



# REGULATORY GUIDE

## OFFICE OF NUCLEAR REGULATORY RESEARCH

### REGULATORY GUIDE 1.71

(Draft was issued as DG-1167, dated October 2006)

## WELDER QUALIFICATION FOR AREAS OF LIMITED ACCESSIBILITY

### A. INTRODUCTION

This guide describes a method that the staff of the U.S. Nuclear Regulatory Commission (NRC) considers acceptable for implementing the agency's requirements regarding the control of welding for nuclear components, as they relate to light-water-cooled and gas-cooled reactors. In particular, General Design Criterion 1, "Quality Standards and Records," as specified in Appendix A, "General Design Criteria for Nuclear Power Plants," to Title 10, Part 50, of the *Code of Federal Regulations* (10 CFR Part 50), "Domestic Licensing of Production and Utilization Facilities" (Ref. 1) requires that structures, systems, and components important to safety shall be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed.

To augment that requirement, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50 requires the establishment of measures to ensure the control of materials and special processes such as welding, as well as proper welder qualification. Moreover, 10 CFR 50.55a, "Codes and Standards," requires, in part, that components of the reactor coolant pressure boundary must be designed, fabricated, erected, and tested in accordance with the standards in Section III, "Nuclear Power Plant Components," of the Boiler and Pressure Vessel Code (Ref. 2) promulgated by the American Society of Mechanical Engineers (ASME), or equivalent quality standards.

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## **B. DISCUSSION**

Section III, “Nuclear Power Plant Components,” of the ASME Code (Ref. 2) specifies standards for fabricating Class 1, 2, and 3 components.

### **Performance Qualification**

Section III of the ASME Code provides for adherence to Section IX, “Welding Qualifications,” which, in turn, calls for welder qualification for production welding. In particular, review of the performance qualifications in Section IX indicates the desirability of supplementary requirements to provide improved control of welder technique in the production welding of low-alloy and high-alloy steels. Specifically, the assurance of satisfactory welds in locations with restricted direct physical and visual accessibility can be significantly increased by qualifying the welder under conditions simulating the space limitations under which the actual welds must be made.

Experience has shown that a welder who is qualified to weld components under normal fabricating conditions may not produce acceptable welds if 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 if the location and other adjacent components or structures prevent the welder from assuming an advantageous position during the welding operation. Limited accessibility is particularly disadvantageous 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 QW-350, specifies conditions for which a welder must requalify, but it lacks a particular reference to conditions with limited welder positioning, accessibility, and visibility. It is general practice in nuclear shipbuilding and petrochemical process piping fabrication to include requirements for welder positioning, accessibility, and visibility to production welds. This practice involves simulating the conditions of restricted welder accessibility to a production weld when the clearance is less than 30 centimeters (12 inches) in any direction from the joint. Requalification would not be required for various restricted accessibility conditions unless the welder performance qualification essential variables of QW-350 changed or the qualification expires per QW-320.

For example, Section IX, paragraph QW-303, defines limits of qualified positions and diameters, and paragraph QW-461 specifies test positions for groove welds. Welding in both positions 2G and 5G, or welding in position 6G, with a corner structural enclosure that limits access to within 30 centimeters (12 inches) on two sides and overhead, may provide an acceptable simulation of welder accessibility. These tests should be evaluated in accordance with Section IX, with at least one test specimen representing the least favorable position, access, and visibility imposed on the welder.

As a preferred alternative, the structure to be welded (including its actual access limits) may be simulated. Using this mockup, one test specimen should be taken from the weld location representing the least favorable position imposed on the welder, and this specimen should be evaluated in accordance with Article III, Welding Performance Qualifications, of Section IX.

## **Production Welds**

The performance qualification of welding with limited accessibility, by itself, does not ensure that production welds with limited accessibility will conform to the specified criteria. To better ensure that welds are acceptable, production welding should be monitored to verify correct application of procedure parameters, welder technique, and limited accessibility qualification criteria.

### **C. REGULATORY POSITION**

Weld fabrication and repair should comply with the fabrication standards specified in Sections III and IX of the ASME Code, supplemented by the following:

- (1) Performance qualification should provide for testing the welder or welding operator under simulated access, and visibility limitations when physical conditions restrict the welder's access to a production weld to less than 30 centimeters (12 inches) in any direction from the joint and which would affect electrode manipulation, or bead progression, or require an indirect means of weld pool observation (such as a mirror).
- (2) Requalification should be necessary when (a) the use of an indirect means is required to view the weld pool (such as a mirror) during production welding and the welder or welding operator did not qualify for welding in areas of limited accessibility using that indirect means of weld pool observation, or (b) any of the essential welding variables for welders (QW-350) or welding operators (QW-360) listed in Section IX change, or (c) the qualification expires per QW-320.
- (3) Production welding and adherence to welding qualification criteria should be monitored.

## **D. IMPLEMENTATION**

The purpose of this section is to provide information to applicants and licensees regarding the NRC staff's plans for using this regulatory guide. No backfitting is intended or approved in connection with its issuance.

Except in those cases in which an applicant or licensee proposes or has previously established an acceptable alternative method for complying with specified portions of the NRC's regulations, the methods described in this guide will be used in evaluating (1) submittals in connection with applications for construction permits, standard plant design certifications, operating licenses, early site permits, and combined licenses; and (2) submittals from operating reactor licensees who voluntarily propose to initiate system modifications if there is a clear nexus between the proposed modifications and the subject for which guidance is provided herein.

### **REGULATORY ANALYSIS / BACKFIT ANALYSIS**

The regulatory and backfit analyses for this regulatory guide are available in Draft Regulatory Guide DG-1167, "Welding Qualification for Areas of Limited Accessibility" (Ref. 3). The NRC issued DG-1167 in October 2006 to solicit public comment on the draft of this Revision 1 of Regulatory Guide 1.71.

## REFERENCES

1. *U.S. Code of Federal Regulations*, Title 10, *Energy*, Part 50, “Domestic Licensing of Production and Utilization Facilities.”<sup>1</sup>
2. ASME Boiler and Pressure Vessel Code, American Society of Mechanical Engineers, New York, NY, 1992.<sup>2</sup>
3. Draft Regulatory Guide DG-1167, “Welding Qualification for Areas of Limited Accessibility,” U.S. Nuclear Regulatory Commission, Washington, DC.<sup>3</sup>

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<sup>1</sup> All NRC regulations listed herein are available electronically through the Public Electronic Reading Room on the NRC’s public Web site, at <http://www.nrc.gov/reading-rm/doc-collections/cfr/>. Copies are also available for inspection or copying for a fee from the NRC’s Public Document Room at 11555 Rockville Pike, Rockville, MD; the PDR’s mailing address is USNRC PDR, Washington, DC 20555; telephone (301) 415-4737 or (800) 397-4209; fax (301) 415-3548; email [PDR@nrc.gov](mailto:PDR@nrc.gov).

<sup>2</sup> Copies of ASME standards discussed herein may be obtained from the American Society of Mechanical Engineers, Three Park Avenue, New York, New York 10016-5990; telephone (800) 843-2763; <http://www.asme.org/Codes/Publications/>.

<sup>3</sup> Draft Regulatory Guide DG-1167 is available electronically under Accession #ML062840416 in the NRC’s Agencywide Documents Access and Management System (ADAMS) at <http://www.nrc.gov/reading-rm/adams.html>. Copies are also available for inspection or copying for a fee from the NRC’s Public Document Room (PDR), which is located at 11555 Rockville Pike, Rockville Maryland; the PDR’s mailing address is USNRC PDR, Washington, DC 20555-0001. The PDR can also be reached by telephone at (301) 415-4737 or (800) 397-4209, by fax at (301) 415-3548, and by email to [PDR@nrc.gov](mailto:PDR@nrc.gov).