

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

*Prepared for*

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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 is allowed by 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-2010-004 dated February 2, 2011; LES responses to NRC Requests for Additional Information, including several documents cited in EG-TQ-2010-004; and limited followup visual inspection information on welds of upper cascade steel of Cascade 3. This inspection review and assessment do not include the welds of "battleship" attachments that have lesser structural redundancy and higher utilization factors.

## **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 N-690 (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 per the acceptance criteria of AWS D1.1, Table 1 revealed that some of the welds did not meet the criteria of this table. 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 all 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 of the bare metal surface after removal of paint of 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 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 welds in the front and back frame connectors (i.e., welds in the "battleship" attachments). The groove welds and H-frame and mobile wall welds have been either verified as acceptable or found not critical, and LES inspection of "battleship" attachment welds is continuing. 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 to be validation of 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 identified gouges (2), cracks (9), porosity (13), undercuts (26), craters (38), and lack of fusion (375). A potential concern with all these weld discontinuities is that 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 that constitutes 80 percent of discontinuities does not have a crack tip for fatigue crack initiation or 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-2011-004, Table 2, the applicant provided results of examination through paint of 1,843 critical welds of Cascade 4 and inspection of bare metal surface after removal of paint of 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 have been identified by bare metal inspection, LES provided analysis and explanation to show that no cases were identified where a structurally significant problem was found by the bare metal inspection after having been missed by examination through the paint. LES determined "use-as-is" for critical welds of Cascade 4.

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 following conducting inspection through paint. In these inspections, 31 nonconforming indications were identified. Similar to the results of Cascade 4 welds inspection, although the examination through paint in Cascade 3 missed 11 nonconforming indications that have been 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 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 calls and missed calls. The analysis and explanation provided by LES for six of seven welds of Cascade 4 whose utilization factors are more than 90 percent is acceptable. However, the explanation provided for the seventh weld (2667-102-A-A-C-C-F3B) of Cascade 4 that also has more than 90 percent utilization factor and two welds of Cascade 3 which failed the alternate acceptance criteria is inadequate. But these three welds represent a very small percentage of the total welds inspected in Cascades 3 and 4.

Based on the (i) assertions that the eight cascades were fabricated by the same fabricator, using identical drawings, with similar utilization factors for similar joints, and were painted using the same paint and application process and (ii) because of a combination of structural redundancy, overall low utilization factors of critical welds, and absence of fatigue loads on

welds, staff determine that there is support for accepting usage of the alternate acceptance criteria for examination of welds through paint for the other cascades of the LES uranium enrichment facility at Eunice. Staff also determine that the LES disposition of "use-as-is" for critical welds of Cascades 3 and 4 is reasonable (note that these determinations do not apply to welds of "battleship" attachments).

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

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 Institute of Steel Construction, Inc. 2007.