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U.S. ATOMIC ENERGY COMMISSION

REGULATORY GUIDE

DIRECTORATE OF REGULATORY STANDARDS

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WELDER QUALIFICATION FOR AREAS OF LIMITED ACCESSIBILITY

A. INTRODUCTION

General Design Criterion 1, "Quality Standards and Records," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, "Licensing of Production and Utilization Facilities," requires that structures, systems, and components important to safety be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety function to be performed. Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50 requires that measures be established to assure control of materials and of special processes such as welding, and that proper welder qualifications be performed. Section 50.55a, "Codes and Standards," of 10 CFR Part 50 requires, in part, that components of the reactor coolant pressure boundary be designed, fabricated, erected, and tested in accordance with the requirements of Section III, "Nuclear Power Plant Components," of the American Society of Mechanical Engineers (ASME) Code or equivalent quality standards. This guide describes a method acceptable to the Regulatory staff for implementing these requirements with regard to the control of welding for nuclear components. This guide applies to light-water-cooled and gas-cooled reactors. The Advisory Committee on Reactor Safeguards has been consulted concerning this guide and has concurred in the regulatory position.

B. DISCUSSION

The American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section III, "Nuclear Power Plant Components," and Section VIII, "Pressure Vessels," [1] specify requirements for fabricating Class 1, 2, and 3 components.

Performance Qualification

Section III and Section VIII require adherence to ASME Boiler and Pressure Vessel Code, Section IX, "Welding Qualifications." [1] One of the requirements is welder qualification for production welds. Review of the requirements of Section IX for performance qualifications indicates the desirability of supplementary requirements to provide better control of welder technique in the production welding of low-alloy and high-alloy steels. Specifically, the assurance of satisfactory welds in locations of restricted direct physical and visual accessibility can be increased significantly by qualifying the welder under conditions simulating the space limitations under which the actual welds must be made.

Experience has shown that a welder qualified to weld components under normal fabricating conditions may not produce acceptable welds if the accessibility to the weld area is restricted. Limited accessibility can occur when component parts are joined or repaired in the final assembly or at the plant site where other adjacent components or structures prevent the welder from assuming an advantageous position during the welding operation. This disadvantage is particularly important in the welding of high-alloy steels and nickel base alloys because welder technique such as electrode manipulation is an important variable in the welding procedure.

Section IX, paragraph Q-22, specifies conditions for which a welder must requalify, but it lacks specific

[1] Copies may be obtained from American Society of Mechanical Engineers, United Engineering Center, 345 East 47th Street, New York, N.Y. 10017.

ference to conditions with limited accessibility and visibility. It is general practice in nuclear ship building to include requirements for welder accessibility to production welds. This practice requires that conditions of restricted welder accessibility to a production weld be simulated when the clearance is less than 30 cm (12 inches) in any direction from the joint. However, requalification would not be required for different restricted accessibility conditions unless other essential elements listed in Section IX are changed.

Section IX, paragraph Q-3, specifies test positions for groove welds. Positions 2G and 5G with a corner structural enclosure which limits access to within 30 to 35 cm (12 to 14 inches) on two sides and overhead would provide acceptable simulation of welder accessibility. Evaluation of tests should be in accordance with Section IX with at least one test specimen representing the least favorable position imposed on the welder.

As an alternative, the structure to be welded, including its actual access limits, may be simulated. From this mockup, one test specimen should be taken from the weld location representing the least favorable position imposed on the welder. The test specimen should be evaluated in accordance with the radiographic requirements of Section IX, paragraphs Q-24(d) and Q-25(3). In addition, the test section should be sectioned for macro examination and hardness evaluation of the composite weldment with particular attention to the root fusion and weld toe conditions.

Production Welds

The welding qualification (procedure and performance) by itself does not assure that the production welds will be made within the specified requirements. To assure that the welds will be acceptable, the welding process should be audited for correct application of procedure parameters and welder technique.

C. REGULATORY POSITION

Weld fabrication and repair for wrought low-alloy and high-alloy steels, including nickel base alloys, or other materials such as static and centrifugal castings and bimetallic joints should comply with the fabrication requirements specified in Section III [2] and Section IX [3] supplemented by the following:

1. The performance qualification should require testing of the welder under simulated access conditions when physical conditions restrict the welder's access to a production weld to less than 30 to 35 cm (12 to 14 inches) in any direction from the joint.

2. Requalification is required:

   a. when significantly different restricted accessibility conditions occur, or
   b. when any of the essential welding variables listed in Section IX are changed.

3. Production welding should be monitored and adherence to welding qualification requirements should be certified.

[2] ASME B&PV Code, Section III
[3] ASME B&PV Code, Section IX