INSPECTION PROCEDURE 55050

NUCLEAR WELDING GENERAL INSPECTION PROCEDURE

PROGRAM APPLICABILITY: 2512, 2515, 2730

55050-01 INSPECTION OBJECTIVES

01.01 To determine whether the licensee's welding specification and procedures meet applicable ASME Code, regulatory, and contract requirements.

01.02 To determine through direct observation whether welding activities are performed in accordance with the ASME Code and SAR Commitments.

01.03 To review a sample of records to determine whether they are prepared, evaluated and maintained in accordance with the ASME Code, applicable commitments and/or requirements.

01.04 To determine that welding specifications, procedures, production equipment and established licensee quality control systems are adequate for the production of sound welds.

Inspection Schedule

Inspection	Must Be Started	Must Be Completed
1st inspection:	After work is 5% complete	Before work is 15% complete

Subsequent inspections: Periodically until startup of the plant.

The schedule listed above applies to inspection of nuclear construction site and other long-term inspection efforts. For short-duration projects and vendor inspections a different schedule may be more practical.

55050-02 INSPECTION REQUIREMENTS

The inspection requirements contained in this section may be fulfilled during a single inspection or several inspections depending upon type and scope of inspected welding activity. For

short duration projects and vendor inspections, the completion of all requirements listed below may not be practical.

02.01 Base Material and Filler Metal Compatibility for Welding

a. Verify that base metal and welding filler material combinations are as those listed in Table 1 of this procedure.

b. Evaluate base material/filler metal combinations other than those listed in Table 1 to determine the suitability of application.

c. Perform the following verifications related to control and handling of welding materials:

1. Verify that the contractor/licensee has established procedures and instructions for purchasing, receiving, storing, disbursing, and handling of welding materials including welding electrodes, filler material, consumable inserts, fluxes, and gases.

2. Review sufficient sampling of welding material purchasing and receiving records to verify that these operations are conducted in accordance with approved procedures or instructions.

3. Verify that welding material storage procedures, contain requirement for environmental (moisture) control, specify appropriate holding and baking temperatures and out-of-oven exposure time for each class of materials, and that actual practice follows these requirements.

4. Verify that there are effective procedures for limiting electrode moisture pickup and maintaining identification after the welding materials are issued to the welder and that these procedures are strictly enforced.

5. If the contractor/licensee uses a single system for welding material control, verify that this system is conservative and meets the requirements for the most restrictive application and personnel involved are knowledgeable of the system, including material designations.

6. Verify that welding materials are clearly identified at all times in accordance with approved procedures and that identification of acceptable material is retained throughout storage handling and use until the material is actually consumed in the process.

7. Verify that the method for disbursement of welding materials is effective and controlled in accordance with approved procedures and the unused welding materials are scrapped or recycled in accordance with special provisions which include maintaining identification and rebaking of coated electrodes when applicable.

8. Verify by examination of representative records or direct observation that ASME Code required tests are performed on each lot of covered, flux cored or bare electrodes,

rod, or wire, for each heat of consumable inserts and for each combination or bare electrodes and dry blend of flux mix to be used for welding.

02.02 Welding Procedures

a. Verify that the contractor/licensee has established adequate procedures or instructions for preparation, qualification approval/certification, distribution and revision of welding procedure specifications (WPS).

b. Select two welding procedures (WPS) from each welding process or combination of processes used for ASME welding applications and verify conformance with procedures referenced in a,above.

c. Verify that the WPSs(b above) define all essential variables, supplementary essential variables and nonessential variables in accordance with the applicable editions of Section III and IX of the ASME Code.

d. Verify that each of the above procedures has been qualified in accordance with Section III and IX of the ASME Code and that the supporting procedure qualification records (PQRs) are on file.

e. Review PQRs for the above procedures and verify that each PQR lists the essential variables for the specific welding process or processes covered and that the values or ranges of these variables are consistent with those permitted by the WPS and are within the limits of Section IX of the ASME Code.

f. Verify that all mechanical tests required by Section III and IX of the ASME Code (including notch toughness when applicable) have been completed and are properly documented in the PQR.

g. Verify that the PQR has been certified by the contractor/licensee and that the mechanical test results meet or exceed the minimum ASME Code requirements.

h. Verify that in making procedure test plates for butt welds of heavy section materials with 80,000 psi or higher tensile strength, consideration has been given to the effect of angular, lateral and end restraints of the weldment (ASME Section III-NX-4320).

i. Verify that any changes or revisions of the WPS essential variables are supported by requalification of the original WPS or a new WPS.

j. Verify that any changes in the WPS nonessential variables are properly identified and documented either as revisions to the original or a new WPS.

k. Verify that, whenever applicable, the WPSs comply or meet the intent of Regulatory Guides referenced in Section 03 of this procedure.

02.03 Welder Performance Qualification

a. Verify that the contractor/licensee has established procedures for qualification of welders and welding operators in accordance with Section III and IX of the ASME Code. These procedures should include adequate provisions to preclude falsification of welders and welding operators qualifications.

b. If practical, sample adequate number of welders taking the qualification tests and confirm by positive identification that the person welding the test weldment is indeed the person being qualified.

c. Verify that the contractor/licensee has a workable system for maintaining a continuous record of the qualification status of all welders and welding operators and that this system is effectively utilized and accurate.

d. Verify by review of the qualification status records that welders and welding operators performing production welding have been and are currently qualified to weld under the respective procedures.

02.04 Production Welding

a. Survey ongoing welding activities and select typical in-process operations representing different welding processes, procedures, and joint configurations for detailed review. Perform the following verifications:

1. Verify that work is conducted in accordance with a "traveler" or similar document which coordinates and sequences all operations, references procedures or instructions, establishes hold points, and provides for production and QC signoffs. This document should be available at the work station.

2. Verify that welding procedures, detailed drawings and instructions if applicable, and weld data sheets are at the work station or readily available.

3. Verify that the WPS assignment is in accordance with the applicable ASME Code requirements. This is accomplished by comparing the essential variables of the WPS with the production weld.

4. Verify that welding technique and sequence requirements are specified.

5. Verify that the base metals, welding filler materials, fluxes, gases, and backing materials are of the specified type and grade, have been properly inspected, tested, and identified and are traceable to test reports or certifications.

6. Verify that weld joint geometry is as specified and that surfaces to be welded have been prepared, cleaned, and

inspected in accordance with applicable procedures or instructions.

7. Verify that parts to be welded are assembled and held in place within specified gap and alignment tolerances and verify that the alignment is within limits allowed by the ASME Code.

8. Verify that temporary attachments such as bridging bars or fit-up clips have been attached by qualified welders, in accordance with qualified WPS.

9. Verify that gas purging, if specified, is used in accordance with the applicable procedure and that protection is provided to shield the welding operation from adverse environmental conditions.

10. Verify that preheat, if specified, is in accordance with applicable procedures requirements.

11. Verify that the technique of each welder is in accordance with the welding procedure.

12. Verify that welding electrodes are used only in the positions and with the electrical characteristics specified in the welding procedure.

13. Verify that shielding gas flow and composition is as specified in the WPS.

14. Verify that shielding gas flowmeters indicate the gas type for which they are applicable and have appropriate conversion factors if a different gas or gas mixture is used for work under review.

15. Verify that welding equipment, including power cables and gas lines, is in good condition and that ammeters and voltmeters used for automatic welding have been calibrated in accordance with applicable procedure requirements.

16. Verify that interpass temperature is controlled in accordance with specified requirements. The interpass temperature for welding austenitic stainless steels and high nickel alloys should not exceed 350°F.

17. Verify that interpass cleaning, grinding (especially starts and stops) and peening are conducted in accordance with applicable procedure.

18. Verify that backgouging, if applicable, is performed as specified.

19. Verify that temporary attachments, arc strikes and weld splatter are removed and inspected in accordance with specified procedures.

20. Verify that the process control system (travelers) have provisions for weld repairs and that approved procedures or instructions are available which describe or reference acceptable methods of defect removal and weld repair.

21. Verify by direct observation and/or record review that repairs are conducted in accordance with specified procedures.

    This verification should include:

    (a) Review of weld repair consistent of mechanical removal of surface defects with no rewelding.

    (b) Review of repair involving metal removal by chipping, grinding or machining followed by rewelding.

    (c) Review of a repair involving metal removal by thermal cutting or gouging followed by rewelding.

22. Verify that any repairs to the base metal are properly documented in a special report as required by Section III of the ASME Code (NB 4132). Verify that any repairs of modifications to ASME Code-stamped components are properly documented in a special report as required by ASME Sections III and XI.

23. Identify all welders and welding operators observed during inspection of joint fitup, welding and weld repair for qualification review per 02.03 above.

24. Verify, if applicable, that no peening has been done on the root and surface layer of the weld or base metal at the edges of the weld.

25. Verify that the contractor/licensee has a periodic preventive maintenance program for welding equipment used for welding safetyrelated materials.

02.05 Preheat and Post Weld Heat Treatment

a. Verify that approved procedures are available for weld joint preheating when required by a welding procedure specification. These procedures should specify acceptable preheating methods and provide requirements for monitoring and recording preheat temperature before, during and, if specified, after welding until post weld stress relief.

b. Sample sufficient number of in-process components to verify that preheat control procedures are being followed in production welding.

c. Verify that the preheat used in production welding is within the limits specified by the welding procedure.

d. Verify that approved procedures are available for the conduct of postweld heat treatment and that the fabricator has a

system capable of meeting the heating and cooling rates, metal temperature, temperature uniformity and control limits specified in Section III of the ASME Code. The procedures should cover furnace as well as local heating if both methods are used in production.

e. If furnace heating is used, verify that furnace atmosphere is controlled as specified in approved procedure.

f. Review a sufficient sampling of PWHT operations (in-process and records) to assure that the following items are satisfied.

1. Verify that components are instrumented to provide time-temperature recordings for the duration of the entire heat treatment cycle (both furnace and local HT).

2. Verify that sufficient thermocouples are used to measure the anticipated hottest and coldest temperatures of the weld during holding at temperature and to measure temperature variation within any 15-foot interval of weld length during heating or cooling. This variation must not exceed 250°F.

3. Verify that the PWHT temperature and holding time is specified, is adhered to and is consistent with ASME Code (NX-4600) requirements based on the material type and wall thickness.

4. Verify that the maximum initial furnace temperature, heatup and cool-down rates are specified, are adhered to and are consistent with the ASME Code (NX-4600) requirements.

g. Verify that procedures are available for conduct of intermediate or "non-code" stress relief of in-process components if such treatments are used in component fabrication.

h. Verify that temperature control is exercised on in-process components which are required to be maintained at pre-heat or other specified temperature for extended time periods while awaiting further processing.

i. Verify that measures are taken to avoid sensitization of austenitic stainless steel and high-nickel alloys during stress relief treatments. This generally involves provisions which preclude furnace stress-relieving of austenitic stainless steel components or parts and limit their exposure to sensitization temperature range (800-1500°F).

j. Examine cumulative stress-relief records for typical component welds and verify that the total time at temperature does not exceed that permitted by Section III of the ASME Code based on the welding procedure qualification records.

02.06 Examination of Welds

a. Select welds produced by different welding processes, procedures, and combination of procedures, and verify by visual examination that the following characteristics conform to the applicable ASME Code and fabricators welding procedure requirements:

   1. Weld surface finish and appearance. Include inside diameter of pipe welds when accessible.

   2. Transitions between components of different diameters and wall thickness.

   3. Weld reinforcement.

   4. Shape and size of fillet and socket welds.

   5. Joint configurations of permanent attachments and structural supports to clad components.

   6. Removal of temporary attachments, arc strikes and weld spatter.

   7. Finish-grinding or machining of weld surface - verify absence of wall thinning.

   8. Absence of surface defects including cracks, laps, lack of penetration, lack of fusion, porosity, slag, oxide film and undercut exceeding prescribed limits.

b. Verify that approved procedures are available for the nondestructive examination of the weld when required by the ASME Code and/or contact requirements.

c. Verify that the fabricator's nondestructive procedures meet the ASME Code and/or contract requirements. To accomplish this, select the applicable nondestructive examination method and inspect per IE Procedures 57050, 57060, 57070, 57080 or 57090 as required.

55050-03 INSPECTION GUIDANCE

General Guidance. The IE inspector performing the inspection under this procedure should be thoroughly familiar with the requirements contained in Sections III and IX of the ASME Code. The knowledge of welding and techniques, their applications, limitations and evaluations, is essential for this inspection. The intent of this procedure is to achieve an in-depth review of the overall welding activities taking place at the construction site. It is intended that early in the construction phase of the plant a cognizant IE inspector will perform this inspection in order to advise the regional management about potentially troublesome areas and identify any significant deficiencies which need correction.

Periodic assessments of the welding activities performed by a cognizant IE inspector will be required throughout the construction phase of the plant. This procedure should be used also in cases

when the regional management have reasons to believe that the welding performed on the site does not meet established practices and standards; e.g., serious allegations related to welding, and discovery of significant welding problems which will lead to degradation of hardware etc.

This inspection of the nuclear welding activities performed on the site as outlined in this procedure can be described as a four-phase progressive review: First, prior to performing an inspection the inspector familiarizes himself with the requirements pertaining to the particular site scheduled for inspection. Second, the licensee's procedures and practices are reviewed. Third, the work is observed to determine that the work is accomplished in accordance with these procedures and practices. Finally, records are reviewed to verify that they are complete, accurate and retrievable. It is estimated that at least three weeks of actual site inspection will be needed to perform the required in-depth review of items b through d below. The complete inspection of welding activities at the site can be accomplished during a single inspection or by the completion of each phase of the procedure during several inspections. Additional guidance concerning each phase of inspection is provided below:

a. Preparation for Inspection. Prior to performing an inspection in accordance with the requirements of this procedure, the IE Inspector should review the following:

    1. NRC requirements.

    2. Licensees' commitments relative to applicable Codes and standards; e.g., which Addenda of the ASME Code applies to this site.

    3. NSSS vendor specification pertaining to welding.

    4. NSSS/AE vendor interface requirements relevant to balance of plant.

    5. Applicable portions of the SAR.

    6. Licensees' programs and procedures pertaining to the subject.

    7. Applicable portions of the QA Manual.

    8. Licensees' commitments relative to welding and associated activities.

b. Review of Welding Specification and Procedures. The inspector should perform the following reviews:

    1. Identify contractors or fabricators performing welding at the site.

    2. Identify which welding processes are used at the site and perform a review of all welding procedures used in

production welding in accordance with the applicable paragraphs of Section 02 of this procedure.

3. Determine whether the welding procedures being used meet all of the ASME Code and additional contract requirements (if any). Establish whether the use of these procedures will result in the production of sound welds suitable for the intended application.

c. Work Observations. The IE inspector should select for work observation a sample of welds composed of a combination of systems and welding contractors associated with the work. The selected welds should also represent a good cross section of the production activities in terms of welding processes used (SMA, TIG, etc.) and materials to be welded (stainless steel, carbon steel, etc.). Considerations such as physical location, difficulties to weld and limited accessibility should be also incorporated in the sample selection. The total number of sampled welds selected for observation should be at least thirty (30) but need not be greater than sixty (60), since statistically a greater sample size will not significantly increase the confidence interval of the sampled production welding. However, it is very important that the inspected sample is representative of all ongoing production welding.

d. Record Review. The IE inspector should review all of the relevant documentation related to a sample of at least thirty (30) randomly selected welds for each ASME subsection (e.g., NB, NC, ND, etc. For subsection NG, "core support structures", the sample size can be reduced at the discretion of the inspector). Same considerations as those stated in c above are applicable. It is preferable that the welds identified for record review are not the same welds identified for work observation. However, certain circumstances may necessitate the use of some of the welds sampled in c above (e.g., contractor/licensee has completed only three welds to date and all three welds need to be included in the sample to provide meaningful statistical representation).

The sampled weld records must be inspected in accordance with the applicable paragraphs of Section 02 of this procedure.

55050-04 REFERENCES

10 CFR 50, Appendix B, Criterion IX

ASME Boiler and Pressure Vessel Code Section III and IX

Safety Analysis Report, Chapters 1, 3, 5, 6 and 17

Regulatory Guide 1.31, Control of Ferrite Content in Stainless Steel Weld Metal.

Regulatory Guide 1.44, Control of the Use of Sensitized Stainless Steel

Regulatory Guide 1.50, Control of Preheat Temperature for Welding of Low-Alloy Steel

Regulatory Guide 1.58, Qualification of Nuclear Power Plant Inspection, Examination, and Testing Personnel

Regulatory Guide 1.71, Welder Qualification for Areas of Limited Accessibility

Regulatory Guide 1.85, Materials Code Case Acceptability ASME Section III Division 1

Regulatory Guide 1.88, Collection, Storage and Maintenance of Nuclear Power Plant Quality Assurance Records

END

TABLE 1

BASE MATERIAL AND FILLER METAL COMPATIBILITY

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