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REACTOR PRIMARY COOLANT SYSTEM PIPE RUPTURE STUDY

METHOD FOR DETECTION OF SENSITIZATION IN STAINLESS STEEL

MONTHLY PROGRESS LETTER

April 1979

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NRC Research and Technical
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NRC CONTRACT 04-75-202

Progress Report for April 1979

Total funds expended during April are estimated to be $24K including G&A, IR&D and fee.

PTL Pipe Measurements

The results of the PTL-tested pipe weldments for degree of sensitization on the outside of the pipes were presented last time. The pipe segments were subsequently split in half and inside EPR measurements taken from companion weld heat affected zones. These measurements were also obtained using the field technique describled last month. The results of all EPR measurements for the PTL pipes are given in Table 1. Based on these data, if we establish a Pa value of 4 C/cm^2 for the highest reading obtained on the outside of the weld heat affected zone, then all of the IGSCC susceptible pipes would have been identified. In two cases, heats 454970 and 497816 outside values were higher than the inside, these irregularities cannot be explained at this time. The significance of these measurements will eventually be enhanced by evaluating pipes which did not fail in the PTL. Most of these non-susceptible pipes are fabricated from Type-304L stainless steel, and are still undergoing testing. One heat of low-carbon Type-304 has surpassed many thousands of cycles without failure. This pipe is scheduled for test interruption at the end of May, at which time we will obtain outside weld heat affected zone EPR measurements.

Nine Mile Point Evaluation

At the request of Niagra Mohawk, we obtained our first EPR field measurements of the Nine Mile Point (NMP) Nuclear Power Station (#1) at Oswego, New York. This was a significant accomplishment as we were given an opportunity to test the field equipment, and to experience the problems encountered during field testing. Although the trip was considered successful, a number of difficulties were encountered which impact on the entire field measurement process. First, a great deal of pre-trip planning and arrangements must be made to assure successful data collection with minimum time spent at the reactor site. Second, at NMP, a minimum of two days are required to attend all of the required classes (radiation protection, security, etc.) and take the tests necessary to gain access to the working areas, prior to beginning work. The workers found it nearly impossible to conduct measurements alone, i.e., two people are required to handle the equipment, prepare an area on the component for testing, and record the data. Access to most of the measurement areas is generally quite limited. The equipment frequently has to be hoisted up to the test area by pulleys and drop ropes, as it will not fit through the cages built around the ladders. There generally is no place to set the instrument, so that one operator holds it balanced on a pipe while the other makes the measurement with the cell. In many instances, the worker is suspended 10-20 feet above the floor, and must work within narrow confined spaces such as on nozzle safe-ends which are within the bored-out portions of the thick liner. In one instance, a measurement was obtained while laying on a narrow plank which was suspended 12-feet above the floor between a pipe elbow and a scaffold. These measurements must be taken within a relatively narrow area of the pipe where the insulation was peeled back just enough to expose the measurement area.

Finally, the time per measurement was much slower than anticipated due to inaccessibility of the measurement areas. It required 2-days of effort to obtain a total of nine (9) measurements. The irradiation field at NMP where the EPR measurements were taken varied from about 50 mr/h to 600 mr/h. Both workers were "burned out" (received a Quarter's dose) after obtaining the nine measurements.

For all the above reasons, the use of a field technique employing stringer welding or spot heat treatments appear preclusive. All of the equipment and instrumentation must be covered with plastic and tape before entering the drywell areas. Otherwise, the equipment must be decontaminated (often not possible) or disposed of when leaving the area. The best EPR field technique still appears to be the evaluation of the pipe weld heat affected zones on the outside, which can be accomplished in most of the limited access areas. These measurements can then be used to access the characteristics of the material, and to make judgements relative to the expected behavior on the inside. Using the data developed during this program, it should be possible to identifiy exceptionally IGSCC susceptible materials based on their response to thermal treatment during welding, as measured in-situ by the EPR method.

Table 1. EPR Results for Weld Heat Affected Zones of PTL Samples
($0.5\underline{M}$ H_2SO_4 + $0.01\underline{M}$ KSCN, 30°C, 6V/h)

Heat	Pa, (C/cm^2) o.d.	i.d.	Cycles to First Failure
M7616	5.7	58.4	72
M7616	15.3	-	
M7616	4.9	-	
M7616	12.2	-	
M0063	1.4	9.7	747
M0063	1.0	2.7	
M0063	4.1	-	
M0063	4.7	-	
454970	6.8	5.2	2276
454970	14.4	3.2	
454970	8.8	-	
454970	6.8	-	
TV002-002	20.8	44.5	456
TV002-002	26.1	35.9	
497816	7.2	17.4	79
497816	42.3	14.2	
181190	4.1	5.3	37
181190	5.3	23.6	
435496	7.5	21.3	839
435496	6.1	19.9	
51416	4.7	3.7	34
51416	2.8	12.4	
51416*	27.4	80.9	27
51416*	21.8	48.9	

*As-welded plus LTS (500°C/24h)