

Attachment 1 to Exhibit A
Scope of Work
Inspection and Acceptance Criteria for Conducting Linear Phased Array (LPA)
Examinations of Boiler Tubing Welds

Purpose

The purpose of this document is to provide the required criteria and a general scope of work for services to be provided by a Consultant or Non-Destructive Examination (NDE) service provider.

Project Scope of Work

The Consultant or NDE service provider shall comply with all the requirements of the Scope of Work Specification for Examination of Boiler Components, High Energy Piping and General Plant Equipment Document

A Work Release, for each project shall be issued by Company. The project description will be provided by Company for each Work Release which will include a general outline of the services to be provided.

The Linear Phased Array (LPA) technique of examining boiler tube welding conducted during boiler overhauls is the primary focus of this Scope of Work.

Consultant or NDE Service Provider Responsibilities

Consultant or NDE service provider shall provide all labor, PPE, materials, and equipment (including supplemental lighting and extension cords) necessary to perform required examinations.

Erection of scaffolding, removal of insulation, and general surface preparation will be provided by Company, unless otherwise noted in the individual Work Release.

Consultant or NDE service provider shall be responsible for obtaining the necessary calibration blocks, at least one week prior to the inspection.

Consultant or NDE service provider shall provide Company with a list of chemical products to be used in these inspections, the Material Safety Data Sheets for these products, and any special storage or disposal requirements.

Consultants or NDE service provider's personnel shall be trained in accordance with OSHA requirements, and will be required to attend the Company Safety training course prior to entering the plant.

Consultant or NDE service provider shall notify Company, at least one week prior to the inspections, of any special auxiliary services (i.e., water, electrical or compressed air) which will be needed for Consultant to perform these inspections.

Consultant or NDE service provider is required to schedule their requirements with Company.

If NDE or other work is being conducted by Company or others, concurrent with Consultant's inspection, Consultant is expected to make reasonable accommodations for these concurrent inspections.

Company may perform examinations based upon the Consultant's findings; therefore, Consultant is required to schedule their efforts to complete the examinations at each location prior to moving to other locations, unless approved by Company's site representative.

Reporting of results and damage shall be in accordance with section 3.0 of the Scope of Work Specification for Examination of Boiler Components, High Energy Piping and General Plant Applications Document

Personnel Qualifications

LPA Technicians performing and/or evaluating LPA examinations shall be qualified in accordance with the American Society of Non-destructive Testing Recommended Practices # SNT-TC-1A. All individuals responsible for data acquisition and/or data analysis shall be certified ASNT Level II technician or above.

LPA Technicians shall also demonstrate their ability to perform LPA on the Company Flawtech Coupons. Alternatively the responsible company represented may approve other methods of qualification than testing using the Company Flawtech Coupons.

Proposals for each Work Release issued shall include recommended staffing level to accomplish the work within the allotted schedule, allowing adequate time for supplemental inspections, if needed, to fully characterize all detected indications. Staffing shall include individual(s), as necessary, depending on specific scope and schedule, to perform data acquisition and independent data analysis.

Resumes of all staff from which the inspection team would be selected should be submitted with the proposal. The specific role of each individual should be clearly identified. Company maintains the right to exclude or otherwise restrict utilization of specific individuals solely at the discretion of Company. No substitution of personnel shall be permitted without the Company's written approval.

Testing Requirements for Welded Repairs in Company Boilers

Welding of boiler tubing conducted during planned overhauls in Company boilers is performed to the requirements of the National Board Inspection Code (NBIC), ANSI/NB-23.

Company's standard Quality Assurance procedures require that boiler contractor quality control personnel conduct a visual examination on each weld at the fit-up, root pass, and final cap stages of welding.

This visual inspection, along with quality LPA inspections, will provide sufficient examinations to verify the quality and integrity of contractor tube welding during planned overhauls.

Ultrasonic Testing (UT) – Linear Phased Array (LPA) Technical Description

For boiler tube welds conducted during major overhauls “linear phased array” (LPA) ultrasonic testing shall be used for the detection and characterization of crack and non-crack like indications.

Ultrasonic examination (UT) is accomplished through the use of transducers which introduce high frequency sound waves into the material being examined. These sound waves travel through the material and are reflected at interfaces such as the back side (inside) of the part or as the reflections created by cracks or other flaws.

An “array” is a type of ultrasonic transducer that has been divided into many individual parallel elements. These elements are individually pulsed to simulate many different conventional probes, thus inspecting a large portion of the weld.

The output image from a LPA unit is a type of polar sweep known as a “sector scan”. Using LPA, a slice of a tube weld can be scanned electronically in milliseconds.

The LPA examinations of boiler tube welding during boiler overhauls shall be in accordance with the American Society of Mechanical Engineers (ASME), Boiler and Pressure Vessel Code (BPVC), Section 5, Nondestructive Examination, Article 4 – “Ultrasonic Examination Methods of Welds”.

Size and Type of Boiler Tubing to be Examined using LPA Techniques

Boiler tubing to be examined during boiler overhauls will typically be between 1.75” OD and 3.50” OD, between 0.148” MWT and 0.500” MWT, and meet material specifications from ASME, BPVC, Section 1, Power Boilers, Part PG-9, “*Pipes, Tubes, and Pressure Containing Parts*”.

Acceptance/Reject Criteria for LPA Examinations of Boiler Tube Welds

Personnel performing LPA examinations shall exhibit proof of competence through the use of training standards provided by Company. These training standards shall consist of tube weld samples containing known flaws. NDE personnel shall prove their ability to determine acceptance or rejection of these flaws at a 95% rate. The Acceptance/Reject Criteria for LPA Examination are as follows:

- **Crack-like, Incomplete Penetration and Lack of fusion Indications,**

- Rejectable
- **Non-crack-like Indications**
 - i.e. slag inclusion, porosity, etc.
 - Tube MWT < .250", indications exceeding ¼" in length with a height > 1/16",
 - Tube MWT > .250", indications exceeding ¼" in length with a height > 1/8".
- **I.D. variations,**
 - i.e. root concavity, weld reinforcement, etc.:
 - Concavity on the root surface of single-welded butt joints is permitted if the depth of the concavity of the weld metal does not exceed the lesser of 3/32" or 20% of the thinner of the two sections being joined when the resulting thickness of the weld is at least equal to the thickness of the thinner member of the two sections being joined.
 - Abrupt transitions to concavity are not acceptable.
 - Weld reinforcement shall apply to the internal surface as well as the external, and shall not exceed the limits as specified in the ASME applicable code section, or,
 - Tubing material ≤ .375" MWT shall not exceed 1/16" internal weld reinforcement.

The responsible company represented may approve or establish varying criteria from those identified above.

Daily On-Site Reporting Requirements

In order to assist the boiler contractor QC personnel to meet the inspection requirements, as specified by the Company QA/QC Welding Requirements for Boiler Overhauls document, the NDE contractor personnel, performing the LPA inspections will provide the boiler contractor personnel a daily list (reader sheet) of welds that have been examined by the LPA technique.

This reader sheet will contain the following information:

- Location of the weld by boiler system, i.e. low temp superheat, reheater, front coutant slope, etc.
- Weld identification, i.e. tube number, pendent or assembly number, weld elevation, etc.
- Welder(s) identification, i.e. CM, MC, RS, 1234, etc. (any random LPA examinations conducted by the NDE contractor personnel will be marked as "random" for welder identifications.
- Material specification, i.e. SA210-A1, 2.5" O.D., .220" MWT, etc.
- Date of LPA weld examination.
- Results of the examination, which will include:
 - Defect or discontinuity found during examination,
 - Location of discontinuity or defect found during examination,
 - Either acceptance or rejection of the tube weld, per the Company Linear Phased Array criteria,
 - Disposition of rejected weld, including date of re-examination, and acceptance or rejection.

Final Report

NDE Contractor shall provide a final report of LPA examinations of all tube welding conducted during boiler overhaul.

This report shall include the following information:

- Total number of welds examined,
- Total number of welds examined per boiler component, i.e. low temp superheat, reheater, front coutant slope, etc.,
- Total number of rejected welds found during the examinations,
- Total number of rejected welds per boiler component,
- Flaw characterization of rejected welds found during examinations,
- Flaw characterization of rejected welds per boiler component,
- Contractor QA verification of final results.

Electronic copies of all daily reports and the final report will be provided to the Company at completion of the examinations and prior to NDE Contractor LPA personnel leaving the plant site.

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