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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION RELATED TO INSPECTION AND REPAIRS OF HATCH UNIT 1 PRIMARY SYSTEM PIPING AND CORE SPRAY SPARGERS

1.0 INTRODUCTION

During the Fall 1984 maintenance/refueling outage, inspection of the Hatch Unit 1 reactor coolant system stainless steel piping was performed in accordance with the Generic Letter 84-11 guidelines. After observing crack-like indications in several piping welds in the Recirculation and Residual-Heat-Removal systems (RHR), the licensee (Georgia Power Company, GPC) elected to ultrasonically examine 100% of the welds in these two systems and in the Reactor-Water-Clean-up system. Core Spray (CS) system piping and Control Rod Drive (CRD) hydraulic return line piping were not examined because CS piping was made of carbon steel and CRD piping was capped and rerouted to the RWCU return line outside the containment. A total of 130 welds were examined in these three systems comprising 97, 12 and 21 welds in the Recirculation, RHR and RWCU piping systems, respectively. The result of the ultrasonic examination showed that crack-like indications were observed in one RHR weld and twenty recirculation welds. Of the 21 cracked welds, 17 were weld overlay reinforced, and 4 were not repaired. A summary of cracks found and actions taken follows:

System	Diameter (in.)	No. Cracked	Overlay	Not Repaired
Recirc.	28	6	4	2
	12	12	12	0
	22	2	0	2
RHR	24	1	1	0

Georgia Power Company (GPC) provided fracture mechanics justification for continued operation without repair for the four welds.

In addition, four Inconel-buttered Recirculation safe-end to nozzle welds and two Recirculation jet pump instrumentation nozzle penetration seal to safe-end welds were ultrasonically examined and no crack-like indications were observed.

Ultrasonic testing (UT) personnel from Southern Company Services (SCS) and its contractor, Sonics Systems International (SSI) performed the ultrasonic examinations for the licensee. The licensee indicated that third-party review was performed on a few selected cracked welds to confirm the crack-like indications and flaw sizing reported by SCS.

The third-party vendors consisted of three teams including Kraftwerk Union (KWU) and NES. The results of the third-party examinations indicated that the UT results reported by SCS were conservative. The licensee indicated that only the UT results reported by SCS were considered in decisions regarding repairs. After reviewing the licensee's UT data, inspection procedures and documented UT personnel qualification, the NRC Region II concluded that the ultrasonic examination was performed satisfactorily, in accordance with the guidelines in Generic Letter 84-11 and the staff criteria.

Of the 21 cracked piping welds, 18 welds showed circumferential cracks and 3 welds showed only axial cracks. All the cracks were reported to be located in the heat-affected-zone adjacent to the welds and were assumed to be intergranular stress corrosion cracks. Sixteen welds were reported to be cracked intermittently around the entire circumference. The deepest circumferential crack (66% of the wall thickness) was reported in a 12 riser weld (12BR-C-3). The worst axial crack with a length of 1.75 inches and a maximum depth of 50% of the wall thickness was reported in a 24" RHR weld (24B-R-13).

Nutech performed the flaw evaluations and overlay design for the licensee. Nutech's crack growth calculations indicated that 17 cracked welds required weld overlay repair. Four cracked welds (two 22" sweepolet welds and two 28" welds) were determined not to require repairs because the final crack sizes at the end of next fuel cycle in these four welds will not exceed 2/3 of the ASME Code IWB-3640 limits. The overlays for the 15 circumferentially cracked welds were conservatively designed to meet the Code IWB-3640 requirements. All the cracks were assumed to be through-wall cracks for the entire observed length. The primary load considered in the overlay designs include pressure, dead-weight and OBE (seismic). The minimum length and thickness of the designed overlays varied from four to six inches and from 0.23 to 0.44 inch, respectively. For an axially cracked weld (1-E11-1RHR-24AR-13), an overlay of two layers was designed to prevent the crack from growing through the wall. The licensee indicated that the overlay weld metal was type 308L stainless steel with controlled delta ferrite content (10 FN minimum) and was deposited by the Gas Tungsen Arc Process (GTAW). Nutech's overlay design did not take credit for the first layer that met the required minimum delta ferrite content of 10 FN.

During this refueling/maintenance outage, the licensee also performed a visual examination of the core spray spargers in accordance with I&E Bulletin 80-13. The results of the visual examination revealed cracking of the lower sparger arm near the 350 degree T-box. The cracks were oriented in the circumferential direction and were located in the heat-affected zone of the sparger to T-box weld, approximately 1/8 inch from the weld. The cracks spanned at least 180 degrees of the pipe circumference with a maximum of 1.010 inch in width (Figure 1).

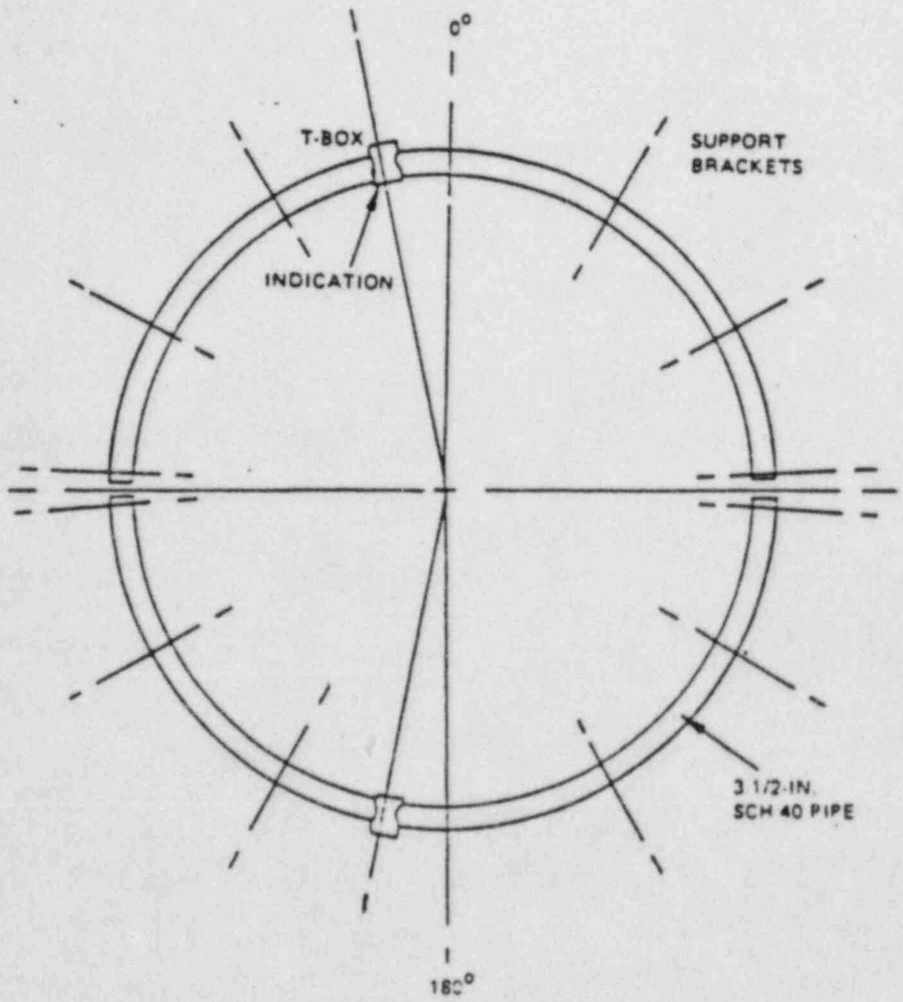


Figure 1-1a. Plan View of Cracked Core Spray Sparger

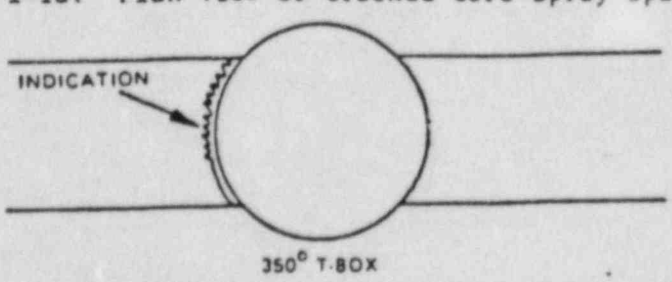


Figure 1-1b. Elevation View of Cracked Core Spray Sparger

Evaluation of the cracking in the core spray spargers was performed by General Electric Company (GE) for the licensee and is contained in General Electric report, NEDO-30825, "Core Spray Sparger Crack Analysis for Edwin I Hatch Nuclear Power Station Unit 1." The cracking was suspected to be stress corrosion cracking resulting from cold work and sensitization during fabrication and installation of the spargers. GE's analysis concluded that the structural integrity of the cracked core spray spargers will be maintained for all conditions of operations even though the crack was assumed to be completely around the circumference and through wall. GE's loose parts analysis also concluded that a possible loose part from the cracked core spray spargers will have essentially a zero probability of causing any serious safety consequences. GE also performed LOCA analyses assuming one cracked core spray sparger. The results of the analysis showed that the current reload calculations are still valid because coolant injection to the upper plenum is maintained.

For added safety margin, the licensee elected to install a clamping device (C-clamp) which gripped the sparger with a pair of fingers on each side of the T-box to limit the relative movement of the two sections of the sparger. The clamp assembly was fabricated from type 304L austentic stainless steel with a maximum carbon content of 0.02 weight percent.

2.0 EVALUATION

2.1 Primary System Piping

The staff has reviewed the licensee's submittals including the inspection results, Nutech's flaw evaluations and overlay design, and GE's evaluation of the core spray sparger cracking, to support the continued operation of Hatch Unit 1 for one fuel cycle (18 months) in its present configurations.

2.1.1 UNREPAIRED WELDS

Two sweepolet to ring-header welds (22AM-1BC-1 and 22BM-1B-1) and two 28" (28A-6 and 28b-16) welds were not repaired. The two 28" welds showed only axial cracks. The reported axial cracks in these two welds were shallow (17% of wall thickness). The growth of axial cracks in length is limited by the narrow heat-affected-zone (HAZ). Therefore, even though the axial cracks were to grow through wall, they would have no significant effect on the structural integrity of the piping. The circumferential cracks in the sweepolet weld #22AM-1BC-1 were very shallow (11% of wall thickness) and were not expected to grow to any significant size under normal operating conditions in one fuel cycle. There were three crack-like indications reported in the sweepolet weld #22BM-1BC-1 with a total length of approximately 13 inches (19% of circumference). The three crack-like indications were 1, 7.5 and 12 inches in length and 29%, 11% and 17% of wall thickness in depth, respectively. The licensee indicated that the shop documents showed that the sweepolet welds were solution annealed. Therefore, we do not expect the cracks to grow to any significant extent in the non-sensitized piping materials. Based on the above considerations, the staff concludes that the four unrepaired welds are acceptable for continued operation for one fuel cycle of 18 months.

2.1.2 OVERLAY DESIGNS

Although Nutech's overlay designs were conservative in that all observed cracks were assumed to be through wall cracks, the designs did not consider thermal stresses in the total design load. The staff performed an independent calculation to determine the required minimum overlay thickness by including the thermal expansion stress, and the shrinkage stress due to weld overlay. A bounding calculation was made on weld 12-AR-F3 which had a total stress of 17,200 psi. The calculation indicated that a minimum overlay thickness of 0.36 inch would be required for weld 12-AR-F3 to meet ASME Code IWB-3640 allowable. The licensee reported that the "as-built" overlay thickness including the first layer (approximately 0.1 inch) for weld 12-AR-F3 was 0.36 inch, which met the required thickness based on the staff's calculation. The staff, in this case, accepts credit for the first layer because the first layer, having low carbon content and was shown to have adequate ferrite content. The maximum crack depth in weld 12-AR-F3 was reported to be 30% of the wall thickness. The uncracked portion (70%) of the piping section will provide additional margin to maintain the integrity of the overlay. The staff concludes that the 17 overlay repaired welds are acceptable for continued operation for one fuel cycle of 18 months.

Six cracked welds were overlay repaired during the previous refueling outage. The results of ultrasonic examinations performed on those welds indicated that the structural and bonding integrity of the overlays were maintained. The crack-like indications reported in those overlays were maintained. The crack-like indications reported in those six welds were mostly short axial cracks. Only one chart (1.5 inches) circumferential crack was reported in weld #1-E11-1RHR-20-BD-3. These short cracks were not expected to grow into any significant sizes to compromise the integrity of the repaired welds. The staff concludes that the six previously overlay repaired welds are acceptable for continued operation for another fuel cycle of 18 months.

2.1 <u>CORE SPRAY SPARGER CRACKING</u>

2.2.1 <u>REPAIR</u>

The staff has reviewed the licensee's analysis and the repair of the cracked core spray sparger. Although the staff may not completely agree with the conclusions of the licensee's analysis, the repair methodology (using clamping devices on cracked spargers) is consistent with the applied at other plants, and approved by the staff. At Oyster Creek and Pilgrim Plants, visual examinations were performed on cracked core spray spargers in successive refueling outages and no significant progression of the cracks were reported. Therefore, based on the field experiences at other plants, the cracks in the core spray sparger are not expected to grow to any significant extent during the next fuel cycle. The staff concludes that the repaired core spray sparger is acceptable for continued operation of one fuel cycle of 18 months. Continued operation of the repaired core spray sparger beyond the next fuel cycle will depend on the evaluation of the inspection results performed during the next refueling outage and the continued effectiveness of the clamping device applied to the cracked sparger.

2.2.2 SYSTEM ASPECTS

GE ECCS analysis indicates that for a core spray line break, there are always at least three low pressure ECCS pumps injecting water into the reactor vessel. It ensures that this break is not a limiting event. The plant specific LOCA analysis based on the SAFE and REFLOOD Codes indicates that a suction line break in the recirculation line with a LPCI injection valve failure is the most limiting break by a large margin. This limiting LOCA analysis was performed with the conservative modeling of counter current flow limits (CCFL) at the fuel assembly upper tie plates. The calculation limits the coolant delivery or downflow from the core spray systems to the fuel bundles. Further it delays core reflooding by neglecting the water held back in the upper plenum. The Peak Cladding Temperature (PCT) using this model did not exceed 10 CFR 50.46 temperature limit of 2200° F (Figure 2, curve 4).

GE Lynn facility large scale tests show that core spray flow injected into the upper plenum drains to peripheral bundles and increases the bottom reflood rate. GE performed a bounding calculation of the limiting LOCA case with CCFS breakdown input. No credit was taken for the spray cooling effect (i.e., the heat transfer coefficient for spray cooling is assumed to be zero). The calculated PCT is about 1380°F. This result demonstrates that the current reload analysis calculation of PCT is conservative (Figure 2, curve 4).

We find this acceptable and conclude that the cooling function of the core spray system would not be degraded.

2.3 SCOPE OF INSPECTION

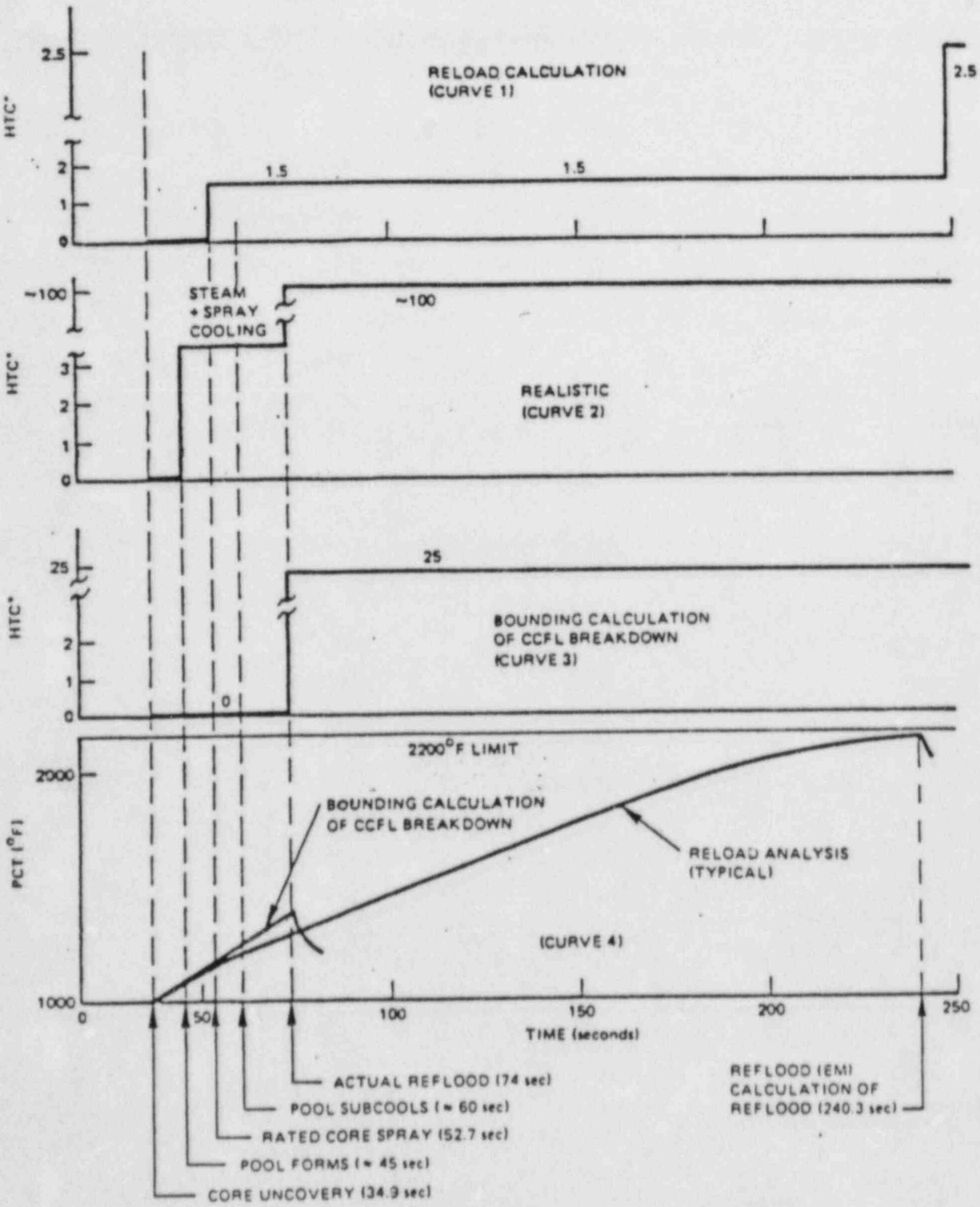
The licensee reported that 100% of the stainless steel piping welds in the Recirculation, RHR AND RWCU systems were ultrasonically inspected during this refueling outage. This included six welds overlay repaired during last refueling outage. The staff concludes that the piping inspection performed during this refueling outage meets the guidelines of the Generic Letter 84-11.

2.4 AUGMENTED LEAKAGE AND LEAK MONITORING

The licensee agreed to continue to implement the augmented reactor coolant leakage limit and leak monitoring in accordance with attachment 1 to the Generic Letter 84-11 during the next cycle. This will provide added assurance that excessive crack growth of through wall will be detected prior to compromising the integrity of the piping.

3.0 CONCLUSION

The staff concludes that Hatch Unit 1 can be safety returned to operation for at least one fuel cycle of 18 months at its present configuration.



*HTC = HEAT TRANSFER COEFFICIENT (Btu/hr-sq ft-°F)

Figure 2 Hatch Unit 1 DBA (Limiting LOCA) Analysis