Tubesheet Repair

By Walter Beach, Independent Consultant to the National Board
Oct. 2013
Considerations For Conducting a Tubesheet Field Repair

Determine if the Code status of the item is to be maintained.

- Jurisdictional requirements
- NBIC requirements
- Code of Construction requirements
General Considerations
by the “R” Certificate Holder (Cont.)

Determine extent of work required. This generally involves a trip to the field site.

A representative of the “R” Certificate Holder’s Engineering or Quality Control department will make the determination for the extent of work (per the Q.C. Manual) and if they are going to accept the customers purchase order for the work.

All work is to be completed in accordance with Jurisdictional requirements, the NBIC and their Q.C Manual/Procedures.
General Considerations (Cont.)

Determine if the work will be a repair, a routine repair or an alteration.

The red outline indicates the extent of the flush patch needed for the repair.
Note: backing bars used in fabricating the boiler are an acceptable method
General Considerations (Cont.)

NBIC Part 3

- **3.3.3 EXAMPLES OF REPAIRS**
  - k) The installation of a flush patch to a pressure-retaining item;

- **3.3.4 REPAIR METHODS**
  - 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

- **f) Bulges**

  2) bulge on a plate shall be investigated to determine the cause and extent of damage to the plate prior to repair. **If the bulge has resulted in metallurgical changes to the original plate material, as determined by field metallography, installation of a flush patch (see NBIC Part 3, 3.3.4.6 a) is required. If the plate has cracks as determined by NDE, installation of a flush patch is required.**
• **g) Blisters**
  - A blister may be caused by a defect in the metal such as lamination where one side exposed to the fire overheats but the other side retains its strength due to the cooling effect of the water. After the blistered material has been removed, the remaining wall thickness shall be determined by ultrasonic thickness testing. A surface examination using liquid penetrant testing or magnetic particle testing shall be made to ensure the remaining material contains no defects. If the remaining wall thickness is adequate, in the judgment of the Inspector, the area may be repaired by welding as covered in NBIC Part 3, 3.3.4.3, Wasted Areas. **If the remaining wall thickness is not adequate, a plate will require a flush patch** (See NBIC Part 3, 3.3.4.6[a]) and a tube will require a new length of tube or tube patch (see NBIC Part 3, 3.3.4.6 b).
3.3.4.6 PATCHES

- a) Flush Patches
  
  1) Weld around a flush patch
  - shall be a full penetration weld
  - accessible surfaces ground flush per original code
  - subjected to NDE method per original code or an alternative acceptable to the Inspector.

  2) Before installing a flush patch,
  - defective material removed until sound material is reached.
  - patch rolled to the proper shape or curvature.
  - Edges align without overlap.
  - In stayed areas, the weld seams come between staybolt rows or riveted seams.
  - made from material whose composition and thickness meet the intended service.
  - rectangular patches need adequate radius at the corners. Square corners should be avoided.
  - The completed welds shall meet the requirements of the original code of construction.
General Considerations (Cont.)

In this case the “R” certificate holder has copies of the P-2, P-6 & P7 Data Reports

**Original Mfg:** Cleaver Brooks

**SN:** OL102454

**NB No.** 12172,

**Original Code:** ASME Section I

2001 edition

**MAWP:** 150 psi

Wetback design
FORM P-2 MANUFACTURER'S DATA REPORT FOR ALL TYPES OF BOILERS
EXCEPT WATERTUBE AND ELECTRIC
As Required by the Provisions of the ASME Code Rules. Section I

1. Manufactured by: CLEAVER BROOKS 221 LAW STREET THOMASVILLE, GA 31792
   (Name and address of Manufacturer)

2. Manufactured for: 4 PASS WETBACK MILWAUKEE WI
   (Name and address of purchaser)

3. Location of Installation: STOCK
   (Name and address)

4. Type: SCOTCH
   (FRT, etc.) Boiler No. OL102454
   (Mfr's. Serial No.) 270-02948
   (CRN) 12172
   (Casting No.) (Natl Board No.) Year Built 2002

5. The chemical and physical properties of all parts meet the requirements of material specifications of the ASME BOILER AND PRESSURE VESSEL CODE. The design, construction, and workmanship conform to Section I of the ASME Boiler and Pressure Vessel Code 2001
   Addenda to _____________, and Code Cases _____________
   (Date) (Number)

Manufacturer's Partial Data Reports properly identified and signed by Commissioned Inspectors are attached for the following items of this report.
P-6 & P-7 attached
   (Name of part, item number, etc., name and identifying stamp)

6. Shells or drums: 1
   (no.) SA516-70 .375" 67" 118"
   (inside, app. gr.) (thickness in.) (dia. (ID)) (length, in) (dia. (ID)) (length, in)
   Welded

7. Joints: Welded
   (long, seamless, welded)
   (efficiency as compared to seamless)
   (girth, seam weld, welded) (no. of seam courses)

8. Heads: N/A
   (Material Specification No., Thickness - Flat, Dished, Elliptical - Radius of Dished)

9. Tubesheets: SA 516-70
   Front-.625" Rear-.875"
   (Material, Spec., Grade, Thickness) Tube Holes 2.525"
   (Dia.) STRAIGHT
Section I Requirements for PWHT

PW-10 HEAT TREATMENT

Vessels and vessel parts shall be preheated and postweld heat treated in accordance with the requirements in PW-38 and PW-39.
Section I Requirements for PWHT

PW-39 REQUIREMENTS FOR POSTWELD HEAT TREATMENT

Except as otherwise specifically provided in PFT-29, PMB-9, PW-39.8, PW-40.2, PW-40.3, and in the notes within Tables PW-39-1 through PW-39-13, all welded pressure parts of power boilers shall be given a postweld heat treatment.
## Section I Requirements for PWHT

### Table PW-39-1
**Mandatory Requirements for Postweld Heat Treatment of Pressure Parts and Attachments — P-No. 1**

<table>
<thead>
<tr>
<th>Material</th>
<th>Minimum Holding Temperature, °F (°C)</th>
<th>Minimum Holding Time at Normal Temperature for Weld Thickness (Nominal)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Up to 2 in. (50 mm)</td>
</tr>
<tr>
<td>P-No. 1 Group No. 1,2,3</td>
<td>1,100 (595)</td>
<td>1 hr/in. (1 hr/25 mm), 15 min minimum</td>
</tr>
</tbody>
</table>

**GENERAL NOTES:**
(a) Postweld heat treatment is not mandatory for P-No. 1 materials under the following conditions:

1. When the nominal thickness of a weld as defined in PW-39.3 does not exceed \( \frac{3}{4} \) in. (19 mm), and a minimum preheat of 200°F (95°C) is applied when the nominal material thickness of any of the base metals in the weld joint exceeds 1 in. (25 mm).

2. When the nominal thickness of a weld as defined in PW-39.3 is greater than \( \frac{3}{4} \) in. (19 mm) but does not exceed \( 1\frac{1}{2} \) in. (38 mm), and:
   (a) the calculated carbon equivalent, CE, of any of the base metals in the weld joint is less than or equal to 0.45, using the formula

   \[
   CE = C + \left( \frac{\text{Mn} + \text{Si}}{6} + \frac{\text{Cr} + \text{Mo} + \text{V}}{5} + \frac{\text{Ni} + \text{Cu}}{15} \right)
   \]

   Note: The maximum chemical composition limit from the material specification or the actual values from a chemical analysis or material test report shall be used in computing CE. If the chemistry values required for the last two terms are not available, 0.15% shall be substituted for those two terms as follows:

   \[
   CE = C + \left( \frac{\text{Mn} + \text{Si}}{6} + 0.15 \right)
   \]

(b) a minimum preheat of 250°F (120°C) is applied

(c) no individual weld pass thickness exceeds \( \frac{1}{4} \) in. (6 mm)
Section I NDE Requirements

PW-11 VOLUMETRIC EXAMINATION OF WELDED BUTT JOINTS

- PW-11.1 Welded butt joints requiring volumetric examination are specified in Table PW-11.
  - PW-11.2 Definitions. For use with Table PW-11 and elsewhere in this Section, the following definitions apply:
    - butt joint: a joint between two members aligned approximately in the same plane.
    - longitudinal butt weld: includes longitudinal and spiral welded butt joints in drums, shells, headers, pipes, and tubes; any welded butt joint within a sphere or within a formed or flat head or tubesheet; and welded butt joints attaching insert-nozzles of the type shown in Figure PW-16.1, illustrations (q-1) through (q-4).
# Section I NDE Requirements

## Table PW-11

<table>
<thead>
<tr>
<th>Butt Weld Type</th>
<th>Contains Steam and/or Water</th>
<th>Not Subject to Furnace Radiant Heat [Note (2)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longitudinal</td>
<td>all sizes and thicknesses</td>
<td>Contains Water</td>
</tr>
<tr>
<td></td>
<td>&gt; NPS 10 (DN 250)</td>
<td>&gt; NPS 10 (DN 250) or &gt; 1(\frac{1}{8}) in. (29 mm) thick</td>
</tr>
<tr>
<td></td>
<td>or</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt; 1(\frac{1}{8}) in. (29 mm) thick</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Contains Steam</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt; NPS 10 (DN 250) or &gt; 1(\frac{1}{8}) in. (29 mm) thick</td>
<td></td>
</tr>
<tr>
<td></td>
<td>or</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt; 1(\frac{1}{8}) in. (29 mm) thick</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Circumferential welds in pipes, tubes, and headers</td>
<td>&gt; NPS 4 (DN 100) or &gt; 1(\frac{1}{8}) in. (13 mm) thick</td>
<td>&gt; NPS 16 (DN 400) or &gt; 1(\frac{7}{8}) in. (41 mm) thick</td>
</tr>
</tbody>
</table>

**GENERAL NOTES:**
- All butt welds, circumferential, and longitudinal welded butt joints shall be examined by a combination of radiographic and ultrasonic examination.
2.5.2 POSTWELD HEAT TREATMENT (PWHT)

a) Postweld heat treatment shall be performed as required by the original code of construction, the construction standard or code selected in accordance with a written procedure. The procedure shall contain the parameters for postweld heat treatment.
2.5.2 POSTWELD HEAT TREATMENT (PWHT)  

When it is impractical or detrimental to Postweld Heat Treat (PWHT) the entire item or band around the item, the following local PWHT method may be performed on spherical or cylindrical pressure-retaining items using the time and temperature parameters in the original code of construction and in accordance with a written procedure acceptable to the Inspector and, when required, by the Jurisdiction.

Use NBIC local post weld heat treatment
2.5.3 ALTERNATIVE WELDING METHODS WITHOUT POSTWELD HEAT TREATMENT

a) Under certain conditions, postweld heat treatment, in accordance with the original code of construction, may be inadvisable or impractical. In such instances, the following alternative methods may be used.

- Welding Method 1 uses a 300 F preheat
- Welding methods 2-5 uses a Temper Bead method
Fortunately both the industry and NBIC realize that full blown PWHT on a repair “may” not always be practical, possible or advisable, hence for our repair, method 1 will be looked at.

A common mistake is to go directly to method 1 instructions without reading all the requirements in paragraph 2.5.3 ALTERNATIVE WELDING METHODS WITHOUT POSTWELD HEAT TREATMENT
Prior to welding, the area prepared for welding shall be examined using either:
- Magnetic Particle (MT) or
- Liquid Penetrant (PT)

After the finished weld has reached ambient temperature, the weld shall be examined again by either:
- Magnetic Particle (MT) or
- Liquid Penetrant (PT)

In addition, welds greater than 3/8 in. (9.6 mm) deep or welds in a boiler, pressure vessel, or piping system that were originally required to be radiographed, shall be
- Radiographically examined.
Perhaps the most used method is **Method #1** and in summary this method requires little more than controlling preheat and interpass temperatures.

From a practical application perspective, we need to ensure:

- The no PWHT WPS permits the application of the 300 F preheat,
  - The increase is a non-essential variable for non-impact test WPS qualifications and would have to be addressed, but if necessary, only a “revision” to the WPS would be required.
- The need to ascertain that they have a means to verify the required preheat and interpass temperature.
  - Simple heat sticks/crayons are sufficient or some type of appropriate thermometer. The point here being that if they have nothing, then I can’t possibly see how compliance with this method could be confirmed!
NBIC Part 3 Alternatives to PWHT

- There were some changes to the 2013 Edition for Welding Method 1

- For P-No. 1, Group’s 1, 2 & 3 materials, the preheat may be reduced to 175 F provided:
  - The carbon equivalent of the base material to be welded is determined to be 0.4 or less.
  - The electrodes and filler metals are classified with a diffusible hydrogen designator of H4 or lower
  - Shielding gases used shall have a dew point -60F or lower.
  - The requirement to maintain a 450 F interpass Temperature has been removed.
General Considerations (Cont.)

Next, the “R” Certificate Holder must determine which Inspector(s) will be involved, this will include:

The Inspector who signed off on the operation certificate for the Boiler

- Authorized Inspection Agency responsible for inservice inspection, or the
- Jurisdiction

OR

Their Inspector assigned by the Authorized Inspection Agency of record responsible for providing 3rd party inspection for their R program

Note: Make sure when obtaining authorization from the owner’s AIA that their Commissioned Inspector will sign the National Board R Form. If not, the “R” Certificate Holder will also need to contact their AIA of record.
General Considerations (Cont.)

Keep the AIA/Jurisdiction responsible for the in-service inspection advised of the repair and obtain authorization as appropriate.

The Commissioned Inspector who will be signing the “R” Form shall be contacted prior to the start of work. This provides for them to set inspection (hold) points prior to the start of work.

Depending on the type and scope of work, the Inspector may give authorization to start work via a phone contact. All such contact should be documented & signed off on the repair plan.
General Considerations (Cont.)

The following are some of the documents that will be required to be at the work site:

A. Copy of the “R" Certificate of Authorization
B. Repair material documentation: Repair Plan, MTR's, NDE reports, Heat Treatment records, etc.
C. Weld Procedure Specification (WPS)
D. Procedure Qualification Record (PQR)
E. Welder Performance Qualification (WPQ)
F. Controlled copy of the Q.C. Manual
General Considerations (Cont.)

Upon completion of the repair or alteration, have the proper “R” Form(s) completed and signed by “R” Certificate Holder’s representative and presented to the Commissioned Inspector for review and signature.
General Considerations (Cont.)

Let's take a look at a sample Repair Plan that would be presented to an Inspector to review.
General Considerations (Cont.)

### Repair Plan

<table>
<thead>
<tr>
<th>Job No.: 204454</th>
<th>Prepared &amp; Approved Quality Control or Project Manager: John Henry Date: 9-14-2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>User/Owner: XYZ Industries, Inc</td>
<td>Reviewed Commissioned Inspector (C.I.):</td>
</tr>
<tr>
<td>Location: Columbus, Ohio</td>
<td>Date:</td>
</tr>
<tr>
<td>Other: Boiler No. 3 Tube Sheet Repair</td>
<td></td>
</tr>
</tbody>
</table>

#### Applicable Code Section: follow ASME Sec I 2011a

#### NBIC: Edition: 2011

#### Location of Repair Sketch / Scope of Work

Weld 0.875 in. partial bottom rear tube sheet to existing 3/8 in. shell plate per attached drawing.

Filet Weld size: _____ in.

![Diagram of repair sketch](image)

#### Item

<table>
<thead>
<tr>
<th>(1) Shell Plate</th>
<th>Original Required Material Markings</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8 inch SA-516-70 in accordance with original MDR</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(2) Tube Sheet replacement Plate</th>
<th>0.875 inch (segment to fit) SA-516 Gr. 70 HT #:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slab #: , Mfg Name: as rolled condition</td>
<td></td>
</tr>
</tbody>
</table>
### General Considerations (Cont.)

<table>
<thead>
<tr>
<th>Item</th>
<th>Comment / Notes</th>
<th>(H = Hold Point)</th>
<th>QCI / Date</th>
<th>C.I. Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.I. Notification</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.I. Recommendations</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drawings</td>
<td>dwg # 160207 Rev 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MRT’s &amp; Markings</td>
<td>Verify markings and thickness of 1-1/4” Plates to MTR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heat Treatment</td>
<td>Per NBIC Part 3 Alternative Welding Method 1, para 2.5.3.1, see page 2 for detailed instructions.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NDE By:</td>
<td>MT or PT prior to welding</td>
<td>See attached NDE Report</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>MT or PT after welding</td>
<td>See attached NDE Report</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>RT long seam of segment</td>
<td>See attached NDE Report</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonconformance Report No.:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test: <strong>Hydro</strong></td>
<td>Test Pressure: 150 psi with 10 min Hold time</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test Gauge Calibration</td>
<td>Gauge # G-101</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final Inspect &amp; Stamping</td>
<td>“R” Repair Hard Stamp or nameplate,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NBIC Form R# 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operation</td>
<td>Description of Work</td>
<td>Welder ID</td>
<td>Proc # Used</td>
<td>QCI</td>
</tr>
<tr>
<td>-----------</td>
<td>---------------------</td>
<td>-----------</td>
<td>-------------</td>
<td>-----</td>
</tr>
<tr>
<td>1</td>
<td>Prepare weld prep per above joint detail &amp; Dwg. Surfaces to be welded shall be cleaned</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>2</td>
<td>Perform PT prior to welding</td>
<td>--</td>
<td>PT-1 R1</td>
<td>--</td>
</tr>
<tr>
<td>3</td>
<td>Fit-up segmented tube sheet plate to shell... Tacks to be removed or stops &amp; starts prepared by grinding. Preheat and maintained at a min. temp. of 300°F during welding. Alignment of Long seam</td>
<td>P1-13-1 R2 (GTAW)</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>4</td>
<td>Weld Root -- ER70S-6 preheat and maintained at a min. temp. of 300°F during welding &amp; prep for NDE as required</td>
<td>P1-13-1 R2</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>5</td>
<td>BackGouge &amp; Determine if PT or MT is required</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>6</td>
<td>Fill Weld -- E7018 preheat and maintained at a min. temp. of 300°F during welding &amp; prep for NDE as required</td>
<td>P1-12-1 R3</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>7</td>
<td>Final visual Inspect and perform Final PT Reinf. inside fillet outside fillet</td>
<td>--</td>
<td>PT-1 R1</td>
<td>--</td>
</tr>
<tr>
<td>8</td>
<td>RT long seam of segment</td>
<td>--</td>
<td>RT-4 R4</td>
<td>--</td>
</tr>
<tr>
<td>9</td>
<td>See additional attached requirements</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>
Commissioned Inspector’s Involvement

Now let us look at some of the steps an Inspector needs to take.

- The Inspector should, on his first visit verify that the repair organization has the proper Certificate of Authorization for the type and scope of work performed by reviewing the certificate itself.
  - Name of Certificate Holder, correct to R Form
  - Physical address
  - “R” symbol authorized
  - Scope, Repair / Alteration / shop / field
  - Expiration date.
Commissioned Inspector’s Involvement
Design

DESIGN REVIEW

- The Inspector needs to verify the tubesheet replacement scope of work is indeed a repair and not an alteration.

  - Review drawings, specifications, instructions and procedures to assure that:
    - Dimensions and tolerances are addressed and meet Code requirements.
    - That weld joint details are available, including dimensions (such as fillet weld sizes).
    - Welding procedure specifications, nondestructive examination, heat treatment and forming procedures are referenced including the appropriate revision number. Also that they meet Code requirements and are properly qualified, as required.
    - Material referenced is acceptable for use and listed in the applicable construction Code.
    - Material references include the ASME specification designation grade, type or class, as applicable; dimensions (plate thickness) are identified in the bill of material.
    - Reference is made to the applicable construction Code (e.g. Section I, or IV). This should also include the appropriate Code Edition and Addenda the item is to be repaired to.
    - Any other information pertinent to the repair activity or required by the Code is available.
Commissioned Inspector’s Involvement

Repair Plan

Repair Plan (Traveler/Process Sheet)

- The Inspector should review the Repair Plan to assure that important stages of work are listed, such as:
  - Spaces for QC inspection and the Inspector for sign-off of those operations witnessed.
  - WPS, NDE, heat treatment procedures and applicable revisions are identified. Are any alternative methods being used.
  - Description of welding requirements are in compliance with the applicable construction Code (fit-up, edge preparation, cut edge examination, tack weld condition, cleanliness, final inspection, etc.).
  - Required NDE is addressed, including method.
  - Verification of transfer of identification when material is cut into two or more pieces.
The Inspector should review the Repair Plan to assure that important stages of work are listed, such as:

- Fit-up inspections (alignment, to permit full penetration, etc)
- Internal inspection for weld joint integrity.
- Pressure testing (hydrostatic/pneumatic). Alternative methods
- Final dimensional inspection to assure drawing requirements have been met.
- “R” Stamping and nameplate verification.
- Certification of “R” Form.
Commissioned Inspector’s Involvement
Repair Plan

Repair Plan (Cont.)

- During this review the Inspector should compare the Repair Plan with any applicable drawing or sketches in order to assure correctness and completeness of the Repair Plan and to designate desired inspection points prior to the start of work.

- Verify the Repair Plan has been reviewed by the person responsible within Repair Organization. This is usually identified in the “R” Certificate Holder’s QC Manual.

- After satisfactory review, indicate concurrence and/or acceptance by sign-off and date on the Repair Plan.
Commissioned Inspector’s Involvement
Nondestructive Examination

- **Procedures**

  - Verify that NDE procedures are prepared and approved in accordance with the Quality Program Manual.
  - Review the appropriate construction Code to determine the requirements for procedure contents.
  - Verify the procedure is in compliance with the appropriate Article of Section V or the requirements of the referencing Code.
  - Witness or otherwise verify that NDE procedures have been demonstrated to the satisfaction of the Inspector.
Commissioned Inspector’s Involvement
Nondestructive Examination

Personnel Qualifications

• Verify that a written practice has been developed in accordance with SNT-TC-1A or as required by the referencing Code.
• Verify that personnel are qualified in accordance with the written practice, and that their eye examination date has not expired
• Verify that the qualification records of certified personnel are maintained as required by the written practice or the referencing Code.
Commissioned Inspector’s Involvement
Nondestructive Examination

- **NDE Operations**
  - Assure the proper NDE procedure being used is as required by drawings and/or Travelers.
  - Verify that procedure being used has been prepared and approved in accordance with the Quality Program Manual.
  - Verify that the person performing the NDE operation is properly qualified.
  - When witnessing NDE operations, verify that personnel are following the procedure requirements.
  - Verify that NDE acceptance criteria is as required by the Construction Code.
  - Verify that the review and interpretation of NDE results are in accordance with the acceptance criteria.
  - Verify that NDE reports have been completed, signed, and reviewed by personnel in accordance with the Code and Quality Program requirements.
Commissioned Inspector’s Involvement

Materials

- **Material Verification**
  - Review of the applicable ASME Code Section for material requirements, including heat treatment, if applicable.
  - Review the applicable Code section and Section II, Part D, and notes for permitted material.
  - Review the Section II Material Specification which states the requirements for the basis of purchase or information which must be contained in the Procurement Documents.
  - Review the Quality Program Manual for the Quality Program requirements.
  - Using the information from the applicable ASME Code Section and the Section II, Part D Stress Tables, the Material Specification and the Quality Program Manual, review the Procurement Documents to verify Code compliance of the material ordered.
Commissioned Inspector’s Involvement

Materials

- **Material Verification (cont.)**
  - Review the material certification against Material Specification and Procurement Documents for assurance that the material is in compliance with Code Quality Program and meets the requirements of the material specification, including heat treatment, for:
  - Traceability to the material. (The Code section and the Material Specification will specify the minimum marking requirements. Traceability may be achieved through the material specification designation grade, type or class as applicable, heat and slab numbers on plate, lot numbers, etc. The Quality Program may have requirement for traceability; that is, P. O. number, shop order number, etc.)
Commissioned Inspector’s Involvement
Materials

- Material Verification (cont.)
  - Examine the material to assure that the material certification represents the material.
  - Assure that the material is identified in accordance with the applicable Material Specification requirements and meets all the Material Specification and Quality Program requirements.
  - For recertified material, assure that the specific requirements of the Code section are met for Material Not Fully Identified.
  - The Inspector need not witness the transfer of identification, but should assure himself that it has been correctly done in all cases.
Commissioned Inspector’s Involvement

Materials

- **Cut Edge Examination**
  - Review the Quality Program Manual and, if applicable, procedures to determine control of cut edge examination (who responsible, how documented).
  - The Inspector should assure himself that cut edge examination has been completed per the requirements of the applicable section of the ASME Code.
  - The Inspector should assure himself that cut edges have been examined for objectionable defects by:
    - Review of Repair Plans to verify that QC inspection personnel have completed the cut edge examination and indicated this inspection by initialing/signing and dating the Repair Plan, and/or
    - Review of the NDE report, signed and dated by the examiner who performed the examination, identifying the acceptability to the cut edges, if applicable.
Commissioned Inspector’s Involvement

Welding

  - Assure that the WPS has been developed and acceptable for the scope of work.
  - Ensure that all essential, supplementary essential (when required), and nonessential variables of Section IX are adequately addressed in the WPS for that process(es).
  - Review the applicable Code section for special requirements pertaining to the class of materials, service restrictions, or other variables that are to be addressed in the WPS.
  - Review the supporting welding Procedure Qualification Record (PQR) to assure documentation and qualification of the essential variables, and the mechanical test results.
Commissioned Inspector’s Involvement

Welding

- **Review Of Welder/Welder Operator Qualification**
  - Assure each welder or welding operator has a record of Welder Performance Qualification (WPQ) for each welding process.
  - Assure that the welder or welding operator performance qualification test was welded in accordance with a qualified WPS.
  - Determine the type of welding process(es) the welder or welding operator is qualified to perform.
  - Review the welder's WPQ record and ensure all the essential performance variables have been addressed for the appropriate welding process and the limits of thickness of deposited weld metal is as defined in Section IX.
  - Assure that the type of mechanical tests and test results and the ranges qualified are in accordance with Section IX for each welder and welding operator.
**Commissioned Inspector’s Involvement**

**Welding**

- **Control Of Welding Procedures and Welders**
  - Review the Quality Program Manual for the controls which ensures that only qualified welding procedures and welders are used during Code construction.
  - Verify that the WPS is in compliance with, and properly qualified in accordance with Section IX.
  - Verify that the welder or welding operator is properly qualified in accordance with Section IX.
  - Verify that the welders continuity records are up-to-date.
Commissioned Inspector’s Involvement
Welding

- **Welding Operations**
  - Verify that the WPS being used is the proper one for the application in accordance with drawings or the Repair Plan.
  - Verify that the welder or welding operator has been properly qualified to implement the procedure being used.
  - Verify that the welder or welding operator is welding within the parameters as specified in the WPS.
Commissioned Inspector’s Involvement

Welding

- **Inspection Of Welds**
  - Inspection of the surfaces to be welded should be made to ensure they are clean and free of scale, rust, oil, grease and other deleterious foreign material.
  - At fit-up, inspection of edges for laminations or other unacceptable defects should be made. If the material was shaped by oxygen or arc cutting, ensure that the edges to be welded are uniform and smooth and free of all loose scale and slag.
  - Inspection of tack welds that are to be left in place should be made for cracks, incomplete fusion, pinholes, etc.
  - Use a welding gauge (such as a Hi-Low gauge) to measure wall thickness, alignment, fit-up gap and the weld prep bevel for conformance with drawings and/or the WPS.
Commissioned Inspector’s Involvement

Welding

- **Inspection Of Welds**
  - Verify that the surface of completed welds are free of coarse ripples, grooves, overlaps, abrupt ridges and valleys.
  - Verify that butt welds have complete penetration and full fusion and fillet welds have adequate penetration into the metal at the root of the weld. base
  - Verify that the reduction in thickness (undercut) due to the welding process is acceptable.
  - Using a welding gauge (such as a Hi-Low gauge) verify that weld reinforcement is not excessive.
  - Using the fillet weld gauge, verify that the fillet weld sizes are in conformance with drawings and/or the WPS.
  - Verify that welder identification symbols are on or adjacent to, and at intervals of not more than three feet along the welds, or as provided by the Quality Program.
Commissioned Inspector’s Involvement

Postweld Heat Treatment

- Postweld Heat Treatment
  - Review the applicable ASME Code Section for the Postweld Heat Treatment requirements.
  - Review the Quality Program Manual and identify the controls concerning Postweld Heat Treatment.
  - Review the implementation of Postweld Heat Treatment procedural requirements required by the applicable ASME Code section. Or
  - Review the implementation of any alternative methods.
  - Review of the Repair Plan signed off by the operator or QC Inspector who verified the application of the procedure
Commissioned Inspector’s Involvement Inspection

- Internal Inspection, Pressure Test, External Inspection
  - As applicable, all inspections should be performed as required by the original Code of construction, using the acceptance criteria identified in the applicable ASME Code section.
  - All internal and external inspections should be performed with the proper equipment.
    - Hi-low (or other suitable) welding gauge.
    - Fillet weld gauge.
    - Flash light or other suitable lighting.
    - Mirrors, magnifying glass, etc.
    - Templates, borescopes or other measuring devices furnished by the Certificate Holder.
Commissioned Inspector’s Involvement Inspection

- **Internal Inspection**
  - Upon completion of all work, where possible, and before the pressure test (hydrostatic or pneumatic), an internal inspection should be performed to the acceptance criteria identified in the construction documents and Code for dimension and welding requirements.
  - When entry of an item is not possible after the completion of work, an internal inspection of welds to assure compliance to the acceptance criteria identified as described above, should be performed before the final closure seam, if possible.
  - A fit-up inspection to verify joint details will produce full penetration welds may become necessary when an internal inspection is not possible.
Commissioned Inspector’s Involvement Inspection

- **Pressure Test**
  - The final pressure test of each item must be witnessed by the Inspector, where required.
  - Pressure tests are applied to items as required by the NBIC. Each construction Code has specific requirements if the work performed is an alteration.
  - Pressure test procedures or instructions should be reviewed during the design/initial review to verify that type of test and pressure application is in accordance with the NBIC and Code of construction.
Commissioned Inspector’s Involvement Inspection

- **External Inspection**
  - Upon satisfactory completion of the pressure test, the pressure may be reduced to a pressure mandated by the applicable ASME Code, and maintained at this pressure while the external inspection is being performed. (Each construction Code has different requirements.)
  - The item should be thoroughly dried prior to inspection so that leaks can be identified. Any allowed leakage of mechanical joints should be directed away from the item so as not to mask leaks in base metal or weld joints.
  - The surfaces of all welds should be visible at the time of the external inspection, unless otherwise permitted by the ASME Code.
  - Any leakage at welds is cause for rejection.
  - Mechanical joint leakage should be as permitted by the ASME Code; usually depends on the item type and/or amount of leakage.
  - In addition to inspecting for leaks, the external inspection of the item should be made for conformance to the construction documents and the Code.
Commissioned Inspector’s Involvement

**Stamping and Reports**

**Stamping**

- The Inspector should verify or witness (when required) that the “R” stamping on each Code item meets the requirements of the NBIC.
- Verification should consist of:
  - Proper size of stamping.
  - Location of the stamping or placement of nameplates.
  - Complete and correct information.
  - When nameplates are used, method of attachment.
  - Legibility of the stamping.
  - Ensure that the nameplate has been attached to the proper item.
Commissioned Inspector’s Involvement

STAMPING AND REPORTS

- **REPORTS**
  - The Inspector should review the “R” Form for the work performed to assure that the form is correct and complete and represents the applicable activities.
    - “R” Forms should be compared with the applicable NBIC, "Instructions for the Preparation of R Form."
    - The as-built condition reported on the “R” Form should be compared with the drawing and revision status that is identified on the “R” Form.
    - Verify Certificate Holder's name and location including zip code, proper Code symbol, certificate number, and expiration date.
    - Verify that the “R” Form is already certified by the person responsible within the certificate holder’s organization. This is usually identified in the certificate holder’s QC Manual.
    - Certify “R” Form.

Recommendation: Request the Repair Plan (Traveler) be attached to the “R” Form
Time for Lunch!