1.0 Purpose

The purpose of this specification is to establish the minimum quality assurance requirements for performing heat treatment at NRG owned or operated facilities.

2.0 Scope

This specification applies to all heat treatment, including preheat and post-weld heat treatment, of welds as required by ASME Section I, ASME Section VIII, Division I, ASME B31.1, AWS, and the National Board Inspection Code.

3.0 Definitions

3.1 AI - Authorized Inspector

3.2 ASME – American Society of Mechanical Engineers

3.3 AWS – American Welding Society

3.4 NRG – The NRG individual responsible for the overall management of the project cost and schedule

3.5 NRG QA - The NRG individual responsible for the quality and welding aspects of the project

3.6 Heat Treatment Charts – Time versus temperature charts used to document heat treatment

3.7 Heat Treatment Contractor – The Contractor performing the heat treatment

3.8 NBIC – National Board Inspection Code

3.9 WRC – Welding Research Council

3.9 Repair Organization – The organization performing the welding

3.10 Work Process Documentation (WPD) – A tracking form that documents the weld procedure specification being used, the essential details of the welding process (e.g., base metal, filler metal, preheat, etc.), and any special procedures/techniques, materials and hold points. Work process documentation may be a Removal and Replacement Procedure, Weld Data Sheet, Repair Plan, or Contractor-equivalent form.

4.0 References

4.1 ASME Boiler & Pressure Vessel Code, Section I, “Rules for Construction of Power Boilers”

4.2 ASME Boiler & Pressure Vessel Code, Section VIII, “Rules for Construction of Pressure Vessels”

4.3 ASME B31.1, “Power Piping Code”

4.4 AWS D1.1, “Structural Welding Code – Steel”

4.5 AWS D14.6, “Specification for Welding of Rotating Elements of Equipment”

4.6 AWS D10.10, “Recommended Practices for Local Heating of Welds in Piping and Tubing”.

4.7 WRC Bulletin 452, “Recommended Practices for Local Heating of Welds in Pressure Vessels”.

The latest edition of the above codes and specifications shall apply. In the event of conflicts between this specification and the references cited above, the Heat Treatment Contractor shall notify NRG, who will make the final judgment and interpretation.

5.0 Responsibility

5.1 The Repair Organization is responsible for providing the Heat Treatment Contractor with a scope of work, including the type and size of the component, material, thickness, applicable code, and work process documentation for welds requiring heat treatment.

5.2 The Repair Organization is responsible for ensuring that the Heat Treatment Procedure is in accordance with the applicable code, the work process documentation, and the requirements as set forth in this specification.

5.3 The Heat Treatment Contractor shall provide trained and qualified Technicians to perform the heat treatment. NRG may request a copy of the Technician's work history.

5.4 NRG is responsible for ensuring the component is tagged, isolated, suitably drained, and ready for heat treatment.

5.5 If heat treatment includes valves, NRG is responsible for ensuring that all valves are in the correct state prior to the heat treatment.

6.0 Procedures

6.1 The Heat Treatment Contractor shall prepare a Heat Treatment Procedure in accordance with all applicable codes, contract documents (drawings, specifications, purchase orders), and the work process documentation.

6.2 The Heat Treatment Procedure shall address, at a minimum, the following criteria (see Attachment 1 for example):

6.2.1 Type of heat source (electric resistance, induction heating, oxyfuel, or NRG-approved alternate)
6.2.2 Temperature requirement
6.2.3 Temperature tolerance
6.2.4 Time at temperature requirement (soak time)
6.2.5 Soak Band
6.2.6 Heated Band
6.2.7 Gradient Control Band
6.2.8 Maximum Allowable Axial Temperature Gradient
6.2.9 Heating and cooling rates
6.2.10 Thermocouple type
6.2.11 Thermocouple location (include sketch)
6.2.12 Method of temperature recording
6.2.13 Code reference

6.2.14 Calibration methods

6.3 The Repair Organization shall submit the Heat Treatment Procedure to NRG QA for review and approval prior to the start of heat treatment.

6.4 The Heat Treatment Contractor's Technician shall review and post the Heat Treatment Procedure at the job site.

6.5 Soak Band, Heated Band, Gradient Control Band and Maximum Allowable Axial Temperature Gradient (Paragraphs 6.2.5 – 6.2.8 above) shall be in accordance with AWS D10.10 for piping work and WRC Bulletin 452 for pressure vessel work.

7.0 Thermocouples

7.1 Thermocouples shall be in direct contact with the component being heat treated.

7.2 If thermocouples or thermocouple nuts are attached by welding, welders, welding procedures and filler metals shall meet the requirements of the applicable code.

7.3 Low-energy capacitor discharge welding may be used for attaching thermocouples directly to pressure parts, provided that they are removed after the heat treatment is completed. Performance and procedure qualifications are not required for this method of thermocouple attachment. After thermocouple removal, the affected area shall be visually examined to ensure no cracks are present.

7.4 For headers, pipe, and tubing, the number of thermocouples shall be in accordance with the following:

Size (Inches)	Minimum Quantity of Thermocouples
Under 3	2
3 – 14	3
16 - 48	4

7.5 Additional thermocouples may be added as spares or to accommodate better temperature control.

7.6 For horizontal sections of headers, pipe, or tubing, one thermocouple must be located at the 6 o'clock position.

7.7 Where two thermocouples are used, one shall be placed at the expected hottest spot and one at the expected coldest spot.

8.0 Equipment

8.1 A copy of the latest equipment calibration certification shall be provided to NRG QA prior to heat treatment activities.

8.2 The Heat Treatment Contractor shall constantly monitor the equipment while heat treatment is in progress.

8.3 The temperature programmer-controller shall be provided with an adjustable high temperature cutout function actuated from the set point output of the temperature recorder.

9.0 Charts

9.1 Heat treatment charts shall be prepared and submitted to the Repair Organization at the conclusion of the work. The charts shall include the following information:

9.1.1 Date of heat treatment
9.1.2 Name of heat treatment Technician
9.1.3 Identification of each item or weld undergoing heat treatment
9.1.4 Heat Treatment Procedure Number
9.1.5 Chart speed or grid interval
9.1.6 A record of all thermocouples by their serial numbers with appropriate identification on the point printout
9.1.7 Serial numbers of the recorder and measuring equipment along with calibration dates

9.2 The Repair Organization, NRG, and the AI (when applicable) shall be allowed access to the job site and the heat treatment charts while the work is in progress.

9.3 Upon completion of the heat treatment, the Repair Organization shall review and sign the chart to verify the work was performed as specified. The Heat Treatment Contractor shall not leave the job site until the chart is signed.

9.4 Strip chart recordings cannot contain data for more than one contractor or work group.

10.0 Attachment

10.1 Heat Treatment Procedure (Sample)

Attachment: 10.1
QAS 4.05
Revision: 0

HEAT TREATMENT PROCEDURE

Date: _____ Station: _____ Unit: ___

Work Process Doc. No.: _____ Repair Org.: _____

Heat Treatment by: _____

Description of Heat Treatment: _____

_____

Applicable Code(s): _____

Material(s): _____ P-No. (s): _____

Pipe or Tube Diameter: _____ Material Thickness: _____

Heat Treatment Temperature: _____° F ± _____° F Hold Time: _____

Soak Band: _____ Heated Band: _____

Gradient Control Band:_____

Maximum Allowable Axial Temperature Gradient: _____° F/ ft.

Heating Rates: _____

Cooling Rates: _____

Thermocouple Type: _____

Thermocouple Placement (sketch if necessary): _____

Type of Heat Source: _____

Recorder Serial No.: _____ Calibration Date: _____

Approved by (NRG signature):_____ Date: _____