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Contract No. NRC–02–06–021
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U.S. Nuclear Regulatory Commission
ATTN: Mr. Tyrone D. Naquin
Office of Nuclear Materials Safety and Safeguards
Division of Fuel Cycle Safety and Safeguards
11555 Rockville Pike
Mail Stop: E2 C40
Rockville, MD 20852

Subject: Final Inspection Report—Evaluation of Alternate Acceptance Criteria for Visual Inspection of Welds for Louisiana Energy Services (Intermediate Milestone 12824.04.004.950)

Dear Mr. Naquin:

Enclosed is the Center for Nuclear Waste Regulatory Analyses document, Evaluation of Alternate Acceptance Criteria for Visual Inspection of Welds for Louisiana Energy Services Facility Cascades, Eunice, New Mexico. This document serves as the deliverable for the subject intermediate milestone.

Please contact me at (210) 522-5282 or Asad Chowdhury at (210) 522-5151 if you have any questions about this document.

Sincerely,

for Todd Mintz, Ph.D.
Program Manager
Licensing and Inspection Program for
Reactors, Fuel Fabrication, Enrichment, and
Interim Storage Spent Fuel

TM:nn

cc:

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EVALUATION OF ALTERNATE ACCEPTANCE CRITERIA FOR VISUAL INSPECTION OF WELDS FOR LOUISIANA ENERGY SERVICES FACILITY CASCADES, EUNICE, NEW MEXICO

Prepared for

U.S. Nuclear Regulatory Commission
Washington, DC
Contract NRC–02–06–021

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SCOPE OF INSPECTION REVIEW

The scope of this review was to assess the alternate acceptance criteria for visual inspection of welds of moment-resisting steel frame cascade structures of the Louisiana Energy Services (LES) uranium enrichment facility at Eunice, New Mexico, as proposed by LES. Use of appropriate alternate acceptance criteria for visual inspection of structural steel welds follows the American Welding Society Structural Welding Code AWS D1.1 (AWS, 2006). This review is based on the information provided in LES Technical Question EG–TQ–2010–404 dated February 2, 2011; LES responses to U.S. Nuclear Regulatory Commission (NRC) requests for additional information (RAIs), including several documents cited in EG–TQ–2010–404; LES submittal on battleship attachment welds dated February 18, 2011; LES responses to NRC RAIs on battleship attachment welds dated April 27 and June 2, 2011; and limited followup visual inspection information on upper cascade steel welds of Cascade 3.

CONDITION DESCRIPTION

The cascades of the LES facility at Eunice, New Mexico, are made of welded, moment-resisting, structural steel frames. These steel frames have been designed to the requirements of American National Standard Institute/American Institute of Steel Construction, Inc. specification ANSI/AISC N690–06 (ANSI/AISC, 2007) and were fabricated to the requirements of American Welding Society Structural Welding Code AWS D1.1 (AWS, 2006). However, the sampling visual inspection of Cascade 1 bare metal weld surfaces revealed that some welds did not meet the acceptance criteria of AWS D1.1, Table 1. To qualify the welds, with or without repairs, the applicant proposed alternate acceptance criteria for visual inspection of welds as allowed by AWS D1.1 (AWS, 2006, Section 6.8).

ASSESSMENT OF DISPOSITION

The disposition is to (i) use the proposed alternate acceptance criteria for visual inspection of welds through paint for other cascades of the LES uranium enrichment facility at Eunice and (ii) "use as is" critical welds of Cascades 4 and 3. The LES activities include (i) selecting representative critical welds for Cascade 4, (ii) selecting representative critical welds for all other cascades, (iii) examining representative critical welds of Cascade 4 through paint, (iv) inspecting the bare metal surface after removing paint from the same representative critical welds of Cascade 4 that have been examined through paint, (v) validating the alternate criteria of examining welds through paint by comparing the results of (iii) and (iv) noted previously, and (vi) assessing the long-term safety of cracked welds.

LES considered the upper cascade steel welds and welds of battleship attachments to be the representative sample of critical welds of Cascade 4 because of their higher utilization factors compared to welds of other areas of Cascade 4. The upper cascade steel of Cascade 4 has 2,874 fillet welds, 522 groove welds, welds in the H-frames and mobile wall, and 38 welds in the front and back frame connectors (i.e., welds in the battleship attachments). The groove, H-frame, and mobile wall welds have been either verified as acceptable or found not critical. Based on the documents reviewed for this assessment, as identified previously under "Scope of Inspection Review," out of 2,874 fillet welds in the upper cascade steel of Cascade 4, 1,843 fillet welds in Rows 1–3 were examined through paint and 1,795 through bare metal surface inspection because 48 fillet welds were not accessible. LES considers these 1,843 fillet welds of upper cascade steel to be representative samples of 2,874 fillet welds because the other 1,031 welds have similar construction. All eight cascades of the LES facility, including

Cascade 4, were (i) fabricated by the same fabricator, using identical drawings, with similar utilization factors for similar joints and (ii) painted using the same paint and application process. Based on these similarities, LES considers the validation of the alternate acceptance criteria for Cascade 4 upper cascade steel and battleship attachments to validate these alternate acceptance criteria for visual inspection of welds of the other seven cascades of the LES facility at Eunice.

The bare metal surface inspection of upper cascade steel welds of Cascade 4 identified gouges (2), cracks (9), porosity (13), undercuts (26), craters (38), and lack of fusion (375). All weld discontinuities are potentially concerning because they can serve as locations for fatigue crack initiation or growth. However, for critical welds at the upper cascade steel, there is no fatigue loading under operating conditions and the number of alternating load cycles under design basis seismic loading is very small. Furthermore, lack of fusion indications that constitute 80 percent of discontinuities do not have crack tips for fatigue crack initiation and growth. Furthermore, in calculating the design strength of welds and their utilization factors, LES alternate acceptance criteria also assume that weld discontinuities do not carry any load.

In Technical Question EG–TQ–2011–404, Table 2, the applicant provided results of examination through paint of 1,843 critical welds of upper cascade steel of Cascade 4 and inspection of bare metal surfaces after removing paint from 1,795 of these critical welds. Examination through the paint found 273 welds with nonconforming indications, whereas bare metal inspection found 414 welds with nonconforming indications. Although the examination through paint missed 213 nonconforming indications that were identified by bare metal inspection, LES provided analysis and explanation to show that no structurally significant problems were found by the bare metal inspection after having been missed by examination through the paint.

There are a total of 30 welds in the battleship components, which include the two battleships and two connectors for each. There are two groove welds (one for each battleship) and 28 fillet welds. There are an additional eight welds that are not part of the battleship attachments but which have been labeled as battleship parts. These eight welds are the ones in which the battleship connector plate is welded to the turnbuckle plate.

All 28 fillet welds on the battleship attachments and the 8 welds of battleship parts were inspected both through the paint and with the paint removed. Any flaws identified in these 36 welds during the through-paint inspections were also identified during the corresponding bare metal inspections, except for the weld leg size. During the process, the inspectors were told not to measure the welds for the leg size during the inspections through the paint. Had the inspectors been instructed to do so, then the defects of this type also would have been identified through paint. The two groove welds for battleship attachments were not inspected due to inaccessibility of the welds; however, in Technical Question EG–TQ–2010–061, LES stated that these 2 groove welds are parts of additional design features that are not needed to carry the design load. One fillet weld had a 10-mm lack of fusion. This lack of fusion and undersize of some battleship welds did not affect the design load carrying capacity of battleship attachments.

In response to NRC RAIs on battleship attachment welds, LES provided on June 6, 2011, results of bare metal and through-paint inspections of an additional 176 welds of Cascade 4. For these welds, all the flaws identified during the through-paint inspections were also identified during bare metal inspections. LES determined use as is for all critical welds of Cascade 4, including welds of battleship attachments.

In a followup inspection of the upper cascade steel of a portion of Rows 1–2 of Cascade 3, LES conducted 333 bare metal inspections that followed through-paint inspections. These inspections identified 31 nonconforming indications. Similar to the results of Cascade 4 welds inspection, although the examination through paint in Cascade 3 missed 11 nonconforming indications that were identified by bare metal inspection, LES provided rationale for determining use as is.

In summary, statistical comparisons between examination through paint and bare metal surface inspection after removal of paint are limited due to the analysis of the critical welds from three rows of upper cascade steel and battleship attachments from Cascade 4 and, to a lesser extent, from a portion of two rows from Cascade 3. LES provided summary statistics on the identified and unidentified nonconforming indications in the welds when using the two inspection procedures. Using this information, inspection through the paint shows weaknesses, such as a large number of false and missed calls. The analysis and explanation LES provided for 6 of 7 welds of Cascade 4 whose utilization factors exceed 90 percent are acceptable. However, staff found inadequate, the explanation provided for the (i) seventh weld (2667–102–A–A–C–C–F3B) of Cascade 4 that also has more than a 90 percent utilization factor and (ii) two welds of Cascade 3, which failed the alternate acceptance criteria. Nevertheless, these three welds represent a very small percentage of the total welds inspected in Cascades 3 and 4.

Staff determine that there is support for accepting usage of the alternate acceptance criteria to examine welds through paint for the other cascades of the LES uranium enrichment facility at Eunice. This is based on (i) the assertions that the cascades of LES facility in Eunice were fabricated by the same fabricator, using identical drawings, had similar utilization factors for similar joints, and were painted using the same paint and application process and (ii) a combination of structural redundancy, overall low utilization factors of critical welds, and absence of fatigue loads on two welds. Staff also determine that the LES disposition of use as is for critical welds of Cascades 3 and 4 is reasonable.

The validity of the assessment presented herein is limited to the particular design and construction of the welds at the LES facility in Eunice, including type and application technique of paint.

REFERENCES

AWS (American Welding Society). "Structural Welding Code—Steel." AWS D1.1/D1.1M:2006. Miami, Florida: American Welding Society. 2006.

ANSI/AISC (American National Standard Institute/American Institute of Steel Construction, Inc.). "Specifications for Safety-Related Steel Structures for Nuclear Facilities." ANSI/AISC N690-06. Chicago, Illinois: American National Standard Institute/American Institute of Steel Construction, Inc. 2007.