



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555
FEB 14 1985

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Docket No. 50-482

MEMORANDUM FOR: B. D. Liaw, Chief
Materials Engineering Branch
Division of Engineering

THRU: *[Signature]* Warren S. Hazelton, Section Chief
Materials Application Section
Materials Engineering Branch

FROM: David E. Smith
Materials Application Section
Materials Engineering Branch

SUBJECT: REPORT ON VISIT TO WOLF CREEK GENERATING STATION
IN SUPPORT OF REGION IV CONCERNING STRUCTURAL STEEL
WELDING

On February 7, 1985, NRC Region IV requested that an NRR representative be present on site the next day to assist in the inspection of coated structural steel weldments at the Wolf Creek Generating Station. Earlier, Region IV had already asked for assistance from Region I to perform an independent visual and nondestructive examination (magnetic particle) of the structural steel welds. David E. Smith, Materials Engineering Branch, Division of Engineering, arrived at the Wolf Creek Generating Station site on February 8 and 9, 1985, to join with Lawrence E. Martin of Region IV, Harry W. Kerch of Region I, and other members of Region I examination team.

The attachment to this memorandum summarizes the events leading to the applicant's decision to reinspect 100% of the safety-related, significant structural steel weldments at this facility; the basis for the examination through coatings as appropriate; and the results of an NRC independent inspection of sample paint-stripped joints.

The magnetic particle (MT) inspections by Region I inspectors of fifty-three (53) joints, stripped of coatings, out of a total of 1300 coated joints in the reactor building was a valid sample of all of the welds in the reactor building. No rejectable flaws were detected in the sample, and accordingly, the maximum number of rejectable flaws in the population would be 3.25 joints; i.e., 0.25% times 1300. The presence of coatings is a moot point. The quality of workmanship for the 1300 joints in the reactor building was independently assessed by the inspections conducted and confirms the conclusions of the applicant.

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In summary, that almost 80% of the joints in various buildings other than the reactor building were unpainted is more than adequate a sample to demonstrate the adequate quality of these joints. As discussed above, a separate independent inspection of a sample of joints in the reactor building which were stripped has demonstrated the adequacy of the joints in this building. In terms of meeting design stress requirements, where the presence, size and length of each weld are necessary to determine structural adequacy, these attributes are measureable through coatings. We have demonstrated that those attributes not detectable through paint are at an acceptably low level by the sample inspections, and that the weld sizes and weld presence were adequate to meet design stress requirements.

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D. E. Smith
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Attachment:
As stated

cc: H. R. Denton
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NAME	: D. Smith	: W. Hazelton	:	:	:	:	:
DATE	: 2/14/85	: 2/14/85	:	:	:	:	:

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ATTACHMENT

WOLF CREEK GENERATING STATION STRUCTURAL STEEL WELDING

MATERIALS ENGINEERING BRANCH DIVISION OF ENGINEERING

BACKGROUND

Initial Inspection: - In the safety significant category of structural steel welds, there are 2,760 joints or connections with approximately 11,000 welds. In the original inspections, although only visual inspections were required, 10% of the joints were magnetic particle (MT) inspected. All joints were accepted. Where there were deficiencies, they were either judged insignificant and could be used "as is" or they were repaired.

Events Leading to Reinspections: - Because of deficiencies found in other structural steel welding, a random reinspection of 241 structural steel fillet welds in all "Q" designated buildings in the Powerblock was performed in February 1983. Correction Action Report (CAR) No. 1-W-0029 of March 22, 1983, was generated because 62% of the welds in the sample did not conform to the acceptance criteria. The applicable criteria were stated in Daniel International Corporation (DIC) Procedure No. QCP-VII-200 and the American Welding Society's (AWS's) D 1.1-75, "Structural Welding Code."

DIC Construction Procedure No. QCP-VII-200 describes the requirements for performance and inspection of safety-related structural steel welds with respect to committed conformance to the American Welding Society (AWS) D1.1.-75. Appendix I in Revision 4 of this procedure invokes a prohibition with respect to lack of fusion, overlap, slag, arc strikes, and weld splatter. Paragraph 6.5.1 of AWS D1.1-75 requires inspector verification that the size and length of welds conform to the drawing requirements and that no specified welds are omitted.

In August 1983, a separate issue arose as a result of documentation review prior to building turnovers. DIC initiated CAR No. 1-C-0031 to document that Miscellaneous Structural Steel Weld Records (MSSWR) could not be located for some of the structural steel welds in "Q" designated buildings, as required by procedures. Nonconformance Reports were generated to document missing MSSWR's in each of these buildings.

KG&E and DIC site management held meetings in May, 1984, to further discuss retrievability of MSSWR's and the problems that had been identified to date. Concerns were expressed through KG&E Quality First to KG&E Construction management regarding the acceptability of "Use-As-Is" dispositions given to NCRs that were written as part of CAR No. 1-C-0031's corrective action in July, 1984. KG&E management requested DIC to generate a revision to CAR No. 1-C-0031 in letter KWCLC 84-814 of July 30, 1984 in response to some concerns noted. Revision 6 to CAR No. 1-C-0031 was generated by DIC in response to KG&E's concerns.

KG&E Quality Assurance performed a detailed review of DIC CAR Nos. 1-W-0029 and 1-C-0031 in August, 1984, identifying numerous concerns to KG&E Construction. In response, KG&E Construction began a documentation reconciliation task on August 13, 1984, to determine which safety-related structural steel welds did not have supportive MSSWR's.

On August 17, 1984, KG&E Construction Quality Control initiated an Inspection Verification Plan to provide an accurate assessment of the "as-built" conditions of safety-related structural steel welds without MSSWR's. DIC and KG&E management discussed revision of this inspection program on August 30, 1984.

KG&E, DIC and Bechtel made a joint presentation to an NRC Task Force on September 10, 1984, ^{in which they presented} which determined that the problem ^{was} one of document retrieval, and not a hardware problem. The NRC Task Force discussed the problems with KG&E again on September 13, 1984, during which KG&E management agreed to perform a sample hardware inspection of six (6) randomly selected, structurally significant joints in the Reactor, Fuel, Control, Auxiliary, Essential Service Water, and Diesel Generator Buildings. This inspection resulted in the discovery of missing welds and missing structural members. This was reported to the NRC by KG&E under 10 CFR 50.55(e) on September 18, 1984.

Reinspections: - The results of the licensee reinspection activities (verified by NRC inspectors) were as follows:

A missing weld was found at the same location in each of six pressurizer support connections. In addition, five of 14 fillet welds in one pressurizer support connection were undersized by 1/8-inch to 1/4-inch with respect to the drawing-required size of 8 inches. The weld dimensions of the remaining five pressurizer support connections were not included in the NRC verification activity.

Reinspection of nine structural steel connections in the auxiliary building disclosed that two welds were missing in one connection. In addition, weld size and length discrepancies were identified in each of the nine connections. Of the total of 106 welds in the connections, eight were found to be undersized by 1/16-inch to 3/16-inch with respect to drawing-required width. Two of the undersized welds were also under the required length; i.e., 2 1/4-inch and 2 1/2-inch in length, respectively, versus a drawing-required length of 3.0 inch. An additional nine welds were also under the drawing-required length of 3-inch by 1/2-inch to 1-inch. An examination of 54 weld returns in the nine connections found 26 to be undersized by 1/16-inch to 3/16-inch with respect to drawing-required widths. One of the undersized weld returns was also under the required length; i.e., 2-inch versus a drawing-required maximum length of 5/8-inch by 1 5/8-inch to 3 5/8-inch. An additional eight weld returns exceeded the drawing-required maximum length of 3/4-inch by 1/2-inch to 2 1/8-inch.

Corrective Actions: - On October 17, 1984, KG&E Quality Assurance issued CAR-19 to KG&E Construction to obtain corrective actions associated with AWS D1.1 structural steel welding. The findings addressed in CAR-19 included missing MSSWR's for safety-related structural steel welds; deficiencies being in previously accepted structural steel welds, missing structural welds or missing structural material; and documentation that a weld was inspected and accepted, but no weld was installed.

KG&E and DIC management representatives subsequently developed a logic chart to organize resolutions relative to CAR-19's concerns, a Management Plan to implement corrective actions, and published a CAR-19 Corrective Action Schedule to provide a means for tracking corrective action progress.

KG&E's corrective action commitments included a 100% visual reinspection of all accessible structurally significant safety-related structural steel field welds. Adequate technical justification was to be provided by Bechtel to validate the result of visual inspection of painted welds. The reinspection results were to be documented in inspection data sheets which were to delineate the design requirements with respect to joint geometry and individual weld characteristics. The Certified Welding Inspectors (CWI's) were instructed to record the inspected as-built condition of all accessible welds, with signature and date of inspection.

KG&E FINAL REPORT

KG&E's final report addressing the violation, dated January 21, 1985, includes Revision 1 to Bechtel's "Final Report on the Evaluation of AWS Field Welding on Structural and Miscellaneous Steel at the Wolf Creek Generating Station," dated January 19, 1985. There will probably be supplemental information provided to demonstrate that the inspections performed by the applicant met or exceeded the criteria in MIL-STD-105D, "Sampling Procedures and Tables for Inspection by Attributes." In addition, a basis will be provided for the conclusions that the 1090 unpainted joints are an unbiased sample for those joints that cannot be inspected because of inaccessibility and, that these 1090 joints are also an unbiased sample for those weld defects that cannot be detected through coatings.

Rationale for Reinspection of Painted Welds: - Incorporated into the KG&E report is Bechtel's engineering position for visual inspection, in accordance with AWS D1.1, of painted welds. In summary, their position states that ". . . fillet welds which have been coated with up to 4 mils of primer and, in some cases, up to an additional 10 mils of topcoat can be visually inspected to the AWS D1.1 acceptance criteria." Those attributes identified as being capable of being fully evaluated to the design requirements and AWS D1.1 acceptance criteria include: weld presence and location; weld length; weld size; weld profile; fusion; overlap; cross-section of weld craters; coarse undercut, and large porosity. The attributes identified

as being more difficult to inspect, or not being visible at all, include: weld cracks; fine porosity, and tight undercut. A discussion followed in which these attributes were identified as being largely dependent on the metallurgical characteristics of the base metal, welding filler materials, and the ability of the welders. With respect to the metallurgical characteristics of the base metal (ASTM A-36) and the welding filler material (Type E7018 electrodes), their compatibility should result in sound, crack and porosity-free welds, provided that normal precautions are taken. The precautions are included in the approved welding procedural specifications used for structural steel welding. A DIC and Bechtel review substantiated that DIC welders involved with structural steel welding were satisfactorily qualified and that the electrodes were controlled in accordance with AWS requirements.

It should be noted that Paragraph 3.10.1, in Section 3 of AWS D1.1-75, states in part, "...Welded joints shall not be painted until after the work has been completed and accepted"

Staff Opinion on Reinspection Through Paint: - While the logic of the Bechtel engineering position regarding inspection through paint appeared sound, the NRC Region IV consulted with technical experts from the Office of Nuclear Reactor Regulation (NRR) in order to arrive at a technically acceptable position.

A memorandum addressing this issue was provided by the Materials Engineering Branch, Division of Engineering, on January 7, 1985. The basic opinion expressed in this memorandum is that the detection through coatings of some weld deficiencies that can adversely affect structural integrity (e.g., missing welds, underlength welds, undersize welds, course or heavy undercut, large porosity) could be accomplished. Fine cracks were unusual in the materials used (E7018 electrodes in combination with A-36 structural steel), and as there was little or no history of such cracking at this site, the probability of having this type of defects was rather small. Light undercut or fine porosity are not considered a threat to structural integrity and, therefore, would be of little concern. Lack of fusion is one defect that can significantly affect the structural integrity and that, in our opinion, cannot adequately be detected through coatings. It was recommended that the applicant address this type of defect in his reinspection plans. During the visit to the site, we found that the 1090 unpainted joints were distributed in all of the buildings, other than the reactor building within a total of 1370 joints. The reinspection of the 1090 unpainted joints provides a sample of the 1370 joints in these buildings that is adequate to characterize the presence of undesirable attributes.

STAFF INDEPENDENT INSPECTION OF PAINTED WELDS

NRC Region IV requested NRC Region I to assist them by conducting an independent nondestructive examination (NDE) program at the WCGS Site. The particular NDE technique being utilized is MT examination, along with

visual inspection. One of the primary goals of the MT is to determine the validity of the visual inspection of painted welds. The results of the NRC Region I inspection will be documented in NRC Inspection Report 50-482/85-12.

Prior to the arrival at the site of the NRR representative, the joint Regions I and IV inspection team had chosen 40 welds in the reactor building to be stripped of coatings and the surfaces be inspected visually and by the magnetic particle method. This is a significantly more rigorous inspection than the originally specified visual inspection. The NRR representative suggested that MIL-STD-105D be used to size the sample such that it would provide a statistically meaningful sample (i.e., results can be compared with MIL-105 Standard) of all of the joints in the reactor building (1300) and hopefully to eliminate the significance of coating being a factor of concern. Accordingly, a sample size of 50 was selected based upon a batch size of 1300 and a General Inspection Level of I. An additional thirteen (13) joints were randomly selected for stripping and inspection by Region I; which include an overage of three (3) because other ongoing work may restrict access to some of the the joints selected. The fifty-three (53) joints were inspected visually and by the magnetic particle method. No defects were found. There were two instances of lamellar tearing found in the structural steel. Both indications were small and tight. In the opinion of the inspectors, the tearing would probably not have been seen in the initial visual inspections because the tears were very tight and subsequent loading might have opened the tears to the extent that became detectable by MT. The tears were very shallow (about 1/8) and they were repaired.

SUMMARY

The MT inspections by Region I inspectors of 53 joints stripped of coatings, out of a total of 1300 coated joints in the reactor building was a valid sample of all of the welds in the reactor building. No rejectable flaws were detected in the sample, and accordingly, a strong conclusion can be drawn regarding the probable number of rejectable flaws in the population of 1300 joints. The presence of coatings is a moot point. The quality of workmanship for the 1300 joints in the reactor building was independently assessed by the inspections conducted and agrees with the conclusions of the applicant.

In summary, inspection of a large number of unpainted joints in various buildings other than the reactor building confirms the overall quality of these joints. As discussed above, a separate independent inspection of a sample of joints in the reactor building by NRC inspectors that were paint-stripped has demonstrated the adequacy of the joints in this building. In terms of meeting design stress level, the presence, size and length of each weld are measurable through coatings. We have demonstrated that weld defects not detectable through paint are at an acceptably low level by the sample inspections, and that the weld sizes and weld presence were adequate to meet design stress requirements.

4-84-A-94

- OI - Q4-84-042 - issued 1/31/85
- Memo GLMadsen to Westerman
2/19/85
- Contact of allegor - To be
handled by Hark/Westerman.

gm 2/19/85

- Same as 4-84-A-85.