



UNITED STATES
 NUCLEAR REGULATORY COMMISSION
 WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATING TO INSPECTIONS AND REPAIRS OF
 INTERGRANULAR STRESS CORROSION CRACKING (IGSCC)

COMMONWEALTH EDISON

DRESDEN UNIT 2

DOCKET NO. 50-237

1.0 INTRODUCTION

The staff has reviewed the licensee's submittals dated February 6 and March 30, 1989, including the inspection results, IGSCC mitigation flaw evaluations and overlay repairs to support the continued operation of Dresden Unit 2.

Generic Letter 88-01 applies to a total population of 276 welds at Dresden Unit 2. Of those, 228 are considered to be susceptible to IGSCC (non-Category A). A total of 192 welds were ultrasonically inspected in the 1988 outage including 190 (83%) of the 228 susceptible welds. 104 (46%) of the 228 susceptible welds were mechanically stress improved (MSIP) this outage. All welds mechanically stress improved were inspected after stress improvement.

Nineteen new flawed welds were identified this outage. Three welds with unrepaired circumferential indication reported during the previous outage were reexamined this outage. All of the circumferential flaws were reported as unchanged. However, two of the three welds were reported as containing new axial indications. Another unrepaired weld (PS2/201-1) reported to have a circumferential crack in 1984, but evaluated as geometry in 1986, was reexamined this outage with automated examination methods (GE SMART System) and confirmed to be geometry.

New weld overlay repairs were applied to 21 welds this outage. Also, three "leak barrier" weld overlays applied during a previous outage were built up to standard thickness, surface finished and baseline UT examined this outage. Due to the large scope of weld overlay activities this outage, two-layer leak barrier weld overlays will be applied as a temporary fix over two welds with axial indications only. These will be built up to standard thickness, surface finished, and examined during the next outage. Also, some overlays applied at

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standard thickness this outage will not be surface finished and examined until the next outage. As a minimum, all weld overlays applied this outage will be examined with liquid penetrant and a bonding UT.

At the end of this outage, Dresden Unit 2 will contain a total of 30 weld overlays. One weld (PD1A-D14) contains a 1" X 10% circumferential flaw and has been evaluated and determined to be acceptable for continued operation as is. The unit has completed three cycles with Hydrogen Water Chemistry (HWC). An evaluation of the effects of HWC at Dresden Unit 2 will be conducted.

2.0 DISCUSSION

2.1 Inspection

Augmented weld inspections were performed during the Dresden Unit 2 Fall 1988 outage to satisfy the requirements of Generic Letter 88-01. Of the 192 total welds inspected during the current outage, 22 unrepaired welds were reported as containing IGSCC indications. Nineteen of these welds had no previous flaw history. The other three welds had previously reported circumferential indications but had been evaluated and approved by engineering analysis for continued operation. Six previously applied weld overlays were reexamined this outage. Three other existing "leak barrier" weld overlays are being built-up to standard thickness, surface conditioned and baseline examined this outage.

2.2 New IGSCC Indications

IGSCC indications were identified for the first time in 19 welds this outage. Ten of the new welds with indications are in 12" Recirculation System risers; nine of these are pipe-to-elbow welds and one is pipe-to-reducer (at the cross) weld. Two of the new flaws are pipe-to-end cap welds on the 22" RECIRC header. The remaining seven are in the 8" Reactor Water Cleanup System.

2.3 Unrepaired Flaws

Welds PD5-D20 and PD2-D5 (12" RECIRC Risers) and PD1A-D14 (28" RECIRC Outlet) had been inspected during the previous (1986) outage and reported as containing circumferential IGSCC indications. These flaws had been evaluated by engineering analysis and approved for continued operation without repair. Reexaminations performed during the current outage showed no change in the characteristics of the circumferential flaws; however, new axial flaws were reported in welds PD5-D20 and PD2-D5.

Weld PS2/201-1 was reported to have circumferential flaws during examinations in 1983 and 1984. Later, in 1986, an examination reported the indications as geometry. This outage, the weld was reexamined and the indications were confirmed as geometry.

2.4 Weld Overlay Reexaminations

At the beginning of the current outage, Dresden Unit 2 contained nine weld overlay repairs. Six of them were standard overlays. The other three were "leak barriers" that will be built up to standard thickness and surface conditioned this outage such that a baseline inspection can be performed.

All six of the existing standard weld overlays were reexamined this outage. Table B-2, "1988 Weld Overlay Reexamination Results," summarizes the 1988 and previous outage examination results.

In 1986 these weld overlays were manually examined. In 1988, five of the six reexaminations were performed using automated examination equipment (GE SMART UT System). In several welds, the 1988 examinations reported additional and/or deeper indications than those reported in 1986. The identification of the new indications is attributed to the differences between the automated and manual UT scanning methods.

In all cases, the design basis flaw assumed in the design of a standard weld overlay per NUREG C313 Rev. 2 bounds all recorded flaws in these weld overlays. The indications recorded with the automated equipment in 1988 will be considered the "baseline" for future examinations.

Weld Number PD2-D5 is a pipe-to-elbow weld on Recirculation System Riser 2-0201F-12. This weld was previously inspected and determined to have IGSCC indications. During the current D2R11 outage it was again inspected and noted to have IGSCC indications. A direct comparison of the previous and current outage flaw sizes would indicate an apparent change. However, when the differences in techniques used to perform the inspections are considered, the previous and current outage data closely match. This note explains the apparent discrepancy in flaw size and why it is believed that there is no change in the actual flaw.

The manual ultrasonic examination of weld PD2-D5 in 1983 detected two circumferential cracks. One crack at 22.5" CW or 17.5" CCW was sized at 17% through-wall depth and 0.250" long. The other crack at 33" CW or 7" CCW was sized at 17% through-wall and 0.500" long. When the weld was reexamined in 1984, the two circumferential cracks showed no change in length or depth. The sizing techniques used in 1983 and 1984 was the 50% amplitude (at reference) db drop method with a 45 degree shear wave transducer. In 1986 a reexamination of the crack indications showed slightly less (11% and 15%) depth and shorter (0.200") length measurements. This was apparently due to sizing from the opposite side

of the weld and a different sizing technique which utilized 52 degree shear wave and 45 degree RL transducers. The current 1988 reexamination of this weld was done with the GE AUTOMATED "SMART UT" System for the purpose of establishing a new baseline and more consistent crack monitoring in the future. Also, in 1988, the crack depth sizing was performed in accordance with a new CECO Ultrasonic Sizing Procedure NDT-C-41, Revision 0 which is written to EPRI sizing guidelines.

The maximum measured crack depth variation between 1983 and the 1988 examination is approximately 10% or 0.060" which includes all of the different depth sizing techniques used. This is considered "acceptable," verifying no significant crack depth growth. The difference in crack length (0.250" and 0.500" to 1.00") measurements reported between 1983 and 1988 is due to the GE AUTOMATED "SMART UT" System which was scanning and recording at a noise level (18db higher) gain setting which imaged and recorded 1.0" long circumferential cracks at their maximum end points. When measuring the cracks, with the image, to their 50% amplitude end points, at scan (18db higher) gain they are reduced to 0.600" long which matches closely to the 1983 and 1984 length measurements. Also, a manual reexamination performed by CECO UT Inspectors in 1988 to verify and evaluate the indications detected in this weld matched closely with the 1983 and 1984 data.

2.5 Disposition of Flawed Weld Indications

Twenty-two welds determined to be flawed during the current outage have been dispositioned. Twenty-one flawed welds were repaired with weld overlay. One weld was evaluated by engineering analysis and has been determined to be acceptable for further operation as is. Due to the large scope of IGSCC associated activities this outage and the potential impact on the outage schedule, two-layer "leak barrier" weld overlays were applied as a temporary fix to two welds with axial flaws only. Also, some weld overlays installed to the NUREG-0313 Rev. 2 standard design thickness were not surface finished as necessary to perform the ISI UT examinations this outage. As a minimum, all weld overlays applied this outage were liquid penetrant examined and ultrasonically examined to insure bonding.

A total of 21 new weld overlays were applied this outage to flawed welds. Additionally, three "leak barrier" weld overlays applied during a previous outage were surface finished and ISI baseline UT examined. The scope of weld overlay repairs required during the current Dresden Unit 2 outage was significantly larger than anticipated. Therefore, in order to minimize the impact on the outage schedule, two-layer "leak barrier" overlays were applied on two welds with axial indications only. These overlays will be built up to the NUREG-0313 Rev. 2 standard design thickness during the next outage, surface finished, and inspected. Also, six overlays that were installed to the standard thickness were not surface finished this outage. These will be surface finished and inspected during the next refueling outage. Optionally,

in the case of the Reactor Water Cleanup System, the affected pipe may be replaced during the next outage. All leak barrier overlays and all standard overlays that were not surface finished this outage were liquid penetrant (PT) examined and a "bonding" UT examination was performed.

2.6 Flawed Welds Approved for Further Operation

Three unrepaired welds with circumferential indications reported during the previous (1986) inspection had been evaluated and approved for continued operation. These welds were reexamined during the current (1988) outage. The results of the current examinations showed no change in the previously reported circumferential flaws. However, welds PD2-D5 and PD5-D20 (12" Recirculation Risers) were noted to contain axial indications in addition to the circumferential and as such, required weld overlay repair. The circumferential flaw in weld PD1A-D14 (28" Recirculation Outlet) was again evaluated by engineering analysis determined to be acceptable for continued operation.

Of seven overlays applied this outage as repairs to new flaws in RWCU piping, six were applied at standard thickness but neither surface finished nor baseline UT examined; one was installed as a two layer "leak barrier" over axial indications only. Prior to the next outage, CECO will evaluate the options of completing these seven repairs as NUREG 0313 Rev. 2 standard overlays, or replacing the affected RWCU piping.

(The minimum thickness of the designed weld overlay for weld L5-D3 is two (2) unrepaired weld overlay layers applied to a surface which has successfully passed liquid penetrant (PT) examination. If repairs are required due to "steam blow-outs" or other reasons, the layer(s) containing repairs are not counted).

"Leak barrier" or other less than standard weld overlays installed in 1988 will be scheduled to be built up to standard thickness, surface finished, and inspected during the next refueling outage. Optionally, affected piping on RWCU may be replaced.

The minimum thickness of designed weld overlay for weld L5-D3 is two (2) unrepaired weld overlay layers applied to a surface which has successfully passed liquid penetrant (PT) examination. If repairs are required due to "steam blow-outs" or other reasons, the layer(s) containing repairs are not counted.

2.7 Mechanical Stress Improvement

A total of 104 welds were stress improved during the current outage. The method utilized was the Mechanical Stress Improvement Process (MSIP) by O'Donnell and Associates. The 104 welds stress improved represents 46% of the 228 IGSCC susceptible (non-Category A) welds governed by Generic Letter 88-01. This is the first outage that welds at Dresden Unit 2 have been stress improved.

Stress improvement was applied to as many IGSCC susceptible welds as possible within the overall constraints of the outage. In general, welds that were originally scheduled to be UT examined to satisfy Generic Letter 88-01 were also scheduled for MSIP. Welds that do not receive full benefit from Hydrogen Water Chemistry were high priority for UT examinations and MSIP. Some welds were added to that scope such that all welds were deleted from the scope during the course of the outage due to interferences, special tooling requirements, and schedule.

All welds that were stress improved were UT inspected after stress improvement. A sample of five welds were UT examined before and after stress improvement. No indications associated with IGSCC indications were reported in these welds either before or after MSIP. Two of these welds were examined with automated examination equipment (GE SMART System). The other three were examined with manual methods. The two welds examined before and after with automatic equipment are 12" Recirculation Riser nozzle-to-safe end welds. The three welds examined manually are a 14" ISCO Supply pipe-to-pipe weld, a 14" ISCO Supply nozzle-to-safe end weld, and a 12" Recirculation Riser pipe-to-safe end weld.

2.8 Hydrogen Water Chemistry(HWC)

As a result of Dresden Unit 2's successful implementation of the HWC for three consecutive fuel cycles, the staff has approved CECO's request for a factor of two reduction in the inspection of Categories C, D and E weldments in this refueling outage. However, in view of the extensive IGSCC found in this outage, the staff has generic concerns regarding the effectiveness of HWC in mitigating the IGSCC. The staff notes that the HWC implemented in this Unit is neither monitored by electrochemical potential (EPC) measurements nor confirmed by on-line crack arrest verification (CAV) testing. Therefore, one possible explanation for the reported inspection results is that the hydrogen injection rate might not be large enough to effectively mitigate the IGSCC. However, this explanation requires further testing and confirmation. To ensure adequate inspection of IGSCC susceptible piping welds, the staff has determined that, any future request for the reduction in the scope or frequency of IGSCC inspection will not be granted until our concern of the effectiveness of HWC in mitigating the IGSCC is completely resolved.

3.0 CONCLUSION

Based upon the staff's review of the licensee's submittals, the staff concludes that the licensee has adequately addressed IGSCC in Class 1 piping with respect to inspections, repairs and mitigations performed during the Dresden Unit 2 1988 refueling outage, and that these activities were performed in accordance with the guidelines in Generic Letter 84-11. In addition, the staff also concludes that Dresden Unit 2 can be safely operated for another 18-month fuel cycle in the present configuration.

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