of the model. For example, the model density is often modeled.
- Show calculations for properties that are modified for the sake of the model.
- Discuss any given artificial properties for the analysis (for example the modulus was set to 1000 psi so that the component would not influence the mechanical model). Or, above 1200F the properties are assumed to be constant.
- Reference the source for all material properties.

SX-5.5 Restraints and loads

- Show all restraints and loads.

- Discuss the justification for all restraints and loads, and give calculations if they were done to determine the restraints or loads (for example, end pressure).
- Discuss any contact regions.
- Give initial or default temperatures.

SX-5.6 Validation

- Tell how the model was validated.

SX-5.7 Results

For each model the following shall be presented

- Give temperature plots.
- Give deformed geometry plots
- Give stress classification line results and comparison to Code allowable.
- Relate the results of the model to the defined allowable stresses of the original Code of construction.
- Refer to ASME Section VIII, Division 2, Part 2, Section 2.3.3.1(c)(2) Documentation requirements of design-by-analysis calculations in Part 5.

SX-5.8 Reference Documents Used:

Typical reference documents could include:

- ASME BPVC II-D
- ASME BPVC Section VIII Division 1
- ASME BPVC Section VIII Division 2
- NBIC
- API-579
- Drawings
- UDS
- ASCE 7-05
- Heat transfer, materials, etc. books.

ABSA the pressure equipment safety authority

Finite Element Analysis (FEA) Requirements Regarding the Use of FEA to Support a Pressure Equipment Design Submission

AB-520

Issued 2009-11-23
Revision 0

This AB-520 document, *Finite Element Analysis (FEA) Requirements Regarding the Use of FEA to Support a Pressure Equipment Design Submission,* has been issued by the Administrator and Chief Inspector for pressure equipment safety in Alberta in accordance with the *Pressure Equipment Safety Regulation* to establish the minimum FEA documentation requirements that must be met.

Dr K T Lau, PhD., P. Eng.
Chief Inspector and Administrator

FEA Submission Requirements

Finite Element Analysis (FEA) may be used to support pressure equipment design where the configuration is not covered by the available rules in the ASME code. We recommend that the designer check with ABSA whether the usage of FEA is acceptable. This must be clarified before the design is submitted. When using this method for justifying Code compliance of the design, a complete FEA report having the elements listed below is required.

Special Design Requirement

As this analysis method requires extensive knowledge of, and experience with, pressure equipment design and the FEA software package involved, we require that the analysis and report **be completed, certified and signed off** by a Professional Engineer registered in any province or territory of Canada or any state of the United States of America. In all cases, the Professional Engineer shall certify that he or she is experienced in pressure equipment design and the application of FEA. The ABSA Design Surveyor may require that the Professional Engineer present a summary of his or her academic credentials and relevant experience in pressure equipment design and FEA usage, *i. e.* references to the projects or equipment designed using FEA and the names of the end users.

Executive Summary

The report shall contain an executive summary, briefly describing how the FEA was used to support the design, the FEA model used, the results of the FEA, and conclusions relating to the FEA results supporting the design submitted for registration.

As part of the design registration submission, the FEA documentation is subject to review and acceptance by ABSA.

Introduction

The introduction shall describe the scope of the FEA analysis relating to the design, the justification for using FEA to support the design calculations, the FEA software used for the analysis, the type of FEA analysis (i.e. static, dynamic, elastic, plastic, small deformations, large deformations, etc.), and a complete description of the material properties used in the analysis.

Model Description

This report section is required to completely describe the FEA model used for the analysis. The description will include dimensional information and/or drawings relating the model geometry to the actual pressure equipment geometry. Simplification of geometry must be explained and justified as appropriate. The mesh and type (h, p, 2D, 3D), shape, and order (2^{nd} order or above) of the elements used must be described. If different types of elements are used, a description of how the different elements were connected together is required. When using shell elements, describe the top or bottom orientation with plots of the elements and indicate if they are thick or thin elements.

The turn angle of each element used on inside fillet radii must be indicated.

Indicate how the size of mesh elements was chosen with reference to global or local (bias) mesh refinement.

When modeling items like flanges, describe in what manner the two separate flange faces are linked (e.g. contact elements)

Boundary conditions such as supports, restraints, loads, and forces shall be clearly described and shown (present the figures). The method of restraining the model to prevent rigid body motion must be indicated and justified. When partial models are used (typically based on symmetry), the rationale for the partial model shall be described with an explanation of the boundary conditions used to compensate for the missing model sections.

The accuracy of the model digitization shall be indicated, either by the described use of convergence studies or by comparison to the accuracy of previous successful in-house models. This section of the Report must include a proposed method to verify that the model results reflect the real response of the physical pressure equipment.

Presentation of Results

The following figures must be presented (coloured prints):

1) Displacements (plot);
2) Deformed shape with un-deformed shape superimposed;
3) Stress plot with mesh, that will :
   a. show discrete fringes → discrete colour separation for stress ranges or plots
   b. allow comparison between the size of stress concentrations and the size of the mesh
4) Plot with element stress and compare nodal (average) stress vs. element (non-averaged) stress (If the small difference is less than 5%, the accuracy should be OK);
5) Reaction forces compared to applied loads;

When plots or figures have been presented, there must be discussion relating to each and every figure to explain what the purpose of the figure is and why it is of importance.

Analysis of Results

Overall model results and areas of interest. Identify any results which are to be disregarded and justify their exclusion.

Conclusion

Relate the results of the FEA to the defined allowable stresses of the Code of construction using the appropriate ASME methodology.

(b) Type of weld joints and the extent of required nondestructive examinations
(c) Non-mandatory or optional provisions of this Division that are considered to be mandatory for the subject vessel
(d) Any special requirements for marking and their location (see paragraph 4.1 and Annex 2-F)
(e) Requirements for seals and/or bolting for closures and covers
(f) Additional requirements relating to erection loadings
(g) Any agreements which resolve the problems of operation and maintenance control unique to the particular pressure vessel.
(h) Specific additional requirements relating to pressure testing such as:
(1) Fluid properties and test temperature limits
(2) Position of vessel and support/foundation adequacy if field hydrostatic testing is required
(3) Location: Manufacturer's facility or on-site
(4) Cleaning and drying
(5) Selection of pressure test method, see paragraph 8.1.1
(6) Application of paints, coatings and linings, see paragraph 8.1.2(e)

2.2.2.3 The User's Design Specification shall be certified in accordance with Annex 2-A.

2.3 MANUFACTURER'S RESPONSIBILITIES

2.3.1 CODE COMPLIANCE

2.3.1.1 The Manufacturer is responsible for the structural and pressure retaining integrity of a vessel or part thereof, as established by conformance with the requirements of the rules of this Division and the requirements in the User's Design Specification.

(a) **2.3.1.2** The Manufacturer completing any vessel or part marked with the Certification Mark with the U2 Designator in accordance with this Division has the responsibility to comply with all the applicable requirements of this Division and, through proper certification, to ensure that any work by others also complies with the requirements of this Division. The Manufacturer shall certify compliance with these requirements by completing a Manufacturer's Data Report (see paragraph 2.3.4).

2.3.2 MATERIALS SELECTION

2.3.2.1 When generic material types (i.e. carbon steel or Type 304 Stainless Steel) are specified, the Manufacturer shall select the appropriate material from Part 3, considering information provided by the user per paragraph 2.2.2.1(g)(3).

2.3.2.2 Any material substitutions by the Manufacturer are subject to approval of the user.

2.3.3 MANUFACTURER'S DESIGN REPORT

2.3.3.1 The Manufacturer shall provide a Manufacturer's Design Report that includes:
(a) Final as-built drawings.
(b) The actual material specifications used for each component.
(c) Design calculations and analysis that establish that the design as shown on the drawings complies with the requirements of this Division for the design conditions that have been specified in the User's Design Specification.
(1) Documentation of design-by-rule calculations in Part 4 shall include the following:
(-a) The name and version of computer software, if applicable
(-b) Loading conditions and boundary conditions used to address the load cases in the User's Design Specification
(-c) Material models utilized for all required physical properties (i.e. stress-strain data, modulus of elasticity, Poisson's ratio, thermal expansion coefficient, thermal conductivity, thermal diffusivity), strength parameters (i.e. yield and tensile strength), and allowable stresses
(-d) Detailed calculations, including results from all of the applicable steps in the calculations, showing the acceptance criteria utilized to meet the requirements of this Division.
(-e) A summary of the calculation results
(2) Documentation of design-by-analysis calculations in Part 5 shall include the following:
(-a) A detailed description of the numerical method used, including the name and version of computer software, if applicable
(-b) Description of model geometry (including element type for finite element analysis)
(-c) Loading conditions and boundary conditions used to address the load cases in the User's Design Specification

(-d) Material models utilized for all required physical properties (i.e. modulus of elasticity, Poisson's ratio, thermal expansion coefficient, thermal conductivity, thermal diffusivity), strength parameters (i.e. yield and tensile strength), strain limits, if applicable, and the design membrane stress intensity per Part 3

(-e) Description of whether material nonlinearity is utilized in the analysis including a description of the material model (i.e. stress-strain curve and cyclic stress-strain curve)

(-f) Description of the numerical analysis procedure (i.e. static analysis, thermal analysis (temperature and stress), buckling analysis, natural frequency analysis, dynamic analysis) and whether a geometrically linear or nonlinear option is invoked

(-g) Graphical display of relevant results (i.e. numerical model, deformed plots, and contour plots of thermal and stress results)

(-h) Method used to validate the numerical model (i.e. mesh sensitivity review and equilibrium check for finite element analysis, e.g. check of hoop stress in a component away from structural discontinuity and a check to ensure that global equilibrium is achieved between applied loads and reactions at specified boundary conditions)

(-i) Description of results processing performed to establish numerical analysis results (i.e. stress linearization method, use of centroidal or nodal values for stress, strain, and temperature results)

(-j) A summary of the numerical analysis results showing the acceptance criteria utilized to meet the requirements of this Division

(-k) Electronic storage of analysis results including input files and output files that contain numerical analysis results utilized to demonstrate compliance with the requirements of this Division

(d) The results of any fatigue analyses according to paragraph 5.5, as applicable.

(e) Any assumptions used by the Manufacturer to perform the vessel design.

2.3.3.2 The Manufacturer's Design Report shall be certified in accordance with Annex 2-B.

2.3.4 MANUFACTURER'S DATA REPORT

The Manufacturer shall certify compliance to the requirements of this Division by the completion of the appropriate Manufacturer's Data Report as described in Annex 2-C and Annex 2-D.

2.3.5 MANUFACTURER'S CONSTRUCTION RECORDS

The Manufacturer shall prepare, collect and maintain construction records and documentation as fabrication progresses, to show compliance with the Manufacturer's Design Report (e.g., NDE reports, repairs, deviations from drawings, etc.). An index of the construction records files, in accordance with the Manufacturer's Quality Control system, shall be maintained current (see paragraph 2-C.3). These construction records shall be maintained by the Manufacturer for the duration as specified in paragraph 2-C.3.

2.3.6 QUALITY CONTROL SYSTEM

The Manufacturer shall have and maintain a Quality Control System in accordance with Annex 2-E.

2.3.7 CERTIFICATION OF SUBCONTRACTED SERVICES

2.3.7.1 The Quality Control system shall describe the manner in which the Manufacturer (Certificate Holder) controls and accepts the responsibility for the subcontracting of activities. The Manufacturer shall ensure that all contracted activities meet the requirements of this Division.

(a) **2.3.7.2** Work such as forming, nondestructive examination, heat treating, etc., may be performed by others (for welding, see paragraph 6.1.4.2). It is the vessel Manufacturer's responsibility to ensure that all work performed complies with all the applicable requirements of this Division. After ensuring compliance, and obtaining concurrence of the Inspector, the vessel may be stamped with the Certification Mark.

2.3.7.3 Subcontracts that involve welding on the pressure boundary components for construction under the rules of this Division, other than as provided in paragraph 6.1.4.2 and for repair welds permitted by the ASME material specifications, shall be made only to subcontractors holding a valid U2 Certificate of Authorization. All such subcontracted welding shall be documented on the Form A-2, see Annex 2-D.

2.3.7.4 A Manufacturer may engage individuals by contract for their services as Welders or Welding Operators, at shop or site locations shown on his Certification of Authorization, provided all of the following conditions are met:

(a) The work to be done by Welders or Welding Operators is within the scope of the Certificate of Authorization.

(b) The use of such Welders or Welding Operators is described in the Quality Control system of the Manufacturer. The Quality Control System shall include a requirement for direct supervision and direct technical control of the Welders and Welding operators, acceptable to the Manufacturer's accredited Authorized Inspection Agency.