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NBIC Subcommittee R&A Action Block

Subject 2007 Edition, Part 3, Paragraph 3.3.4
Repair of Pressure Retaining Items without Complete Removal of Defects

File Number NB05-0122 **Prop. on Pg.** 2-5

Proposed Revision Revise Part 3, paragraph 3.3.4 Repair Methods to address repairs when the defect is not completely removed.

Statement of Need There are instances when it is not practicable to completely remove a defect during repair of a PRI and yet still place the RPI back in service. The proposed rules address the necessary controls needed under these circumstances.

Project Manager G. Galanes B. Aben

SubGroup Negatives 0 **SG Meeting Date** 07/22/08

Background Information for MC Members

In Part 3 of the NBIC, under Section 3.3.4 Defect Repairs, the proposed concept is to add a new section under 3.3.4.8 devoted to repairs that would not result in the complete removal of a defect. I took the position that temporary or interim repairs would not be popular with the Jurisdictions. Instead, this proposal provides rules for Jurisdictions to follow, if they so choose, to deal with repairs of pressure retaining items where defects found may not require complete removal and, in some cases, weld repairs are performed to assure the pressure retaining item is safe to place in operation for repair at a later date or to monitor the item. These concepts are not new and are currently being performed in industry. It is my intention to recognize these options and develop rules for them in the NBIC.

This proposal was discussed during the August, 2008 SG and SC meetings after a letter ballot for the item passed Part 3 R&A SG-Specific and the SC (unanimously). A brief discussion of the item occurred during the Main Committee meeting held in August, 2008 and it was decided to withhold action until the Chiefs meeting in October, 2008.

I presented this item to the Chiefs meeting in Columbus, Ohio and it was well received by them with several constructive comments. What you have before you for your consideration is the final revision of this action item ready for main committee consideration.

Respectfully Submitted;
George Galanes, P.E.

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e) Replacement of heat exchanger tubesheets in accordance with the original design;

f) Replacement of boiler and heat exchanger tubes where welding is involved;

g) In a boiler, a change in the arrangement of tubes in furnace walls, economizer, or super heater sections;

h) Replacement of pressure-retaining parts identical to those existing on the pressure-retaining item and described on the original *Manufacturer's Data Report*. For example:

   1) Replacement of furnace floor tubes and/or sidewall tubes in a boiler

   2) Replacement of a shell or head in accordance with the original design

   3) Rewelding a circumferential or longitudinal seam in a shell or head

   4) Replacement of nozzles of a size where reinforcement is not a consideration

i) Installation of new nozzles or openings of such a size and connection type that reinforcement and strength calculations are not a consideration required by the original code of construction;

j) The addition of a nozzle where reinforcement is a consideration may be considered to be a repair provided the nozzle is identical to one in the original design, located in a similar part of the vessel, and not closer than three times its diameter from another nozzle. The addition of such a nozzle shall be restricted by any service requirements;

k) The installation of a flush patch to a pressure-retaining item;

l) The replacement of a shell course in a cylindrical pressure vessel;

m) Welding of gage holes;

n) Welding of wasted or distorted flange faces;

o) Replacement of slip-on flanges with weld neck flanges or vice-versa;

p) Seal welding of buttstraps and rivets;

q) Subject to the administrative procedures of the Jurisdiction and approval of the Inspector, the replacement of a riveted section or part by welding;

r) The repair or replacement of a pressure part with a code accepted material that has a nominal composition and strength that is equivalent to the original material, and is suitable for the intended service; and

s) Replacement of a pressure-retaining part with a material of different nominal composition, equal to or greater in allowable stress from that used in the original design, provided the replacement material satisfies the material and design requirements of the original code of construction under which the vessel was built.

3.3.4 REPAIR METHODS

3.3.4.1 SCOPE

Except as provided in 3.3.4.8

A repair of a defect in a welded joint or base material, shall not be made until the defect has been removed. A suitable Nondestructive Examination (NDE) method such as Magnetic Particle (MT) or Liquid Penetrant (PT) may be necessary to assure complete removal of the defect. If the defect penetrates the full thickness of the material, the repair shall be made with a full penetration weld such as a double buttweld or single buttweld with or without backing. Where circumstances indicate that the defect is likely to recur, consideration should be given to removing the defective area and installing a flush patch or taking other, corrective measures acceptable to the Inspector and when required by the Jurisdiction.

3.3.4.2 DEFECT REPAIRS

Before a repair is made to a defect in a welded joint or base metal, care should be taken to investigate its cause and to determine its extent and likelihood of recurrence.

a) Cracks
A repair of a crack in a welded joint or base material shall not be made until the defect has been removed. A suitable nondestructive examination method such as a MT or PT may be necessary to assure complete removal of the defect. If the defect penetrates the full thickness of the material, the repair shall be made with a full penetration weld such as a double butt weld or single butt weld with or without backing, as allowed by the original code of construction.

b) Unstayed Boiler Furnace Cracks
Cracks at the knuckle or at the turn of the flange of the furnace opening require immediate replacement of the affected area or specific approval of repairs by the Jurisdiction. See Figure 3.3.4.2-a.

c) Rivet or Staybolt Hole Cracks
Cracks radiating from rivet or staybolt holes may be repaired if the plate is not seriously damaged. If the plate is seriously damaged, it shall be replaced. For suggested methods of repair, see Figure 3.3.4.2-b.

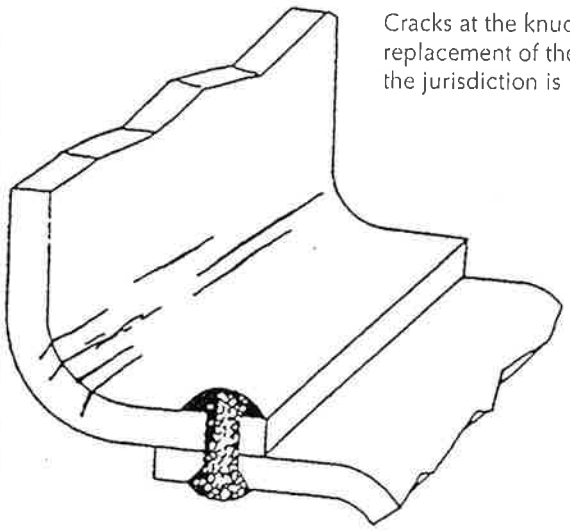
d) Minor Defects
Minor cracks, isolated pits, and small plate imperfections should be examined to determine the extent of the defect and whether repair by welding is required. Prior to repair by welding, the defects shall be removed to sound metal. Liquid penetrant or magnetic particle examination may be used before or after welding.

e) Defective Bolting
Defective bolting material shall not be repaired but shall be replaced with suitable material that meets the specifications of the original code of construction.

f) Bulges

1) A bulge on a watertube shall be investigated to determine the cause and extent of damage to the tube prior to repair. If the bulge has resulted in metallurgical changes to the original tube material, as determined by field metallography, installation of a new length of tubing or tube patch [See 3.3.4.6(b)] is required.

FIGURE 3.3.4.2-a
Unstayed Boiler Furnaces



Cracks at the knuckle or at the turn of the furnace opening require immediate replacement of the affected area. If repairs are attempted specific approval of the jurisdiction is required.

a small bulge. This is referred to as a window patch. Suggested methods for window patches are shown in Figure 3.3.4.6-b.

3.3.4.7 STAYS

Threaded stays may be replaced by welded-in stays provided that, in the judgement of the Inspector, the material adjacent to the staybolt has not been materially weakened by deterioration or wasting away. Requirements of the original code of construction governing welded-in stays shall be met.

3.3.4.8 Insert "A"

3.3.5 REPAIR OF ASME SECTION VIII, DIVISION 2 OR 3, PRESSURE VESSELS

3.3.5.1 SCOPE

The following requirements shall apply for the repair of pressure vessels constructed to the requirements of Section VIII, Division 2 or 3, of the ASME Code.

3.3.5.2 REPAIR PLAN

The user shall prepare or cause to have prepared a detailed plan covering the scope of the repair.

a) Professional Engineer Review
The repair plan shall be reviewed and certified by a Professional Engineer who is registered in one or more of the states of the United States of America or the provinces of Canada, is experienced in pressure vessel design, and is knowledgeable in ASME Section VIII, Division 2 or 3, as applicable. The review and certification shall be such as to ensure the work involved in the repair is compatible with the User's Design Specification and the *Manufacturer's Design Report*.

b) Authorized Inspection Agency Acceptance
Following review and certification, the repair plan shall be submitted for acceptance to the Authorized Inspection Agency/Owner-User Inspection Organization whose Inspector will make the acceptance inspection and sign the Form R-1.

3.4 ALTERATIONS

3.4.1 RE-RATING[10]

Re-rating of a pressure-retaining item by increasing the maximum allowable working pressure (internal or external) or temperature or decreasing the minimum design metal temperature below which notch toughness testing is required by the original code of construction shall be done only after the following requirements have been met to the satisfaction of the Jurisdiction at the location of the installation:

a) Revised calculations verifying the new service conditions shall be prepared in accordance with the "R" Certificate Holder's Quality Control System. Establishing a higher joint efficiency to re-rate a pressure-retaining item is not permitted.

b) All re-ratings shall be established in accordance with the requirements of the construction standard to which the pressure-retaining item was built.

c) Current inspection records verify that the pressure-retaining item is satisfactory for the proposed service conditions.

d) The pressure-retaining item has been pressure tested, as required, for the new service conditions. Any insulation, coatings, or

10 Re-rating: Except as provided for Yankee Dryers in Supplement 5, this code does not provide rules for de-rating boilers or pressure vessels; however, when the MAWP and / or allowable temperature of a boiler or pressure vessel is reduced, the Jurisdiction where the object is installed should be contacted to determine if specific procedures should be followed.

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Insert "A"

3.3.4.8 Repair of Pressure Retaining Items without Complete Removal of Defects

(a) There may be cases where removal of a defect in a pressure retaining item is not practical at the time the defect is found. In such cases, with approval of the Inspector and, when required, the Jurisdiction, an engineering evaluation shall be performed to determine the scope of the repair and impact to safety prior to returning the pressure retaining item to service for a specified period of time. The engineering evaluation shall be performed by an organization with demonstrated experience in defect (and flaw) characterization of pressure retaining items. The method of defect evaluation and time interval for returning the pressure retaining item back to service shall be as agreed upon by the Inspector, and when required, the Jurisdiction. The specified period of time the defect can remain in service shall not exceed the remaining life of the pressure retaining item. This repair method is not permitted for vessels used in lethal service or compressed air storage.

(b) One or more fitness-for-service engineering evaluation methods as described in Part 2, Section 4, Paragraph 4.4 shall be used to determine whether the defect may remain, either in part or in whole, in the pressure retaining item. If it is determined that the defect can remain in the item, a risk-based inspection program shall be developed to assure inspection of the defect and monitoring of defect growth over time. This program shall be a controlled and documented inspection program that specifies inspection intervals as agreed upon with the Inspector and, when required, the Jurisdiction, and shall be maintained until the defect can be completely removed and the item repaired.

(c) The following requirements shall apply to the weld repair of pressure retaining items without complete removal of defects;

(1) Engineering evaluation of the defect in the pressure retaining item shall be conducted using one or more fitness-for-service condition assessment method(s) as described in Part 2, Section 4, paragraph 4.4. Engineering evaluation of the condition assessment results shall be performed by an organization that has demonstrated industry experience in evaluating pressure retaining items as referenced in Part 2, Supplement 5.3.

(2) If engineering evaluation indicates a defect can remain in the pressure retaining item, a risk-based inspection program shall be developed and implemented based on review and acceptance by the Inspector and, when required, the Jurisdiction. The risk-based inspection program shall be in accordance with the requirements in Part 2, Section 4.4.

(3) The fitness-for-service condition assessment and risk-based inspection programs shall remain in effect for the pressure retaining item until such time that the defect can be completely removed and the item repaired. The fitness-for-service condition assessment method, results of assessment, and method of weld repair shall be documented on a Report of Fitness for Service Assessment (FFSA) Form as described in Part 2, Section 4, Paragraph 4.4.1 (d) and shall be filed with the Jurisdiction.

(4) When weld repairs are performed without complete removal of the defect(s), this shall be noted on the Form R-1 in the description of the work. The R-Stamp holder performing the weld repairs shall provide detailed information on the Form R-1 describing the method and extent of repair and include the specific location of the repair on the item.

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(5) The interval to either re-inspect or remove the item from service for repair shall be determined based on a risk-based inspection program developed and implemented as required by Paragraph 3.3.4.8 (c) (2). The inspection interval shall not exceed the remaining design life of the item, and shall be documented on the FFSA Form and in the remarks section of the Form R-1. The FFSA Form shall be affixed to the Form R-1 ~~if~~ when weld repairs are performed in 3.3.4.8 (c) (4).

(6) A copy of the completed Form R-1 with the completed FFSA Form attached shall be registered with the National Board, and when required, filed with the Jurisdiction where the ~~repair was made.~~ item is installed.

For INFO only 5.3.7

REPORT OF FITNESS FOR SERVICE ASSESSMENT FORM (NB-403)

The National Board of Boiler and Pressure Vessel Inspectors
REPORT OF FITNESS FOR SERVICE ASSESSMENT

F.F.S. Assessment No. (1)

1. Equipment Owner Information: (2)
(Name)
(Address)

2. FFS Assessment Performed By: (3)
(Name of Organization or Individual)
(Address)

3. Location of Equipment Installation: (4)
(Name of Company)
(Address) (5) (Jurisdiction)

4. Equipment or Component Information: (6)
(MFG SR#, NB#, Jurisdiction# , Year Built, Other)
(Equipment Material Specification, Grade)
(Design & Operating Pressures, Design & Operating Temperatures)

5. Original Code of Construction: (7)
(Name) (Section) (Division) (Edition) (Addendum)

FITNESS FOR SERVICE STANDARD USED FOR ASSESSMENT (8)

6. Flaw Type(s) and/or Damage Mechanisms considered in FFS Assessment: (9)

7. FFS Assessment Procedures (attach FFS Assessment reference documents with details if applicable): (10)

Inspection Results: (11)
(Type of NDE Performed, Pressure Tests, Thickness Measurements, etc.)

Failure Modes Identified: (12)
(Crack-Like Flaws, Pitting, Bulges/Blisters, General or Localized Corrosion, etc.)

(12)

For INFO only

8. FFS Assessments Results / Recommendations (Check boxes that apply and provide details): (13)
☐ Continued Operation ☐ Repair ☐ Replace ☐ Continue Operation Until: (18)
(14) (15) (16) (17)

Details (if applicable) _____

9. Owners Inspection Intervals (Based on Assessment): (19) _____
(Months/Years)

10. Inservice Monitoring Methods and Intervals: (20) _____
(Methods, Months/Years)

11. Operating Limitations (if applicable): (21) _____

I, (22) _____ certify that to the best of my knowledge and belief the statements in this report are correct and that the information, data, and identification numbers are correct and in accordance with provisions of the *National Board Inspection Code*, Part 2, 4.4. Applicable documentation is attached to support this assessment.

Owner Name (23) _____
(Printed)

Signature (24) _____ Date (25) _____
(Owner)

Organization Performing Assessment (26) _____
(Name)

Signature (27) _____ Date (28) _____
(Responsible Engineer)

Verified By (29) _____ Employer (30) _____
(Inspector, Printed) (Accredited Inspection Agency)

Signature (31) _____ Date (32) _____
(Inspector)

NB Commission # (33) _____
(National Board & Jurisdiction Number)

This form may be obtained from The National Board of Boiler and Pressure Vessel Inspectors, 1055 Crupper Ave., Columbus, OH 43229 NB-403 Rev. 0

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5.3.7.1

GUIDE FOR COMPLETING FITNESS FOR SERVICE ASSESSMENT REPORTS

1. For tracking and reference purposes indicate the sequential Fitness for Service Assessment number.
2. Name and address of the owner of the equipment that is being assessed for Fitness for Service.
3. Name and address of the organization or individual performing the Fitness for Service Assessment.
4. Name and address of the facility where the equipment being assessed for Fitness for Service is located.
5. Name of the Jurisdiction where the assessed equipment is located.
6. Identification of Equipment including Manufacturer, Manufacturer's serial number, National Board Number, Jurisdiction assigned registration number, and Year built. Also include Equipment/Component Material Specification/Grade, Design and Operating Pressures, Design and Operating Temperatures, if applicable.
7. Indicate the name, section, division, edition, and addenda of the original Code of Construction.
8. Name of the Standard used to perform the Fitness for Service Assessment.
9. Description of the Equipment / Component damage mechanism or flaw types considered in the Fitness for Service Assessment.
10. Description of the Fitness for Service Assessment level and technique. Attach all relevant Fitness for Service Assessment procedures and detailed documentation.
11. Description of the Inspection and NDE results as prescribed in the Fitness for Service Assessment analysis.
12. Description of the Failure, Damage and/or Deterioration modes identified in the Fitness for Service Assessment.
13. Indicate the results of the Fitness for Service Assessment, including remediation recommendations.
14. Indicate if the equipment can continue current operation.
15. Indicate if repairs are required.
16. Indicate if equipment replacement is required.
17. Indicate if continued operation has a finite date.
18. Indicate finite date of continued operation (if applicable).
19. Indicate the required Inspection intervals as determined by the Fitness for Service Assessment.
20. Indicate the required inservice monitoring methods and intervals for the equipment as defined by the Fitness for Service Assessment.
21. Describe any operating or inservice limitations for the equipment. This would include any reductions / changes in operating pressures or temperatures.
22. Type or print the name of the representative of the Organization or individual performing the Fitness for Service Assessment.
23. Name of the Owner of the equipment.
24. Signature of Owner.

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25. Indicate the month, day, and year of the Owner review and acceptance of Fitness for Service Assessment.

26. Indicate the name of the organization performing the Fitness for Service Assessment (this may be the same name as in line 22)

27. Signature of the responsible engineer performing the Fitness for Service Assessment.

28. Indicate the month, day, and year of the completion of the Fitness for Service Assessment by the Organization responsible.

29. Type or print the name of the Inspector.

30. Name of the Accredited Inspection Agency employing the Inspector.

31. Signature of the Inspector.

32. Indicate the month, day, and year of the review and acceptance by the Inspector of the Fitness for Service Assessment.

33. National Board commission number of Inspector, Jurisdiction, and Certificate of Competency Numbers.

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