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October 5, 1988

Mr. Thomas E. Murley, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Dresden Station Unit 2
Additional Information on the
Fall 1988 IGSCC Inspection
NRC Docket No. 50-237

Reference: Letter from W.E. Morgan to T.E. Murley
dated July 29, 1988.

Dear Mr. Murley:

Commonwealth Edison Company (CECo) responded to Generic Letter 88-01 concerning Intergranular Stress Corrosion Cracking (IGSCC) in the referenced letter. The response, which included the inspection plans for each susceptible CECo unit, proposed a Fall 1988 program for Dresden Unit 2 that reflects effective implementation of Hydrogen Water Chemistry (HWC) since 1983. The enclosed information further elaborates on CECo's basis for crediting the benefits of HWC in suppressing IGSCC.

Please contact this office should further information be required.

Very truly yours,

J A Silady

J. A. Silady
Nuclear Licensing Administrator

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Enclosure

cc: A.B. Davis - Regional Administrator, RIII
S.G. DuPont - NRC Senior Resident Inspector, Dresden
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I. HWC IMPLEMENTED TO MEET RECOMMENDATIONS OF EPRI-NP-4947-SR-LD, FOR ONE COMPLETE FUEL CYCLE

and

HWC MAINTAINED WITH EQUIVALENT EFFECTIVENESS FOR SUBSEQUENT FUEL CYCLES

A Hydrogen Water Chemistry (HWC) materials test program, sponsored by EPRI, was carried out at Dresden Unit 2 from late 1982 to early 1984 with a long term HWC verification program implemented since April 1983.

The results of this HWC materials test program (EPRI report NP-4592-SR) indicated that:

* IGSCC was suppressed at electrochemical potential (ECP) below - 0.23 volts SHE (i.e. more negative than -0.23 volts SHE).

* For Dresden Unit 2 ECP levels below - 0.23 volts (SHE) were achieved when dissolved oxygen content in reactor water was less than 20 ppb and when reactor water conductivity was less than 0.3 umho/cm.

* A period of 10.4 to 15 hours off HWC could occur without IGSCC initiation. This is termed as the "memory effect".

The original system used to measure ECP at Dresden Unit 2 during the EPRI test program was retired in place, therefore, no information on ECP valve was available beyond the test program. However, available data on reactor water conductivity, reactor water dissolved oxygen, and hydrogen injection rate, as shown in Tables 1 and 2, indicate that:

* The monthly average reactor water conductivity for cycle 10 (April 1985 to November 1986) and cycle 11 (May 1987 to present) has met the current EPRI BWR Hydrogen Water Chemistry Guidelines of 0.20 umho/cm or less for power operation (EPRI NP-4947-SR-LD final draft).

* A high system availability for the Hydrogen Addition system has been achieved.

* Hydrogen has been injected at a relatively consistent rate during fuel cycles 10 and 11 implying that reactor water dissolved oxygen content below 20ppb has been achieved during these periods.

* With reactor water dissolved oxygen content less than 20ppb, Dresden Unit 2 reactor water ECP levels is expected to be below -0.23 volts (SHE) which is consistent with the ECP value recommended by the current EPRI BWR hydrogen Water Chemistry Guidelines (EPRI NP-4947-SR-LD final draft).
The relationship between ECP and dissolved oxygen for Dresden Unit 2 was established during the HWC material test program (EPRI report NP-4592-SR).

Commonwealth Edison (CECo) concludes that the HWC program was effectively implemented at Dresden Unit 2 for fuel cycle, 10 (from May 1985 to November 1986), and that for the subsequent fuel cycle 11 (from May 1987 to present) HWC has been implemented with equivalent effectiveness to that of fuel cycle 10.

TABLE 1: Dresden Unit 2 Reactor Water Chemistry Data
Fuel Cycle 10 (April 1985 - November 1986)

YEAR	MONTH	HYDROGEN ADDITION SYSTEM AVAILABILITY[1] (%)	AVERAGE HYDROGEN ADDITION RATE[2] (SCFM)	AVERAGE CONDUCTIVITY[3] (umho/cm)	DISSOLVED OXYGEN[4] (ppb)
1985	APRIL	71.2	NOT AVAILABLE	0.102	NOT AVAILABLE
1985	MAY	78.2	NOT AVAILABLE	0.092	NOT AVAILABLE
1985	JUNE	93.0	NOT AVAILABLE	0.082	NOT AVAILABLE
1985	JULY	91.5	37.88	0.079	NOT AVAILABLE
1985	AUGUST	72.0	40	0.108	NOT AVAILABLE
1985	SEPTEMBER	89.3	32	0.075	NOT AVAILABLE
1985	OCTOBER	UNIT SHUT DOWN	UNIT SHUT DOWN	UNIT SHUT DOWN	NOT AVAILABLE
1985	NOVEMBER	82.8	27.13	0.089	NOT AVAILABLE
1985	DECEMBER	77.5	NOT AVAILABLE	0.082	NOT AVAILABLE
1986	JANUARY	96.0	36.66	0.068	NOT AVAILABLE
1986	FEBRUARY	88.4	NOT AVAILABLE	0.062	NOT AVAILABLE
1986	MARCH	96.2	40.55	0.065	NOT AVAILABLE
1986	APRIL	95.1	37.83	0.087	NOT AVAILABLE
1986	MAY	89.8	NOT AVAILABLE	0.174	NOT AVAILABLE
1986	JUNE	86.1	39.08	0.093	NOT AVAILABLE
1986	JULY	88.3	34.88	0.224	NOT AVAILABLE
1986	AUGUST	86.3	37.39	0.169	NOT AVAILABLE
1986	SEPTEMBER	91.8	37.27	0.092	NOT AVAILABLE
1986	OCTOBER	91.5	35.65	0.090	NOT AVAILABLE
1986	NOVEMBER	85.9	NOT AVAILABLE	0.127	NOT AVAILABLE

NOTE: 1. Percentage of time the hydrogen addition system operational at reactor power level of 200 MWe or above.

2. Average hydrogen injection rate for the month based on available data.

3. Average recirculation water conductivity, excluding times when unit is in shutdown.

4. Average dissolved oxygen in the recirculation water when the hydrogen addition system is operational. A memory effect of 10 hours is utilized.

TABLE 2: Dresden Unit 2 Reactor Water Chemistry Data
Fuel Cycle 11 (May 1987 - Present)

YEAR	MONTH	HYDROGEN ADDITION SYSTEM AVAILABILITY[1] (%)	AVERAGE HYDROGEN ADDITION RATE[2] (SCFM)	AVERAGE CONDUCTIVITY[3] (umho/cm)	DISSOLVED OXYGEN[4] (ppb)
1987	MAY	33.8[5]	NOT AVAILABLE	0.146	NOT AVAILABLE
1987	JUNE	94.6	44.17	0.118	NOT AVAILABLE
1987	JULY	91.7	25.08	0.090	NOT AVAILABLE
1987	AUGUST	99	28.62	0.067	NOT AVAILABLE
1987	SEPTEMBER	91.2	32.25	0.065	5.1
1987	OCTOBER	89.9	39.1	0.059	4.3
1987	NOVEMBER	96.7	37.0	0.061	1
1987	DECEMBER	87.5	36.73	0.060	1
1988	JANUARY	93.8	36.43	0.059	1.3
1988	FEBRUARY	100	37.83	0.059	3.5
1988	MARCH	96	37.93	0.060	3.4
1988	APRIL	100	36.96	0.059	3.5
1988	MAY	83	37.6	0.061	3.3
1988	JUNE	83	35.91	0.064	4.3
1988	JULY	97.6	29.53	0.063	3.5
1988	AUGUST	100	25.71	0.059	2.3

NOTE: 1. Percentage of time the hydrogen addition system operational at reactor power level of 200 MWe or above.

2. Average hydrogen injection rate for the month based on available data.

3. Average recirculation water conductivity, excluding times when unit is in shutdown.

4. Average dissolved oxygen in the recirculation water when the hydrogen addition system is operational. A memory effect of 10 hours is utilized.

5. Unit was starting up from a refueling outage.

II. NO SIGNIFICANT NEW CRACKS OR STATISTICALLY SIGNIFICANT GROWTH IN OLD CRACKS DETECTED UPON INSPECTION AFTER ONE FUEL CYCLE ON HWC

The following sections contain essentially the same information found in part of the Final Report which was submitted by the CECo Nuclear Licensing Department to the Office of Nuclear Reactor Regulation, USNRC (Letter from J.R. Wojnarowski to H.R. Denton dated March 2, 1987) after the completion of the augmented piping inspection program at Dresden Unit 2 during the Fall 1986 refueling outage.

A. General Observation

Extensive ultrasonic (UT) examination programs of IGSCC susceptible stainless steel piping have been performed during both the 1983 and 1984 Dresden Unit 2 refueling outages. As a result of these examinations, IGSCC indications have been identified in a number of welds. Flawed pipe analyses have been performed for each of these welds, with weld overlay repairs being utilized for some of these welds. Three (3) welds reported as flawed in 1983 were left as is and re-examined midcycle 1983, during the 1984 outage and during the last 1986 refueling outage.

During the last 1986 refueling outage, UT examinations of approximately 50% of all class 1 and 2 IGSCC susceptible stainless steel piping were performed. This was the result of the apparent change in the UT indications of a previously flawed weld and the detection of a single IGSCC flaw in another weld. A summary of the UT results of the flawed welds is contained in Table 3.

Some general observations related to the examination reported in Table 3 include:

1. Three (3) flawed welds examined four (4) times since 1983 - one (1) weld had no significant change, one (1) weld was reclassified as not cracked, and one (1) showed an apparent change.

2. One (1) weld evaluated as geometry in 1984 had no significant change in UT signals in 1986.

3. One (1) flawed weld reported as no recordable indications in 1984 showed a significant flaw in 1986.

B. Specific Weld Discussion

1. Weld PD5-D20 (12" Recirculation - Elbow to Pipe)

Indications of IGSCC were ultrasonically detected by Lambert, MacGill and Thomas (LMT) in February 1983. The flaws were reported as having a maximum depth of 17% throughwall. This weldment was monitored by ultrasonic examination techniques at each subsequent outage. Three subsequent examinations by LMT revealed no change in the depth or length of the indications. A fourth subsequent examination performed by General Electric (GE) resulted in a reported length increase from 1/4 inch to 2-1/2 inches and a reported new flaw indication located away from the previous flaws. All examinations were performed using Commonwealth Edison procedures.

This apparent length increase, coupled with the identification of an additional flaw indication, prompted CECo to contact EPRI, LMT, and GE for assistance in determining an explanation for this apparent change in the UT results.

After an independent review of the UT data generated over the last 4 years by each of the individuals involved, a meeting was held to discuss their conclusions. The general agreement was that the flaw indication that apparently grew longer was probably always approximately 2-1/2 inches long and that the new flaw indication detected could have been missed by LMT in the earlier examinations.

In addressing the 2-1/2 inch flaw indication, consideration was given to the length and depth measurements originally reported by LMT. If the flaw was only 1/4 inch long, 17 percent through wall, and 90 percent of the distance amplitude correction (DAC) curve; it would be extremely difficult to detect. The feeling is that the flaw was longer, but could only be detected by the examiner for 1/4 inch. During the 1986 examination, GE used a different revision of the procedure than did LMT. Additionally, different equipment was used. LMT used a Nortec 131 ultrasonic instrument with Harisonics 1/2 X 1/2 inch search units. GE used a Krautkramer USIP-11 ultrasonic instrument with Aerotech 3/8 inch diameter search units. Both vendors used 45 degree refracted shear waves of 2.25 Mhz. The difference in instruments and search units could very easily result in different measurements for the flaw length and amplitude. The flaw indication amplitude as detected by GE was higher from approximately the 9 to 9-1/2 inch markers but could be followed to the 7 inch marker with the signal amplitude much lower. This seems to be the best explanation for the increase in recorded length, i.e. that the signal dropped off in amplitude sharply and then continued at a low level (apparently undetected by LMT) for an additional two inches.

In addressing the new flaw it was stated that this flaw, reported by GE as 5/8 inch in length, could have been missed by LMT during the initial examination. In reviewing earlier LMT strip chart records, an indication was detected in the same vicinity, and had been characterized as geometry by the examiner at the time.

It is believed that these flaw indications were present in 1983 and not detected for the reasons above.

2. Weld PD2-D5 (12" Recirculation - Pipe to Elbow)

No significant changes have been observed during 1986 outage in the UT flaw signals from previous examinations.

3. Weld PS2/201-1 (28" Recirculation - Safe End to Elbow)

In 1983 an IGSCC flaw indication was detected by LMT. This weld was re-inspected mid cycle in 1983 and showed no change from the previous examination. During the 1984 refueling outage an LMT inspector re-examined this weld pre-decontamination and found no change in the UT signals. A post decon examination by a different LMT inspector detected the same indication and called it root geometry. In 1986 GE examined this weld and could not find any evidence of an IGSCC flaw indication but GE detected ID root geometry due to beam redirection in the same area. It is believed that this indication is an ID root geometric indication and not an IGSCC flaw.

4. Weld PD1A-D14 (28" Recirculation - Elbow to Pipe)

This weld was inspected by LMT in 1984 and a circumferential flaw indication was found of .88 inches by 7% through wall. During that same outage Universal Testing/KWU re-examined this weld using I.D. creeping wave and shear wave. They also used a longitudinal wave transducer to map the ID surface configuration in the area of the indication found by LMT. Their conclusion was that the indication is caused by ID geometry in a window closure at the end of the welding operation and could not find any conclusive evidence of an IGSCC flaw indication.

General Electric re-examined this weld during the 1986 outage and detected the same indication as LMT found. In conversations with GE, the flaw indication was very shallow and difficult to detect. The indication was called by GE as an IGSCC flaw indication.

There was no significant change in the UT flaw signals from the previous exams.

5. Weld 8-12 (8" Reactor Water Clean Up - Pipe to Valve)

Weld number 8-12 is a pipe to valve weld on the reactor water clean up line (RWCU). In 1984 the examination of all welds on the RWCU line revealed 16 welds with IGSCC flaws; 15 of which were replaced out-board of the isolation valve and one was weld overlayed in-board of the isolation valve. During the 1986 outage, UT exams detected an IGSCC flaw indication on the pipe side of the in-board pipe to valve weld.

This weld was examined in 1984 before the portion of the RWCU line out-board of the valve was replaced and no indications were detected. This flaw may have been very tight thus being a poor reflector and not detectable in 1984. Due to fit up and replacement welding on the other side of the valve, it is postulated the existing flaw had apparently opened up and become a better reflector for 1986 UT examinations.

Due to the size of this flaw the weld was overlayed with a full structural overlay and surface conditioned to permit the application of EPRI techniques for overlay UT inspection.

C. Effectiveness of Hydrogen for Mitigation of IGSCC

The question of the effectiveness of hydrogen on IGSCC in stainless steel piping was raised due to the apparent growth of one flaw and the detection of two apparently new flaw indications.

If the premise is taken that the new flaws were not present in 1984, they have then been initiated and grown to their current lengths and depths (2" x 30% and .625" x 20%) in an 18 month period. This is not consistent with typical IGSCC crack growth. In the case where apparent flaw growth has occurred, the flaw has grown in length and not in depth. This growth is not typical to any kind of IGSCC crack growth characteristics. Technical rationale, given the typically observed weld induced stress patterns for any crack growth, would lead one to believe that if any significant flaw growth in length occurs then growth in depth must also occur.

The effectiveness of hydrogen addition is demonstrated by the stability of the previously reported IGSCC indications from 1983 to 1986, from only one new flaw indication being reported during the 1986 examinations, from the minimal repairs at Dresden Unit 2 during the last two (2) cycles, and the stabilization of the furnace sensitized safe ends.

III. CONCLUSION

The results of extensive review of the past ultrasonic data reports on the known flawed welds in the Dresden Unit 2 stainless steel piping reinforce the conclusion drawn from the review of available reactor water chemistry data. The conclusion is that HWC has effectively inhibited the initiation and growth of IGSCC in the Dresden Unit 2 stainless steel piping. Therefore, credit for reduced stainless steel inspection frequency for Dresden Unit 2 is warranted.

TABLE 3

DRESDEN UNIT 2
COMPARISON OF ULTRASONIC EXAMINATION RESULTS FOR IGSCC FLAWS

FLAW IDENTIFIED

Weld Number	1983 UT Exam Results LMT	1983 Midcycle UT Exam Results LMT	1984 UT Exam Results LMT	1986 UT Exam Results GE	Remarks
PD5-D20 12 inch Elbow to pipe	0.25" x 19% (elbow side) 0.25" x 17% (elbow side)	0.25" x 17% (elbow side) 0.25" x 15% (elbow side)	0.25" x 16% (elbow side) 0.25" x 16% (elbow side) Note 1	0.25" x 12% (elbow side) 2.5" x 15% (elbow side) 0.625 x 20% (pipe side)	Apparent change (See Specific Weld Discussion section)
PD2-D5 12 inch Elbow to pipe	0.5" x 19% (elbow side) 0.25" x 14%	0.5" x 18% (elbow side) 0.25" x 16% (elbow side)	0.5" x 17% (elbow side) 0.25" x 17% (elbow side) Note 1	0.2" X 15% (elbow side) Spot x 11% (elbow side)	No significant change from previous exams.
PS2/201-1 28 inch Safe end to elbow	1" x 16% (elbow side)	1" x 17% (elbow side)	1" x 17% (elbow side) Note 1	Root geometry due to beam redirection	Re-evaluated as an I.D. Root Geometric indication by General Electric in 1986
PDIA-D14 28 inch Elbow to pipe	No Exam	No Exam	0.88" x 7% (Pipe Side)	1" x 8% (Pipe Side)	Evaluated by KWU as a geometric reflector in 1984. No significant change from previous exam.
8-12 8 inch Pipe to valve	No Exam	No Exam	No recordable indications	2" x 36% pipe side	Apparent new IGSCC (see Specific Weld Discussion section)

Note 1. Pre and post-decontamination examinations were performed - results were identical