U. S. ATOMIC ENERGY COMMISSION
DIVISION OF COMPLIANCE
HEADQUARTERS

CO Report No. 219/68-9

REPORT OF REACTOR PRESSURE VESSEL REPAIR PROGRAM

Licensee:	JERSEY CENTRAL POWER AND LIGHT CO. CONSTRUCTION PERMIT NO. CPPR-15
Time Interval Covered:	September 29, 1967 - November 4, 1968
Number of Visits:	30
Place of Visits:	26 to Oyster Creek reactor site 3 to Combustion Engineering, Chattanooga, Tennessee 1 to General Electric Co. San Jose, California

Inspections By: G. W. Reinmuth [signature] 1-6-69
Reactor Inspector (Program Standards) (Date)

Reviewed By: H. R. Denton [signature] 1/6/69
Chief, Technical Support Branch (Date)

Proprietary Information: None

SCOPE

The purpose of this inspection effort was to gather and report factual information relative to the repair of the Oyster Creek reactor pressure vessel; to evaluate the quality of the work performed; to determine that specified repair procedures were followed; and to witness final tests demonstrating that the vessel had been restored to its original condition. These activities were a part of the Compliance program to determine the readiness of the Oyster Creek reactor for operational licensing.

SUMMARY

Extensive cracking of the control rod drive (CRD) stub tubes was experienced in the Oyster Creek reactor pressure vessel due to corrosion, stress assisted, intergranular attack. The stub tubes were manufactured from 304 stainless steel and in the fabricated state were in a fully sensitized condition. Follow-up investigations disclosed that the sensitized 304 stainless steel parts of the nozzle safe ends and a forged ring in the shroud support also had been damaged. In addition to the intergranular attack, welds attaching the CRD housing to the stub tubes, commonly referred to as the field welds, and the in-core flux monitor tube welds also were identified as defective.

As a consequence of these events, an extensive repair program was undertaken to return the reactor vessel to a condition equal to or better than its original state. To accomplish the repair, all sensitized areas of the stub tubes which would be exposed to the reactor environment were clad with 308L material. All sensitized material contained in the nozzle safe ends was either replaced or clad with 308L on both internal and external surfaces. Since cladding of the shroud support structure was considered to be impractical, a redundant auxiliary support structure was installed as a corrective measure. Faulty field welds were completely ground out and replaced.In-core flux monitor tube welds were hand ground to a predetermined depth after which the removed weld metal was replaced.

From numerous observations of the work at the several repair stages, from examination of both intermediate and final test results and from record reviews, it has been concluded that the work was completed according to procedure and is of an acceptable quality.

DETAILS

I. Persons Contacted

The following individuals were involved with the repair program and contributed information or aid to the inspector:

General Electric Company

E. A. Lees, Metallurgical Engineer
D. C. Bertossa, Metallurgical Engineer
W. R. Smith, Metallurgical Engineer
T. F. Robinson, Metallurgical Engineer
A. Hubbard, Manager of Materials
J. Bland, Welding Engineer
D. Tackett, Welding Engineer
R. A. Huggins, Project Engineer
D. Willet, Test and Startup Manager
L. Koke, Resident Manager
N. Strand, Resident Manager
W. Hess, Startup Engineer
R. C. Haynes, Startup Engineer
H. Engelking, Lead Engineer-Supervisor
W. Royce, Records Manager
C. Buckner, Records Manager
A. Dunning, Construction Engineer
C. Smith, Construction Engineer
L. Loeb, Q. C. Coordinator
S. Naymark, Manager
J. B. Graham, Washington Technical Representative
J. Barnard, Manager
W. L. Walker, Corrosion Engineer

R. C. Holt, Testing Engineer
I. R. Kobsa, Design Engineer
S. W. Taggart, Stress Analyst
D. Hackney, Metallurgist
J. McDaniel, Master Welder
L. Finney, Welding Supervisor
A. Toule, Q. C. Inspector
Mr. Cortez, Welding Supervisor
Mr. Lindemann, Q. C. Inspector
A. Tassona, UT Technician
J. F. Cage, Project Engineer
S. G. Hall, Q. C. Site Representative (at CE)
C. T. Ward, Engineer

Jersey Central Power and Light Company

L. Roddis, Vice President, General Public Utilities
G. H. Ritter, Vice President
G. F. Trowbridge
D. R. Rees, Project Manager
T. McCluskey, Site Manager
N. Nelson, Maintenance Foreman
Mr, Kossatz, Maintenance Foreman
I. Finfrock, Technical Supervisor
F. Anderson, Welder
D. E. Hettrick, Operations Supervisor

Combustion Engineering

W. B. Bunn, Metallurgist Consultant
E. C. Chapman, Manager
R. Lorenze, Manager
R. L. Lumpkin, Stress Analyst
J. W. Harper, Engineering Supervisor
J. J. Barger, Engineer
D. Randolph, Metallurgist
E. S. Proctor, Manager, Q. C.
F. Hill, Stress Analyst
T. M. Pierson, Metallurgist
Wayland Powell, Welder (at O.C. site)
P. Runion, Inspector (at O.C. site)
S. Baxtor, Inspector (at O.C. site)
R. Rockwell, Metallurgical Engineer

MPR Associates (JCP&L)(Consultants)

W. R. Schmidt

II. Introduction

A complete description of the Oyster Creek reactor vessel problem and the known considerations believed to have been factors in causing those problems are fully documented in the several amendments submitted by the licensee (Amendments 29, 35, 36, 37, 40, 43, 47). The substance of this report will be limited to documenting the observations of this inspector in assuring that the vessel repairs were carried out as prescribed in the above amendments.

There were two distinct types of problems experienced: 1) intergranular corrosive attack on furnace sensitized stainless steel components; and 2) faulty welding. Since their correction proceeded in a sequential manner, without regard to cause, this report will also be categorized according to the specific repair work classifications.

To further clarify the several considerations involved in the vessel repair, a detailed chronological history of events and the inspector's activities are given in Attachment A.

III. Bottom of Vessel Repair

A. Initial Observations

During the initial field hydrostatic pressure test of the reactor pressure vessel on September 29, 1967, a leak was observed by G-E construction personnel, to be emanating from the vicinity of stub tube 31-46. The leak was described as about a drop per minute.

This inspector visited the site on October 19, 1967, for the first time and observed that the vessel was still full of water from the cleaning and hydrostatic pressure test. It was noted that the water was not clear. Furthermore, workmen were installing the storage pool liner plates immediately above and surrounding the top of the vessel. No protective cover was over the vessel. The possibility and probability of extraneous material falling into the vessel from this work was considered to be high and comments to this effect were made to Mr. Royce of G-E. The vessel was subsequently covered. Also, at this time, the entire south wall of the upper superstructure of the building was open to the environment.

These observations are recorded for the purpose of documenting the construction environment to which the vessel was exposed and which may have been a contributing factor to the cause of the problem.

B. Detection and Evaluation of Problems

On October 25, 1967, another visit was made to the site at which time the first entry was made into the vessel. Entry was accomplished by crawling through one of the five main recirculation system pumps, up the 26" recirculation system pipe, through a restricting orifice and into the vessel via the inlet nozzle.

Tube 31-46 was dye penetrant tested at this time and a linear indication approximately 6" long was observed by the inspector and others at the fusion line between the Inconel shop weld and the stub tube on the high side (furthest from vessel center). Minor dye indications, all considered within code requirements, were also observed on the surface of the stub tube to control rod drive (CRD) housing weld, commonly referred to as the field weld. Since the linear indication was obvious, the assumption by all observers was that the leak must be at this location, probably caused by a lack of fusion between the Inconel shop weld and the stainless stub tube.

Following this initial observation, additional selected tubes were dye penetrant tested. These tests showed similar indications in similar locations. As a consequence of these findings, all stub tubes were subsequently tested and of the 137 total, 108 were found with linear indications ranging from approximately ½" to 8" in length. All indications were on the high side of the stub tube with the longest indications on the outermost tubes, decreasing in severity in a progressive pattern toward the center of the vessel. Those tubes with no indications were located near the center of the vessel. Indications were also found in the field welds but were considered to meet code requirements and to be insignificant at this time.

To determine the nature and possible cause of the cracking, a limited grind-probe was performed on the leaker in the region of the observed indication. Removal of approximately 1/8" of the Inconel weld metal and 1/16" of the stub tube base metal did not disclose the direction of cracking but did succeed in reducing the length of the dye indication.

As the probe grinding was inconclusive, a metallurgical sample was trepanned from tube 34-51 which showed a dye indication similar to that of the leaker. The sample was removed so that a section of the stub tube, the Inconel shop weld and a portion of undisturbed cracked area were contained within the sample. Microscopic examination of this sample disclosed the first evidence of intergranular corrosive attack which was subsequently confirmed by additional metallurgical samples. Reference should be made to Amendment 29 for details of the metallurgical examinations, the results and their interpretation. This sample also demonstrated that the Inconel shop weld was sound.

The inspector and Mr. J. Chyle, welding engineer from Parameter, Inc., were at the reactor site on October 31 when this first metallurgical sample was removed. Even with good lighting, a 10X magnifying glass, and knowing the precise location of the indications, direct examination did not disclose a clearly discernible crack. Subsequent observation also by Mr. Chyle and the inspector by microscope at the CE laboratory in Chattanooga, Tennessee, confirmed the findings as documented in Amendment 29. Figure 1, page 22 of that amendment is an accurate view of the sample cross-section observed.

Since the metallurgical samples showed the Inconel shop welds to be sound and the intergranular attack to be limited in depth, the field weld became suspect as the source of the leak. Further probe grinding of the field weld did in fact demonstrate that the leak resulted from a series of welding flaws, primarily lack of fusion and porosity type defects. For details, see Amendment 29, page 20. Further probe grinding of other field welds indicated a general welding problem which was subsequently confirmed by ultrasonic tests. With this evidence, G-E made the decision to remove and replace all field welds.

With the identification of a basic welding problem, the Inconel welds attaching the in-core flux monitor tubes to the vessel also became suspect. Grind probing and dye penetrant tests confirmed that these too would require repair.

Verification of the existence of a stress corrosion type problem led to more detailed and extensive evaluations of the probable causes. Among the efforts were stress analyses of the stub tube-housing design. These analyses showed that the short stub tube length inherent in the design resulted in the highest concentration of stress on the high side of the stub tube in the region of the observed attack. Furthermore, during shop installation of the stub tubes, excess weld metal had been applied and only minimal effort made to smoothly flare and blend the weld metal into the stub tube wall. These actions further reduced the effective length of the stub tubes thereby accentuating the stress concentration in the affected area.

Following these preliminary analyses in early December 1967, G-E's initial repair plan was to increase the effective stub tube length by grinding out the excessive metal in the Inconel shop welds and smoothly flaring the transition area. All crack indications were also to be removed by grinding according to prescribed procedures. (See Amendment 29, Figure 10, for geometry limitations.) At this time, Mr. Foley, stress analyst from Parameter, Inc., was requested by Compliance to accompany this inspector to Chattanooga, Tennessee, to review these considerations with CE design personnel. His findings agreed with those of G-E and CE in that increasing the stub tube length and flaring the weld would reduce stress concentrations by redistributing the stresses more uniformly over the length of the tube.

Further dye penetrant tests tended to confirm that the area of attack was limited to the parts of the vessel fabricated of 304 stainless material which had become fully sensitized during the final stress relief. Additional indications were found on the stub tube walls at random locations and generally unrelated to high stress points. Other indications were subsequently found on nozzle safe ends and on the shroud support forging. The extent of attack is described in detail in Amendment 35, Section III.

Other tests in both G-E and CE laboratories were conducted in attempts to identify the specific cause. Full scale mock-ups were constructed by CE and subjected to shop and field fabrication procedures. These mock-ups were observed at Chattanooga. These tests, the results and the conclusions are also described in Amendment 35. In essence, the basic conclusion reached was that all sensitized material would be clad with 308L stainless or replaced. Vessel repairs proceeded on this basis.

As the need for a major repair program was now evident, preliminary steps were taken at the site to facilitate the work conditions. One of the five recirculation system piping loops was cut loose from the vessel to permit easier access into the vessel. Other dismantling work on the in-core monitoring tubes was also performed.

C. Field Weld Removal

Having made the decision to remove the original field welds and clad the stub tube surfaces, G-E and CE began development of custom tooling for weld removal, automatic weld replacement and automatic stub tube cladding. The progress of this development was followed by this inspector including demonstration of the welding machines on mock-ups. In all cases, the machines and the operators were qualified according to detailed prescribed procedures before production work was permitted in the vessel.

Initial efforts were made to develop two types of weld removal machines; one mechanical, the other electric arc. The electric arc method was discarded after the device failed to meet the precision and speed requirements. Ultimately, a vertical milling machine was adapted to the job and was successfully employed in removing the welds and preparing the top of the stub tube to the proper contour for rewelding. (See Figure 3-1, Amendment 36.) Operation of these machines (two in number) was observed on three occasions. From these observations and reviews of the accompanying records, this inspector concluded that the operation was carried out in accordance with Repair Procedure RP-3-1 included as part of Amendment 36.

With the start of the repair work, access control procedures were put into effect to control the entry of extraneous material into the vessel. It was noted that during the machining operation, demineralized water was used to lubricate and cool the cutters. Oils were not permitted. Cleanup of chips and a hose-down of the vessel were performed at least once per shift. The diligence used by personnel in wiping material from their feet before vessel entry and continued use of coveralls without periodic laundering were considered areas where tighter control might have been practiced.

D. CRD Housing Removal

Access to the field and in-core monitor tube welds with all housings in place was difficult or impossible because of the geometry of the vessel. This was particularly true toward the center of the vessel where the housings extended up into the vessel approximately 3-½ feet, thus preventing workmen from reaching the subject welds. To permit contact work and also to provide space for the automatic welding machines, 79 selected housings were removed.

Removal of the housings was a relatively easy operation following the cutting of the original field weld. This weld, plus a close fit between the stub tube and the housing, holds the housing in the proper location and in alignment. To facilitate removal, the upper part of the housing projecting into the vessel was machined on the outside diameter .060". Machining was accomplished at the same time as field weld removal using the same milling machine. Removal of the hydraulic piping from the lower end of the housing was also required. The procedure followed for this work was as described in Amendment 36, RP 3-3.

Removal of 79 housings permitted a number of additional observations. Dye tests of the inside of the 79 stub tubes disclosed no intergranular attack on any of the tubes. Testing of two of these tubes was observed by this inspector. Some question was raised about the possibility of residual stresses in the shop welds if the stub tubes were "bottomed" in the machined socket into which the stub tube is set prior to welding to the vessel. Several of these were visually checked by this inspector. Of those examined, all had a gap ranging from the width of a finger nail to 1/16". Removal of the housings also permitted additional ultrasonic tests from the inside of the stub tube. These tests did not disclose any cracking which had not been identified by the original dye tests.

With improved access permitted by the housing removal, a second comprehensive dye test was undertaken for record purposes. These tests disclosed additional indications as well as more extensive indications in areas previously observed. (See Amendment 35, Section III for results.) This new information raised the question as to whether the cracking mechanism was continuing. G-E stated that the additional indications resulted from the improved access which allowed better testing techniques and that the experience achieved by the personnel in conducting extensive dye tests resulted in more careful observation and more conservative interpretation of results. From this inspector's observations, a higher level of diligerce was evident in the performance of the tests.

E. Contouring of Shop Welds

With CRD housing removal, actual repair operations commenced. Contouring of the shop welds to increase the effective stub tube length to a minimum of 1-1/8" was performed on a total of 68 tubes according to the procedure documented in Amendment 36, Repair Procedure No. 5. (Also, see Figure 3-1 for dimensional requirements.)

The contouring was accomplished by use of a grinding wheel fixture which attached to the stub tube. The stub tube provided a firm base for the grinding wheel as well as a fixed reference point to prevent excessive grinding. Movement of the grinding wheel was manual within the guides of the fixture.

Work quality was examined on a sample of 12 tubes and was considered satisfactory on the basis of dimensional measurements and the finished contour surfaces. Dimensional records were maintained and dye tests performed according to procedure.

F. Preparation of Stub Tubes for Cladding

Included in this phase of the repair was removal by grinding of all intergranular attack indications on the stub tube walls; repair welding of the ground areas to restore the original contour of the stub tube; polishing by light grinding of all the stub tube surfaces to assure a clean condition prior to overlay; a final dye test to assure that no indications had been overlookd; and finally, cleaning with isopropyl alcohol. These procedures are documented in Amendment 35, RP 6-1 and RP 8-1.

Each of these operations was observed at various times during a series of visits to the site. The prescribed procedures were being followed. Vessel work was under the direct supervision of both G-E and CE supervisors, and also separate quality inspectors at all times. Workmen did not appear to be pressured to complete the work within a given time schedule. On the basis of these observations and the appearance of the stub tubes prior to cladding, control of the job was considered by this inspector to be adequate.

G. Cladding of the Stub Tubes

A substantial and comprehensive joint effort was made by G-E and CE to develop an automatic weld overlay machine which would perform reliably. The machine as developed utilized a GMAW (gas metal arc weld) process which featured automatic wire feed, a preset rotation speed around the stub tube, automatic indexing from bead to bead, a fixed angle between the weld wire and stub tube, continuous gas purge, and preset voltage and current inputs. In addition, limit position fingers were provided which changed the direction of rotation to permit cladding the lower portions of the stub tubes which could not be clad by complete rotation around the tube.

Qualification of the procedure was completed according to ASME Section IX requirements. Several metallurgical specimens as well as routine bend test samples were prepared to demonstrate weld soundness. All types of specimens were examined by this inspector as well as direct observation of the machine in operation during both qualification runs and in the reactor under production environment.

Personnel were given a training program after which they were required to demonstrate their capabilities prior to work in the vessel. The demonstrations were exceptionally stringent in that both G-E and CE engineering personnel had to be satisfied with the individual welder performance. These requirements were in addition to those required by the ASME code.

Other checks to assure that the applied cladding would be of an acceptable quality included certification checks of the weld wire (all wire used was from a single heat), magnetic checks with a Severn gage, verification of ferrite content (5% -10% limit) by chemical analysis and checking results with the Schaeffler diagram and metallurgical and bend test samples prepared from run-off tabs. These tabs were made by attaching an extension sleeve to a stub tube and continuing the application of clad material onto the sleeve. Four of these run-off tabs, one from each quadrant of the vessel, were prepared. Several of the bend test samples were examined by this inspector and found to be acceptable according to code. In addition, the tops of two of the center stub tubes, which have a greater length than the periphery tubes, were removed for metallographic examination. Samples of these tubes were also directly observed and confirmed to be similar to those shown in Amendment 40, Figure IV-3-A and Figure IV-3-B.

In addition to the foregoing checks, dye penetrant examinations were conducted after application of the cladding. If defects were detected, repairs were affected by shallow grinding (minimum thickness of clad was 1/16") or stick electrode metal addition. Approximately 10% of the tubes required minor repair. A final dye penetrant test was required which imposed a 1/16" maximum bleedout acceptance criteria. Typical photographs of the cladding operation are shown in Amendment 37, Figures V-1, V-2 and V-3. Figure V-3 is an excellent representation in that the picture was taken with the dye penetrant developer on the tube and illustrates an all "white" condition. Figure V-1 shows the temporary stainless wire which was placed at the bottom of the stub tube at the start of the operation. The purpose of the wire was to furnish a visual guide to the operator in setting up the machine, so that the stainless cladding would not intersect with the lower Inconel weld metal.

During one of the early inspections of the cladding operations, this inspector was accompanied by Mr. Collins, Compliance Metallurgical Engineer. Mr. Collins noted a black powder was being deposited on the stub tube surface above the cladding. No effort was made to remove it and as the operation moved up the tube, the powder was absorbed by the weld metal. In Mr. Collins' view, the powder was caused by an inadequate gas purge as the weld bead was applied. During the next visit, it was admitted by the G-E site personnel that one of the gas supply lines was found to be leaking, thus supporting Mr. Collins' view. Investigations of the powder material indicated it to be Fe_3O_4. G-E personnel considered it not to be detrimental as evidenced by the soundness of the completed work. Another question Mr. Collins raised was the qualification of the procedure on non-sensitized material. As a result of this inquiry, G-E conducted a requalification of the process on sensitized material which demonstrated that weldability was not affected. Bend test samples and metallurgical samples were observed to support this position. Mr. Collins concurred that these results were satisfactory.

A third observation made at this time was an apparent brittleness of the stub tube. When the cladding machine was set up on a tube, a collar was first tack welded to the top of the stub tube. After completion of the cladding, the collar was then broken loose and removed. In observing the stub tube in the vicinity of these broken tack welds, the fractured surface looked like a brittle rather than ductile fracture. Subsequent bend tests of actual stub tube material (Amendment 40, Figure IV-1) and microscopic examination of weld samples disclosed the material to be ductile, however.

Repair Procedure 6, Amendment 36, describes the use of a mandrel during cladding to control shrinkage. Observations by this inspector confirmed that mandrels were used. The mandrels were employed to maintain a minimum internal diameter rather than as a means to control residual stresses.

H. Inconel Tie-in Welds

Following the cladding of the stub tubes, manual Inconel 182 tie-in welds were required at the junction of the Inconel shop weld and the 308L stainless stub tube cladding. Performance of this work was as described by Repair Procedure 6, Amendment 36.

From observations of this inspector, more than normal care was taken, as called for in the procedure, to prepare and test the excavated areas prior to deposit of the Inconel weld metal. Since the maximum cracking and subsequent grinding occurred in those areas and because residual stresses were known to be high, each layer of weld metal was surface ground and dye tested before the next weld bead was placed. This procedure was considered necessary to ensure high quality welds and was followed until the final contour was achieved. Even though this process was slow (five tubes per day), no deviations were made. The final welds were considered to be of high quality by this inspector as evidenced by the smooth contours achieved and the results of intermediate and final dye penetrant tests conducted after the hydrostatic pressure test. (See Amendment 47.)

I. In-Core Flux Monitor Tube Weld Repairs

As previously indicated, these Inconel, field placed welds were found to be faulty in that they contained excessive amounts of slag and porosity. Repair Procedure 4, Amendment 36, was prepared for the repair; however, the procedure as submitted did not include Sketches No. 1 and No. 2. These sketches, showing the limits of grinding and weld build-up, are included as Attachment 2 and Attachment 3 to this report.

Of significance in this repair was the need to avoid grinding into the vessel base metal during removal of the defects. The procedure specified dimensional grinding limits beyond which consultation with G-E and CE engineering was required. Several such instances did occur. As a consequence of this experience, templates were subsequently provided and used to define the precise limits of grinding.

The weld repairs were conducted using the same techniques as in the Inconel tie-in welds on the stub tubes. Observations of the grinding, in-process welding and the completed welds were made by this inspector during site visits. The repair is considered to have been performed according to the procedure and the overall quality adequate as demonstrated by successful dye penetrant tests.

J. Replacement of Field Welds

As with the cladding machine, considerable effort was made by G-E and CE to provide a fully automatic GMAW (gas metal arc weld) welding machine for replacement of the field welds. This device was subsequently developed by rebuilding and modifying the original semi-automatic welder. Because difficulty was experienced during initial welding in the vessel, a conventional manual, stick electrode procedure was also qualified. Both procedures were ultimately used with approximately 65% of the welds being machine welded.

The basic process employed a GTAW (gas tungsten arc weld) root pass, manually applied after which the GMAW machine or manual stick SMAW (shielded metal arc weld) method was used for weld buildup. The purpose of the GTAW pass was to position the CRD housing and to provide a good root geometry for start of the GMAW welding. Dye tests within the first 1/3, when the weld was flush with the top of the stub tube, and the completed weld were required. The acceptance standard was a maximum 1/16" bleedout, the same as that required on all the repairs. In addition to the dye tests, a UT of each completed weld was required to confirm the quality of the weld. These requirements are spelled out in Repair Procedures 2 and 3, Amendment 36. From observations of the work, and the associated records, the repairs were considered to have been made in accordance with these procedures.

Initial attempts to complete a satisfactory weld in the vessel were not successful despite acceptable procedure and welder qualification welds on mock-ups. The first weld was placed in a center tube which was to be cut out to provide metallurgical samples and is shown in Figure IV-1, Amendment 40. This weld indicated a lack of fusion in the root pass. Subsequent changes to the process included making the first weld pass a 360^{o} traverse rather than an intermittent tack weld; changing the gas purge mixture from 100% argon to a mixture of 75% argon-25% helium; and improving the stability of the power supply. Of the six welds which were removed a second time, five occurred during the time of these improvement efforts. In each case, the decision to replace the weld was made on the basis of UT results, the maximum flaw observed being 1/8" by 1/4" in size. This was considered rejectable and the weld was replaced.

As during the cladding operation, mandrels were used on the inside of the CRD housings to insure a minimum internal dimension.

Following placement of the field weld, another manual tie-in weld was necessary on each tube to tie the 308L cladding to the 308L field weld metal. Similar methods were used as in the lower Inconel tie-in welds; principally manual weld metal application, grinding to a smooth contour and dye penetrant testing.

Observations of these operations were made at intervals so as to observe the various stages of the operation. Mr. Collins reviewed the UT techniques and the test results and concluded they were acceptable. In this inspector's view, the work was of a quality equal to or better than similar work which has been observed in the fabrication shops.

K. Housing Alignment

With the placement of all new field welds, realignment of the housings was required. Progressive checks were made during welding which dictated stop-start points to maintain a reasonable alignment. Final alignment, however, was necessary on almost all the tubes and was accomplished by adding weld metal at the junction of the CRD housing and the field weld on the side of the tube toward which the tube was to be pulled. This work was accomplished according to Repair Procedure 3, Section 4.2, Amendment 40.

IV. Nozzle Safe End Repair

A. Identification of Problem

With intergranular corrosive attack observed on the furnace sensitized 304 stub tubes, all other components made of this material became suspect. One of the more important areas having safety significance were the 304 stainless transition pieces on the nozzles, commonly referred to as safe ends.

Early dye tests of the safe ends and the transition welds disclosed a number of small (< 3/32") spot indications which were considered at that time to be acceptable since they met the code criteria. Documentation of these early results is provided in Amendment 35. As the site personnel became more familiar with the sensitivity of the dye test method and the appearance of intergranular attack indications, additional testing and the removal of metallurgical samples was considered to be prudent. Although the results were somewhat inconclusive, G-E made the decision to replace or clad all sensitized 304 material contained in the safe ends. These included the safe ends on the ten large recirculation system nozzles, two emergency steam generator nozzles, two core spray nozzles and one hydraulic return line nozzle. No work was scheduled for the three nozzles in the vessel head. The justification given by G-E was that it would be more economical to perform the work at this time than during operation should a leak later develop.

This early work was predicated on the basis that all intergranular attack was limited to internal surfaces. However, with further testing intergranular attack was identified on the outer safe end surfaces as well. Subsequently, the work was extended to include the cladding of the external surfaces and also the three nozzles in the vessel head.

B. Repair of Safe Ends

Results of the investigations and the procedures employed for the repair are documented in Amendments 40 and 43. This inspector observed the progress of the work at varying intervals and concluded that compliance with the procedures was practiced. Included in those items observed were the qualification welds, both procedure and welder, and the associated bend test samples. These were satisfactory. Since the cladding work was performed manually, in place, the finished surfaces were not as smooth or polished as those achieved on the stub tubes. However, all manual cladding passed the same dye penetrant test criteria, maximum of 1/16" bleed out, thus it is concluded that the work was acceptable.

V. Shroud Support Ring

A. Identification of Problem

As with the nozzle safe ends, early dye penetrant tests of this structure were conducted and the results considered by G-E not to be safety significant. The defects, shown by Figure 4, Amendment 35, were removed by grinding. With later discussions and evaluations of the potential problems and confirmation by additional dye and metallurgical tests, it was concluded by G-E that this structure had also experienced intergranular attack and would require repair. These evaluations and findings are documented in Amendments 37 and 40.

Because access to the 304 stainless part of this structure was difficult, cladding as a repair method was considered prohibitive. In lieu of cladding, a redundant, auxiliary pin-clevis support structure was designed and subsequently installed. Description of these devices, the associated stress analyses, and the installation procedures are spelled out in Amendment 40.

B. Observations of Repair

Installation of the 36 pin-clevis devices was conducted according to procedure and did not entail any unusual considerations. Work access was limited in the shroud area; however, was not prohibitive. All welding was performed manually with stick electrode.

One observation made by this inspector was that the welds were of the filet type rather than full penetration as indicated on Figure VI-2, Amendment 40. G-E responded to the observation by indicating the stress analysis considered the welds as of the filet type.

In examining the records, it was also observed that the mill certification reports specified that the yield strength of the pin material was 27,000 psi. Amendment 40 referenced ASTM A-276 as the applicable specification for the 304 stainless material which states the minimum yield strength must be 30,000 psi. G-E again responded by indicating that the material used was 304L rather than 304, the 304L having a minimum requirement of 25,000 psi. Furthermore, the maximum calculated load stresses imposed upon the pin were below the 27,000 psi test strength. G-E stated that Amendment 40 was in error in designating 304 as the material to be used rather than 304L.

Quality of the work was judged to be acceptable by this inspector on the basis of observations of the in-process welding and the final dye test results. Test results again met the 1/16" bleedout acceptance criteria.

VI. Miscellaneous Aspects of Vessel Repair

A. Combustion Engineering Participation

Active and direct participation by Combustion Engineering personnel in the investigation of the problem and in the repair work was evident throughout most of the repair period. This participation contributed to the assurance achieved by this inspector that the work was properly engineered and properly carried out.

High level engineering personnel of proven competence were observed at the site on many occasions. Periodic contact with these individuals at Chattanooga on other pressure vessel work during the course of the Oyster Creek problem, disclosed them to be knowledgeable of current considerations and in many instances actively engaged in resolving questions independently of the General Electric Company.

Crews of supervisory and quality control inspectors from Combustion Engineering were maintained in the pressure vessel during most of the repair. These people were in addition to the General Electric personnel, thus providing double coverage of the in-place work. CE elected to remove their people following the completion of the cladding and lower Inconel tie-in welding (June).

B. Records

A comprehensive system of record keeping was established and maintained throughout the program. These are on file by G-E for reference by authorized parties. Several types of data sheets and record forms were included in the Amendments as samples. To further demonstrate the degree of record control practiced, Attachment 4 is attached to this report which shows the amount of detail actually recorded for one specific phase of the repair. The records were examined on a selective and periodic basis to confirm that records were being maintained and that they reflected the work requirements. They were found to be complete and accurate.

C. Dye Test Criteria

Considerable discussion took place during the repair program relating to the sensitivity of the dye penetrant test method and the interpretation of the observed results. From the Oyster Creek experience, the responsible personnel concluded that the code acceptance criterion was not sufficiently definitive in identifying either the spot type intergranular attack or the weld defect problems actually experienced. For instance, the typical "strawberry" type of spot intergranular attack indications were frequently very small and well within code bleedout size limitations. From their experience with extensive dye testing, site personnel formulated their own acceptance standards. These standards enabled the identification of intergranular attack on the outside surfaces of the nozzle safe ends which might otherwise have been overlooked or considered insignificant by ordinary standards.

D. Use of Mandrels

In the published procedures included in the Amendments, there are references to the optional use of mandrels. For record purposes, mandrels were used in the stub tubes (the 79 which had the CRD's removed) during cladding and in the CRD's during placement of all field welds. Noteworthy, however, is that they were used to maintain a minimum internal dimension rather than as a mechanism for reducing fabrication stresses during welding.

E. Repair of Recirculation Nozzle Arc Strikes

During the Compliance quality assurance program review, which was conducted during the same time period as the vessel repair, it was observed that the base metal of the recirculation system nozzles had been damaged by weld arc strikes. Since these arc strikes create stress risers which can lead to cracking, repairs were necessary. One of the pecularities of the 302B base metal used for the construction of pressure vessels is that it cannot be welded without preheat or post-weld stress relief, thus repair by welding under field conditions is generally avoided. The repair actually performed provided for grinding out the defective area and verifying by etching that all damaged material had been removed. The procedure for performing this work is included in Amendment 36, Repair Procedure 9.

It was verified by this inspector that these repairs were completed according to procedure. Fifteen arc strikes were identified having a maximum depth of 0.007" and ranging in size up to 8" long by 0.035" wide.

VII. Post Repair Hydrostatic Pressure Test

The second hydrostatic pressure test of the reactor vessel at the site was successfully performed on October 5, 1968, following the completion of the repair program. The maximum pressure attained was 1,800 psi which is a few percent below the code specified 150% of vessel design pressure (1,250 psi). G-E stated a higher pressure was not permitted because of a lower design pressure (1,200 psi) of the connected piping. No leaks in the pressure vessel were detected during any phase of the test.

The inspector observed the vessel at pressure and inspected the stub tube region to verify that the repairs were successful from a leak tightness viewpoint. No leaks were observed.

The test was conducted according to procedure which had been prepared before performance of the test. The procedure provided detailed check-off sheets for vessel temperature, water chemistry, time-pressure monitoring, as well as specific weld joint inspection assignments. These data sheets were properly completed, copies of which were attached to a final report of the test given to the inspector.

An unusual occurrence during the test was the detection of chlorides up to 30.9 ppm in the bottom of the vessel during introduction of the TSP (tri-sodium phosphate) solution. TSP was used as a corrosion inhibitor. This degree of chloride concentration was stated to be within the limits of the specified TSP to chloride ratio (5 to 1). The observed concentration was caused by incomplete solution of TSP and mixing in the reactor water during the initial introduction of the TSP. The condition existed for a period of about five hours. Concentration of the phosphates ranged up to 5,500 ppm during this same time period, well above the specified 5 to 1 ratio. Subsequent to this 5-hour period, the concentration of phosphates stabilized at 450 ppm and the chlorides at approximately 6 ppm. The chlorides originated from the commercial grade TSP which permits a maximum of 0.7% by volume chloride content. Actual test of the material used showed a concentration of 0.043% chloride. Since the TSP was used as a corrosion inhibitor, G-E did not consider the observed concentrations to be detrimental.

Vessel temperature (metal) was maintained at approximately 110°F as measured on the outside surfaces of the vessel and head flanges during the hydrotest period. Water temperatures were approximately 140°F during the same time interval. Filling of the vessel began on October 4 and draining on October 9. Time of the vessel at temperatures above 100°F is estimated at approximately 36 hours.

From examination of the documented test results and the direct observations made by this inspector, it is concluded that the test successfully met all objectives.

VIII. Post Hydro Inspection Results

Inspection consisted of dye penetrant testing all stub tubes surfaces from bottom to top. These surfaces included an approximate 1" band of the vessel cladding around the shop weld, the shop weld, the stub tube, the field weld, and approximately 1" of the CRD housing. In addition, eight stub tubes were ultrasonically tested. Representative safe end repair locations were also dye tested. The auxiliary shroud support clevis-pin structures were visually examined.

All test results are documented in Amendment 47. In essence, the test results show that the hydrotest resulted in no detectable changes in the repaired components. Good correlation between pre-hydro and post-hydro test results, both dye penetrant and ultrasonic, was demonstrated.

In addition to reviewing the test result records, this inspector observed the dye testing of three stub tubes. The test was conducted according to prescribed ASME code, Section III procedures and demonstrated an acceptable "all white" no defect condition on the three tubes. From these observations, the results documented in Amendment 47 are considered to be accurate.

Attachments:
Attachments 1, 2, 3, & 4

CHRONOLOGY OF EVENTS

1967

Sept. 29	-	First field hydrostatic pressure test completed. Water detected leaking from tube Y-31, X-46.
Oct. 19-20	-	First visit to reactor site by this inspector. Vessel observed to be still full of water.
Oct. 25-26	-	First entry into bottom of vessel. Observed dye indication of crack on leaking tube 31-46. Crack approximately 6" long on high side of tube. J. C. Bertossa, G-E Metallurgical Engineer states G-E will dye test all stub tubes.
Oct. 31- Nov. 1	-	Visited site. Inspector accompanied by consultant J. Chyle. Dye test results of stub tubes (137 total) showed 108 to have indications varying in length from ½" to 8". Twelve peripheral tubes were probe ground in the cracked areas to 1/8" depth. Grinding failed to eliminate indications but length of crack decreased as grinding progressed into tube. One sample trepanned from tube 51-34 having indication similar to leaker. Sample to be split, half going to Combustion Engineering (CE) in Chattanooga and half to G-E, San Jose, for metallurgical examination. CE engineers on site to observe dye tests and sample removal. Grinding of all tubes to maximum depth of 7/32" into stub tube wall proposed as repair procedure. AEC suggests second sample be removed to confirm findings.
Nov. 3	-	ACRS informed of problem.
Nov. 7	-	Inspector, accompanied by consultant, J. Chyle, visited CE plant in Chattanooga, Tennessee, to observe sectioned sample removed from Oyster Creek stub tube 51-34.
Nov. 8	-	Information received from reactor site via telephone. Control rod drive (CRD) housing in position 31-46 (leaker) locally hydrostatically pressure tested. Housing leak tight. Leak now believed to be from stainless field weld at top of stub tube joining CRD housing to stub tube. Probe grinding of weld to ½" depth did not remove porosity. Twenty percent of remaining field welds also show porosity indications.

ATTACHMENT 1

Grinding of stub tube surfaces in areas of crack indications completed on 45. Most indications are disappearing by grinding to maximum 7/32" depth. Second sample from position 03-34 removed for metallurgical examination.

Site personnel state stub tube problem will delay fuel loading by two weeks.

Nov. 14 - Information from site via telephone. Indications removed from 70 tubes by grinding. Six required grinding deeper than 7/32" depth limit. Leaker confirmed to be in field weld. Dye tests on 60 field welds show porosity indications on 50%. Two additional metallurgical samples removed from vessel. G-E, San Jose, confirms CE metallurgical results on their half of first sample. Grinding on stub tubes and dye testing of field welds continuing. CE engineering personnel continue to observe work.

Nov. 15 - G-E-JC-Regulatory meeting in Bethesda to discuss vessel problem and quality control. G-E disclaims chlorides as contributing cause -- believe cleaning solutions more likely. G-E taking extensive investigatory steps in effort to determine cause. Grinding and contouring of crack areas continuing. Need for stress analysis review emphasized by AEC. Fabrication records show stub tube material to be fully sensitized during final stress relief of vessel.

Nov. 16 - Dye tests of Niagara Mohawk, Nine Mile Point stub tubes discloses no cracking. Dye tests on two Tarapur, India vessels reported to show similar but more extensive cracking than at Oyster Creek.

Nov. 17 - Visited site. Eighty-five of 108 stub tube defects removed by grinding. G-E-CE qualifying weld repair procedure and welders. Jersey Central engages MPR Associates as their consultant.

Nov. 21 - Inspector and W. Foley, Parameter, Inc., visited CE, Chattanooga to discuss stress analysis considerations. CE and G-E performing independent stress analyses of Oyster Creek vessel design. A third party analysis is also planned. Results to be available in January. CE fabricating mockup of stub installation for test purposes. Samples confirmed earlier findings.

Nov. 22 - G-E-JC-Regulatory meeting in Bethesda to further discuss problem and proposed repair. Fabrication history, cleaning procedures and other background information presented. Ninety-nine of 108 stub tube cracks now ground out. AEC requests hold on representative tubes for future reference. By the time the site is informed, only two tubes remain untouched. Three of 13 field welds probe ground with little or no removal of porosity indications. G-E informed by AEC, repair work could proceed at their risk.

Nov. 28 - Site personnel informed by G-E, San Jose not to proceed with any weld repair.

Nov. 29-
Dec. 1 - Visited site. Nine metallurgical samples now removed for investigatory efforts. Field continuing to probe grind field welds with generally unfavorable results. Additional evidence of intergranular attack on stub tube walls has been found. CE insisting that welders to be used for repair be requalified to their requirements. No weld repairs started.

Dec. 7 - Amendment 29 documenting problem and investigatory results received by AEC.

Dec. 8 - Information from site via telephone. Field welds to be ultrasonically tested starting today. Six water samples collected from low points in reactor system indicated chloride contents from less than 5 ppm up to 131 ppm. Highest chloride found in water from bottom of one of two CRD housings.

Dec. 9 - Reported status of vessel to ACRS.

Dec. 12 - CO-DRL meeting to discuss Oyster Creek problem. Engelken suggests licensee be required to submit new safety analysis and inspect all sensitized stainless material in vessel.

Dec. 18 - Inspector, accompanied by L. Porse, DRL, visited Chattanooga, Tennessee, to observe stub tube mockup and discuss stress analysis details. Mockup to be used for UT calibration and corrosion tests. Short stub tube design of Oyster Creek vessel indicates thermal cyclic stresses will enter plastic zone. Lifetime leakage requirements questioned. No repairs will be initiated at Oyster Creek until stress analysis work is completed according to CE.

Dec. 20-21 - Visited site. Decision made by G-E to remove all field welds as result of UT. Are currently in process of developing milling machines. First to be ready by second week in January. G-E site construction manager states repair can be completed in five weeks. Gene Lees, G-E metallurgical engineer assigned responsibility for vessel repairs at site. Detailed mapping of dye penetrant indications underway. One of the recirculation loops to be cut for easier access in to vessel.

Dec. 29 - Information from site via telephone. Recirculation loop has been cut loose from vessel.

1968

Jan. 5 - Information from site via telephone. Site to measure and forward stub tube ID and OD dimensional profiles to ACRS. Work on electric arc milling machine not successful. Effort now concentrated on mechanical cutter, currently mocked up at San Jose. Expect to arrive at site mid-January. CE modifying field welding machine to convert it from semi-automatic to fully automatic.

Jan. 12 - Status reported to ACRS.

Jan. 16-17 - Visited site. Only minor work in progress on vessel, primarily dye testing. Awaiting tool development.

Jan. 26 - Visited site. (G-E-JC-Regulatory Quality Control meeting) Comprehensive dye tests show intergranular attack more extensive than originally reported. In-core monitor tube to vessel Inconel welds also found to be defective and will require repair. First field weld milling machine now at site. Verbal information received that G-E is considering cladding the stub tubes with 308L as permanent fix.

Feb. 5 - Visited site. Continuing to probe-grind defects in in-core monitor welds. Observed cutting of field welds and obtained chip showing defect. Four removed. New weld prep surfaces appear to be equivalent to shop quality.

Feb. 6 - DRL receives copy of letter, Huggins to Ritter, summarizing test findings and proposed repair by cladding.

Feb. 9 - Status reported to ACRS by Compliance.

Feb. 16 - Information from site via telephone. Thirty-five field welds removed by new milling machine. Selected CRD housings being removed to achieve work access. Contouring of shop welds started by use of special fixture. Three Admiral-Doyle welders sent to Chattanooga to train and qualify stub tube cladding procedure using the specially developed cladding machine.

Feb. 19 - Information from site via telephone. Fifty field welds removed. Cutting of field welds also removes 0.8" from top of stub tube and prepares end for reweld. By contouring lower Inconel shop weld, original length (about 1") of stub tube is maintained. No weld repair will start until all machining is complete. Inside of one stub tube with CRD housing removed, dye tested. No indications. No plans to UT inside of stub tubes at this time.

Feb 20 - Inspector and L. Kornblith visited site. Confirmed above information. Total repair expected to be complete by mid-June.

Feb. 21 - Briefed representatives of RDT on Oyster Creek problems. Received information about Tarapur in return.

Feb. 28 - Information from site via telephone. Seventy field welds removed and 11 CRD housings removed. Contouring complete on five shop welds. Dye tests of stub tubes on inside after housing removal have shown no indications. CRD housings removed, to be sent off site for rework and cleaning. Work force working two 9-hour shifts, six days per week.

Mar. 7-8	-	Visited site. One hundred four field welds cut and 40 CRD housings removed. Contouring complete on seven tubes. Dye observed on inside of several stub tubes -- no indications. Cladding machine at site and being used on mockups to qualify personnel. Observed machine in operation. Also observed the reworked field weld machine. Obtained sectioned sample from qualification weld. Sample welds in each quadrant of the vessel to be made for test purposes during production welding. G-E desires release of the two stub tubes reserved for the AEC. Access control into vessel tightened up.
Mar. 18	-	Information from site via telephone. One hundred thirty-five field welds now removed. Forty-six CRD housings out -- G-E is considering removal of 32 more. Contouring of shop welds complete on 20. Welder qualification now complete.
Mar. 25	-	Amendment 35 describing latest findings and proposed repair program received. Regulatory informs G-E that repair may proceed at their own risk.
Mar. 28	-	Visited site. Cleanup and final dye testing of stub tube surfaces in progress preparatory to start of cladding operation. Further minor surface indications being found on stub tubes. Sixty-five CRD housings now out -- 14 others shaved (upper diameter reduced by a few thousandths inches) if removal found desirable. All planned contouring of shop welds on high side stub tubes now completed. Total number was 68. Fifty-three stub tubes with housings removed were checked by UT. Tests showed nothing. Obtained copies of detailed repair procedures.
Mar. 28	-	Amendment 36 containing the repair procedures received.
April 3	-	G-E-JC-Regulatory meeting to discuss Amendment 35. Suitability of shroud support structure questioned in light of corrosion attack. Additional metallurgical samples to be taken by G-E.
April 4	-	Information from site via telephone. Flushing water used in vessel checked out at 10 ppb chloride. Seventy-nine housings now out. Cladding of first stub tube expected momentarily.

April 4	-	Status reported to ACRS.
April 9	-	Briefed DRL consultants (Patriarcha, Miller) on Oyster Creek problems and proposed repair procedures.
April 15	-	Information from site via telephone. Vessel work delayed past week by local labor strike. Strike now over. Seven tubes have been successfully clad.
April 17	-	Inspector, accompanied by W. Collins, CO, Metallurgical Engineer, visited site. Sixteen tubes clad. Mandrel being used during welding to minimize dimensional distortion. Interpass temperature being controlled to 650°F. Ferrite checks of as-applied cladding are checking out at 5-10%. Surface dye checks satisfactory. Observed black soot-like material on stub tubes in process of cladding.
April 18	-	Discussed above inspection findings with DRL, DRS personnel.
April 24	-	Information from site via telephone. Further dye testing and grind probing of in-core monitor tube welds disclose need for extensive repair. Repair will be performed after cladding operation completed. G-E requalifying clad and field weld procedures with sensitized material. Are considering cutting off 1" from the top of a clad stub tube in center of vessel for metallurgical examination to demonstrate adequacy of repair procedures.
April 26	-	Visited site. Forty-one tubes now clad. Cleaning and final dye test mapping on remainder complete. Two AEC tubes still in original condition. Minor indications on stub tube surfaces still being found. Ferrite content of clad continues to check out greater than 5%.
April 29	-	Attended Commissioners' Meeting. Presentation on Oyster Creek problem given by P. Morris.
May 6	-	Amendment 37 received. Covers additional information on vessel repair program. G-E states stress analysis work shows proposed repair is adequate for lifetime of vessel.
May 8	-	Inspector, accompanied by R. E. Behmer, Division of Inspection, visited site. Eighty-eight tubes now clad. Cladding temporarily halted to permit manual tie-in welding of stub tube cladding to bottom shop weld. Four tubes partially complete. The manual Inconel welding is

requiring more time than anticipated. G-E now planning removal of the tops from two center stub tubes, one containing a housing welded in by the reworked automatic welder. Metallurgical samples also to be removed from sensitized nozzle safe ends.

May 9 - Briefed DRL personnel on results of visit.

May 10 - Status reported to ACRS.

May 22 - Information from site via telephone. Results of metallurgical sample removed from bottom of shroud support ring shows intergranular attack 30-49 mils deep. One hundred twenty-seven tubes now clad. Inconel tie-in weld on 14 tubes completed. Center stub tube samples cut and sent to San Jose for analysis. This included first field weld.

May 24 - Visited site. One hundred thirty-four of 137 tubes now clad. Tie-in welds complete on 18 tubes. Metallurgical samples removed from top of shroud support ring and from nozzle safe ends. No results yet. G-E anxious for AEC to release the two untouched stub tubes.

May 28 - DRL, DRS and CO meeting. L. Porse, Patriarcha, DRL consultant, and inspector to go to San Jose to observe metallurgical samples. Trip to influence decision as to whether or not AEC should release two untouched stub tubes.

June 4-6 - Porse, Patriarcha and inspector visit G-E, San Jose, to examine metallurgical samples removed from two stub tubes in Oyster Creek vessel. Samples also included section of first in-place field weld. Samples from Nine Mile Point vessel also observed and showed no evidence of intergranular attack. A decision has been made by G-E to replace or clad all 304 stainless safe ends at Oyster Creek. Cladding would be limited to the internal surfaces. Design of a redundant auxiliary support structure for the shroud is currently in progress.

June 7 - Gave short status presentation to ACRS.

June 14 - Dr. C. F. Cheng, corrosion consultant engaged by DRL at recommendation of ACRS. Attended DRL meeting to brief Dr. Cheng on history of Oyster Creek problem. Information from site via telephone indicates work is continuing on manual tie-in welds at bottom of stub tubes. Ninety of these are complete.

June 19	-	Contributed to DRL decision to release two AEC stub tubes for repair.
June 23-24	-	Visited site. Welding of stub tube to CRD housings (field welds) started with modified procedure. Twelve completed, eight by manual welding following electronic problems with automatic welder. Welds being dye tested at three stages. Completed welds to be UT'd. One hundred fifteen Inconel tie-in welds at bottom of stub tube now complete. Re-dye testing and mapping of in-core monitor tube welds in progress preparatory to repair.
June 25	-	Jersey Central notified by DRL, two AEC stub tubes may be repaired. Some test and measurement conditions recommended.
July 5	-	DRL received telegram from G-E in response to June 25 letter. G-E plans no sample surveillance program.
July 9	-	Visited site. Collins accompanied inspector. Thirty-six field welds completed using both manual and machine methods. One hundred thirty-five bottom tie-in welds complete. Twenty tie-in welds at top of stub tube between cladding and field weld completed. Setting up grinding machine to remove original field welds on two AEC tubes. One emergency condenser line cut for safe end cladding. Procedure and personnel qualification in progress for cladding work. Contract awarded to Philadelphia firm to fabricate auxiliary shroud supports -- now a clevis-pin design rather than initial turnbuckle. Witnessed UT of field welds from under reactor vessel using specially designed apparatus.
July 12	-	Gave status report to ACRS.
July 23-24	-	Visited site. Fifty-six field welds complete, 36 by manual welding. Grinding and repair welding of in-core monitor tube welds started -- 22 of 69 completed. Field weld removed from two AEC tubes, outside surfaces clad and bottom tie-in welds complete. Spot checks by dye testing of selected stub tubes after completion of all welding have shown no cracking indications. Cladding and/or safe end removal work on nozzles progressing on schedule. No installation of auxiliary shroud supports started.

July 25	-	Discussed results of site visit with DRL, DRS and CO.
July 26	-	Attended DRL meeting with representatives from the Indian government to discuss Tarapur vessel problems. Problems described as "similar but more extensive" than those at Oyster Creek.
August 7	-	G-E-JC-Regulatory staff meeting to discuss Oyster Creek vessel repairs and results of investigative tests. Cause of cracking still not definitely determined. Justification for installation of auxiliary shroud support presented.
August 8	-	Visited site, accompanied by Dr. Cheng, L. Porse and V. Stello. Seventy-five field welds now complete, 44 by manual welding. Seventeen CRD housings replaced as field welding progresses in predetermined sequence because of access considerations. Repair of in-core monitor tubes also in progress, 62 of 69 complete. Housing realignment in progress. Dr. Cheng suggested removal of fiberglass matting placed around completed stub tubes for mechanical protection. States fiberglass contains chlorides. G-E will comply with suggestion. Nine of ten large recirculation nozzles now clad. Other nozzle work about 50% complete. Dye tests show cladding to be satisfactory.
August 9	-	Presented short status report to ACRS.
August 22	-	Information from site via telephone. In-core monitor tube weld repairs completed. One hundred one field welds complete. UT of welds being performed as they are completed. Results satisfactory to date. Seventy-five housings now realigned. Safe end work about 75% complete. Eight of 36 clevis-pin assemblies welded into vessel as part of redundant shroud support.
August 28	-	Visited site. One hundred six field welds complete. Eighty-five housings aligned. Safe end work about 80% complete. Twenty-seven of 36 clevis-pin assemblies installed. Clevis-pin welds being dye penetrant tested only. Results OK to date according to Lees. Arc strikes observed on vessel nozzles in November 1967 have been repaired by grinding.
Sept. 5	-	Amendment 40 describing auxiliary shroud support structure plus updated repair program received.

Sept. 13 - Visited site. All housings have been reinstalled and all field and tie-in welds completed. Twenty tubes remain to be realigned. Dye test and UT of completed work show the welds meet the acceptance criteria. Safe end work about 90% done. All shroud support work complete.

Sept. 20 - Inspector accompanied by Collins visited site to examine and discuss UT records of field welds with R. C. Holt, G-E Test Engineer. Collins reviewed test techniques and results. Work on vessel in final stages. Preparations underway to reinstall recirculation pipe removed for vessel access. G-E will clad outside of safe ends on main recirculation system nozzles and replace safe ends on head nozzles after hydro.

Sept. 30-
Oct. 1 - Accompanied O'Reilly and Keppler to reactor site to discuss quality control aspects other than the pressure vessel with JC and G-E. Obtained copy of hydrostatic pressure test procedure and discussed with G-E personnel. Reinstallation of recirculation pipe 75% complete.

Oct. 5 - Visited site to observe hydrostatic pressure test. Completed as planned with no observed leaks from vessel.

Oct. 17-18 - Visited site. Reviewed post hydro dye test results. Only 25% of stub tubes dye tested which does not comply with earlier statements. Three tubes were dye tested for inspector - one not previously checked. All three were "white." No further UT planned on field welds.

Oct. 19 - Reviewed all literature submitted by licensee relative to the vessel repair to determine test commitments. One hundred percent dye tests but no post hydro UT were documented as intended requirements.

Oct. 21 - Attended AEC staff meeting to discuss AEC position relative to test requirements. G-E to be invited in to discuss. Amendment No. 43 covering additional details of the nozzle safe end repair program received.

Oct. 24 - G-E-JC-Regulatory staff meeting to discuss post hydro testing. Dye tests of 47 additional tubes for total of 79 and UT of 8 were performed between October 18 and this date. No verbal commitments made by G-E to perform additional testing.

Nov. 1 - ACRS updated.

Nov. 4 - Amendment 47 received documenting post hydro test results. One hundred percent dye test of stub tubes was performed but no further UT. Test results satisfactory.

GENERAL ELECTRIC

ATOMIC POWER EQUIPMENT DEPARTMENT

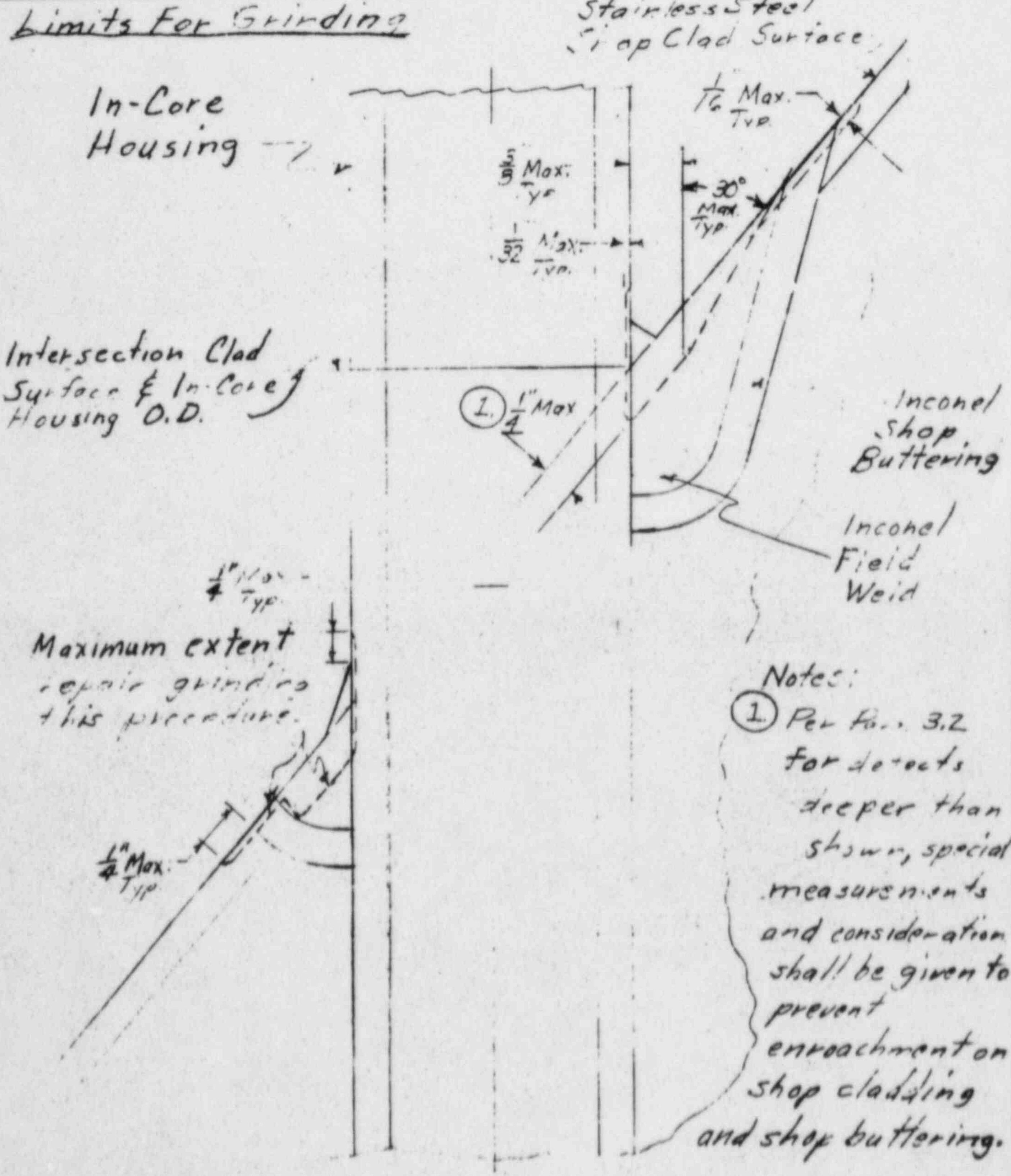
PURCHASE SPECIFICATION

SKETCH #1

Repair Procedure #1

TITLE Oyster Creek In-Core Housing Field Weld Repair

Limits For Grinding



Notes:

(1.) Per Para. 3.2 for defects deeper than shown, special measurements and consideration shall be given to prevent encroachment on shop cladding and shop buttering.

ATTACHMENT 2

BY:	ISSUED:	SPEC. NO.	REV. NO.	CONT ON SHEET ____ SH NO. ____
[illegible] 1-13-80				

GENERAL ELECTRIC

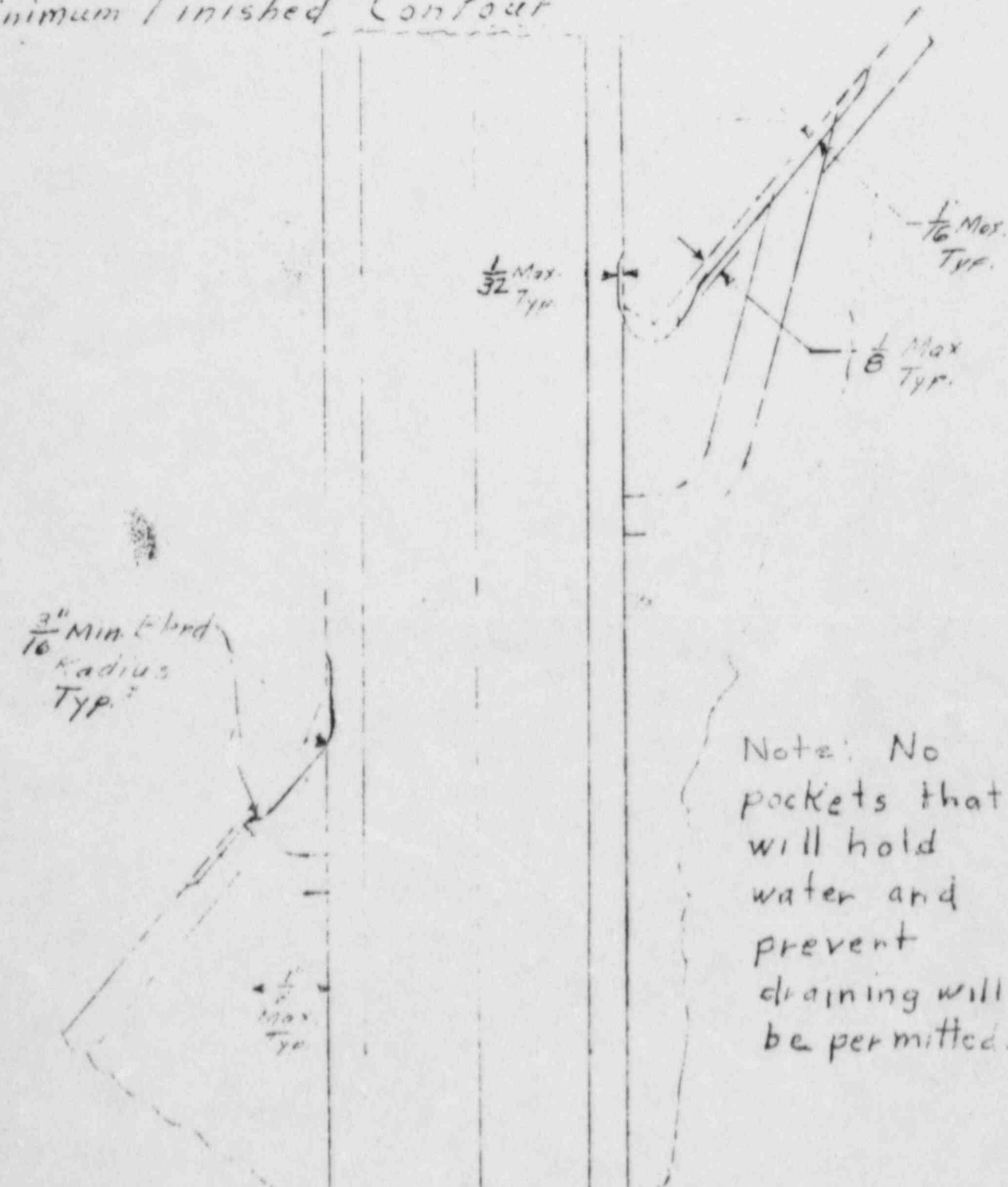
ATOMIC POWER EQUIPMENT DEPARTMENT

PURCHASE SPECIFICATION

SKETCH #2
Repair Procedure #4

TITLE Oyster Creek In-Core Housing Field Weld Repair

Minimum Finished Contour



Note: No pockets that will hold water and prevent draining will be permitted.

ATTACHMENT 3

BY:	ISSUED:	SPEC. NO.	REV. NO.	CONT ON SHEET ___ SH NO. ___

Figure 1 Form OCRPVR - 10

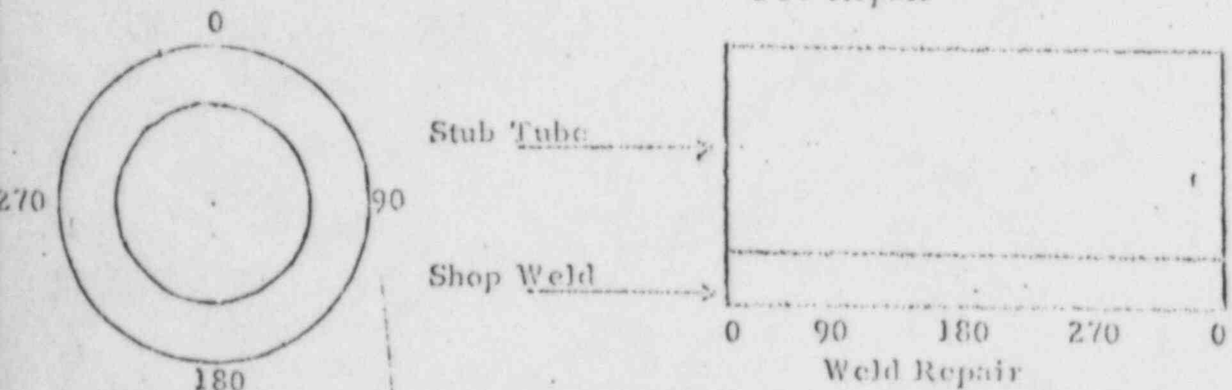
STUB TUBE WELD REPAIR

RECORD P. T.

(Reference: Repair Procedure Numbers 1, 6, 8)

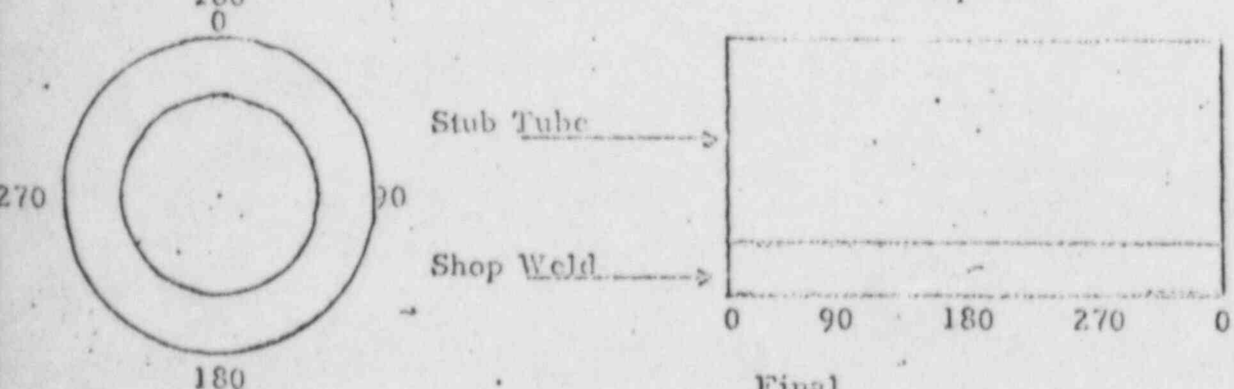
Stub Tube No. ____________

Pre Repair



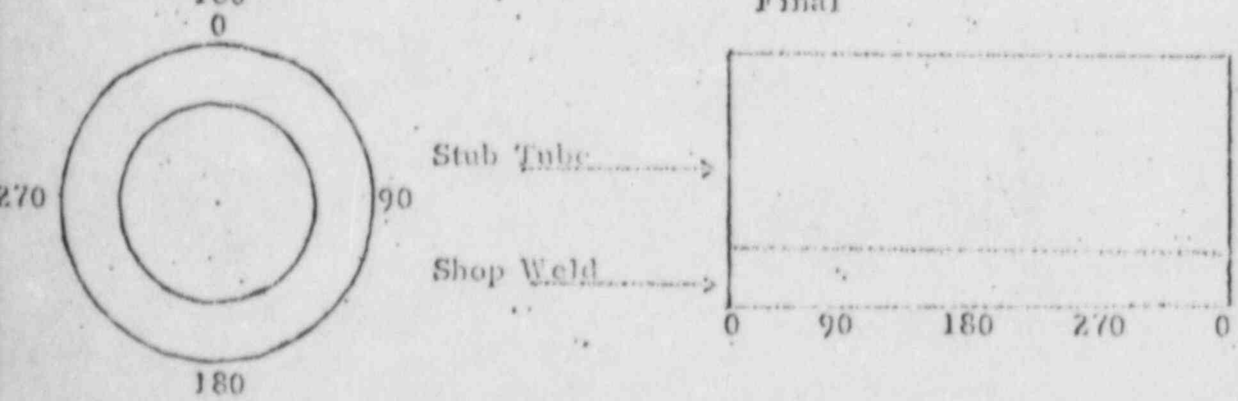
Inspector:
GE ____________
CE ____________
Date ____________

Weld Repair



Inspector:
GE ____________
CE ____________
Date ____________

Final



Inspector:
GE ____________
CE ____________
Date ____________

WELD REPAIR

Procedure: GE- Date: ____________

Welder: Name ____________ No. ____________

Max. Interpass Temp. ____________

Welding Current ____________ amps

Electrode: Type ____________ Size ____________

Lot No. ____________ Ferrite ____________

G. E. Supervisor

C. E. Supervisor

Shift Foreman

ATTACHMENT 4

Form OCRPVR 11

FIGURE 2

STUB TUBE I.D. MEASUREMENTS

Stub Tube Number______________________ Date__________________

Measurements taken by____________________

G. E. Inspector____________________________

Before Cladding:

	0°-180°*	90°-270°*
1/8" Below Weld Prep.		
1" Below Weld Prep.		
At Shop Weld Location		

After Cladding:

	0°-180°*	90°-270°*
1/8" Below Weld Prep.		
1" Below Weld Prep.		
At Shop Weld Location		

Shrinkage Computed

	0°-180°*	90°-270°*
1/8" Below Weld Prep		
1" Below Weld Prep.		
At Shop Weld Location		

* Azimuth as determined below:

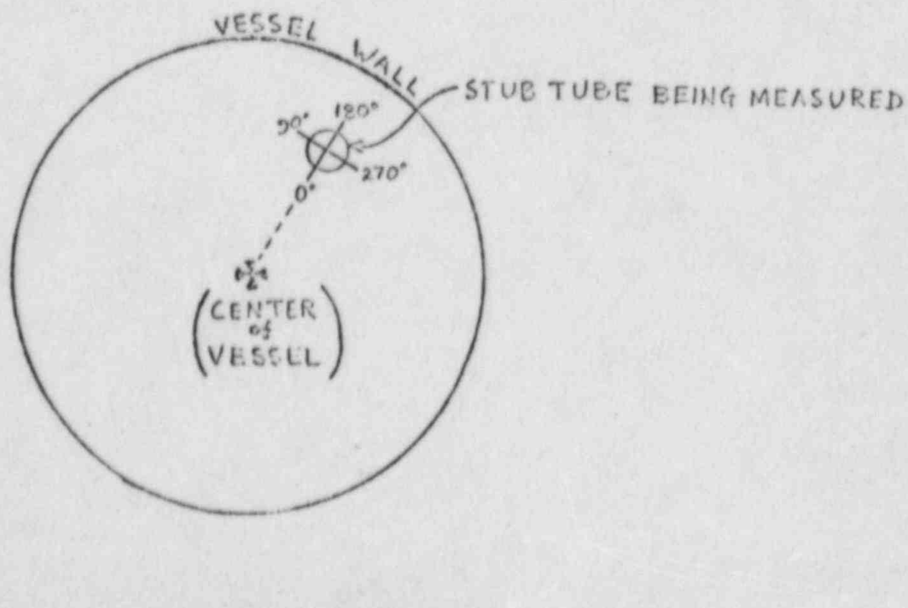
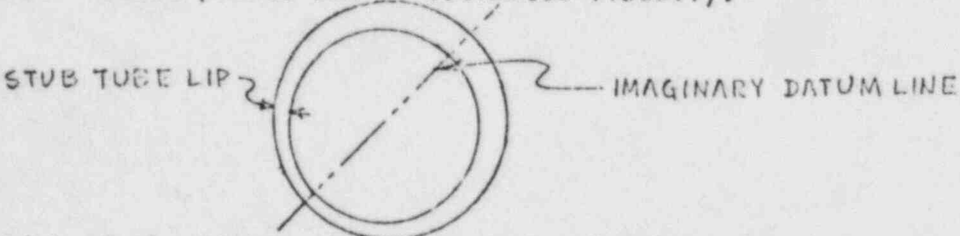


FIGURE 3 Form OCRPVR - 12

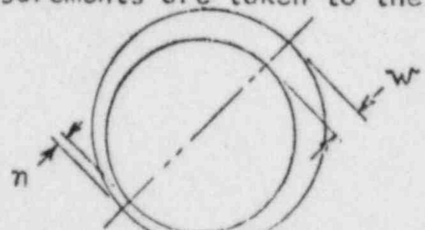
STUB TUBE CLADDING MACHINE

SETTING UP THE OFFSET SHAFT AND COLLAR TO COMPENSATE FOR NON-CONCENTRIC STUB TUBES

1. Examine the upper machined "lip" of the stub tube. Draw an imaginary diameter across the stub tube from the point where the lip is widest to the point where it is narrowest. These points can be estimated visually:

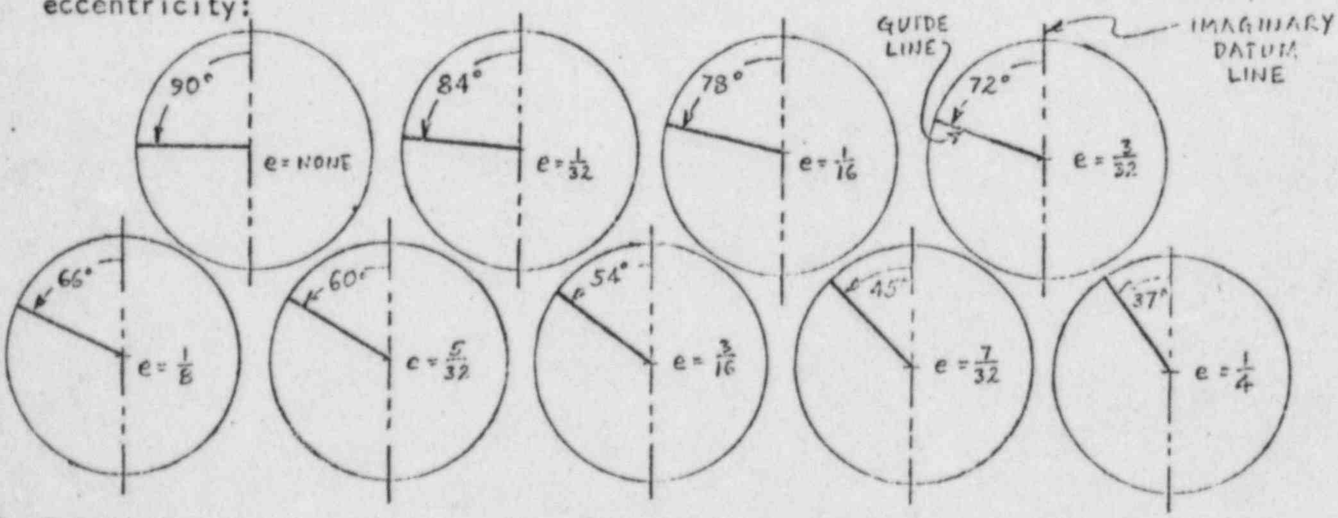


2. Measure the width of the lip at the widest point ("w") and at the narrowest point ("n") and subtract one from the other to find the eccentricity ("e") of the stub tube. All measurements are taken to the nearest 1/32 inch.



$$e = w - n$$

3. Set the offset mandrel arbor (or housing extension shaft) in place, with the guide line offset to the left of the imaginary datum line according to the sketches below. Note how the offset angle changes with changing amounts of eccentricity:

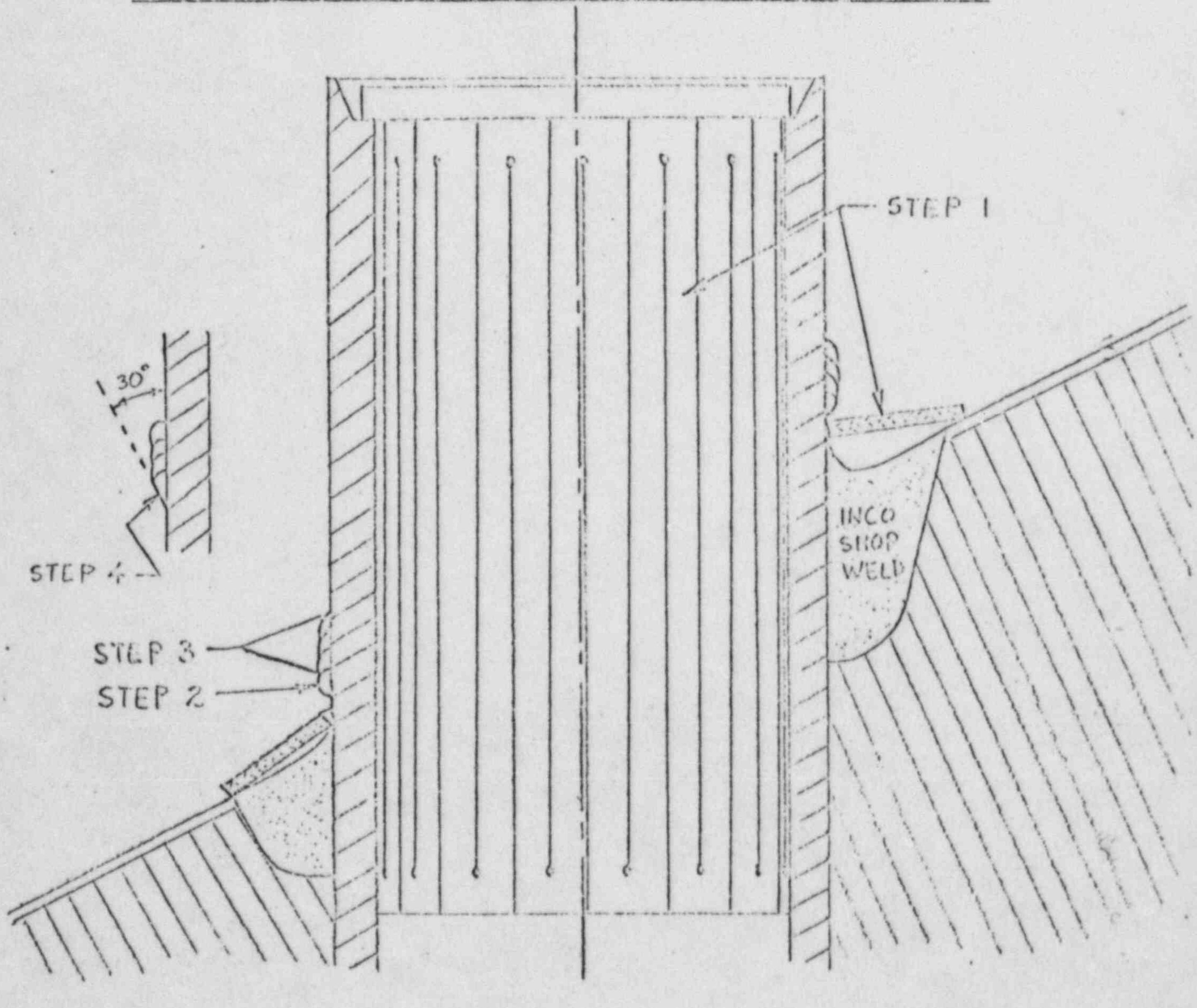


4. Set the eccentric collar on the offset shaft and rotate it until the saw cut is as far to the right of the imaginary datum line as the guide line (on the shaft) is to the left:

5. The shaft and collar are now ready for the cladding machine to be attached. When the machine is attached, run it around the stub tube at least once to check whether or not the torch rollers track smoothly and evenly all the way around. If not, remove and repeat this entire operation.

FIGURE 4

TYPE 308 AUSTENITIC STAINLESS STEEL BUFFER PASSES



Step No. 1 - Place a "collar" of heat resistant material over the shop weld to protect the Inco 182, and place a mandrel inside.

Step No. 2 - Using either the GE-3VA, GE-3VB or GE-3VC SMAW process or the GE-4VA GTAW process, deposit a weld bead circumferentially around the entire stub tube 1/2 inch ± 1/16 above the junction with Inco 182 shop weld.

Step No. 3 - Continue with similar circumferential manual deposits to overlay the stub tube wall a minimum of 5/16 inch in the vertical dimension. Each successive pass shall overlap the preceding pass a minimum of 1/16 inch. Use 1/8" diameter electrodes for the initial pass.

Step No. 4 - Blend to allow good welding visibility for the joining welding

FIGURE 5

CHECK - OFF LIST

Setting Up Cladding Machine

Date ______________________

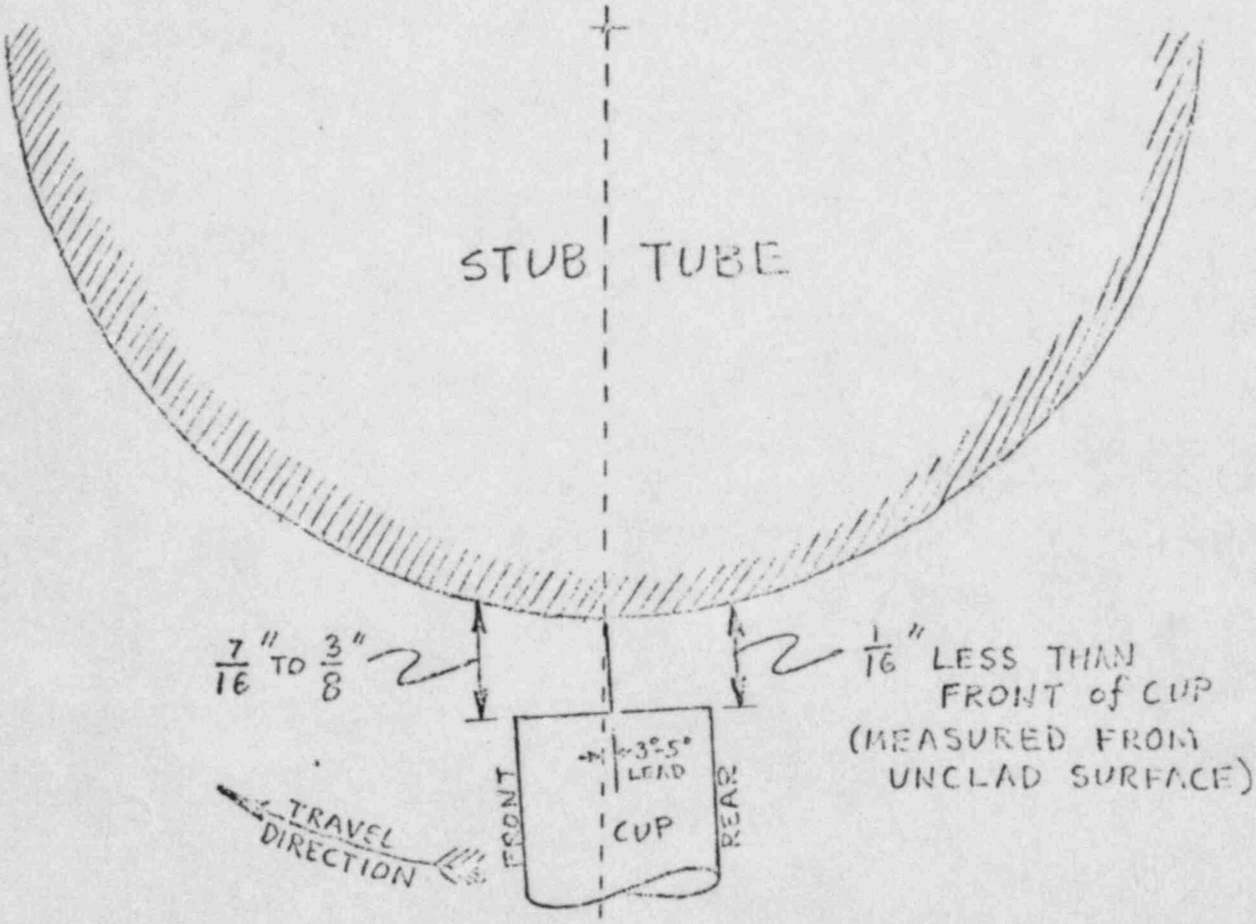
Operator ______________________

Stub Tube ______________________

	Beginning of each shift	After meal break	Locating on new stub T.	After clear up "birdnest"
1. Check physical condition of tractor (top to bottom):				
(a) Filler wire fed properly between feed rolls and out through contact tip properly, with no kinks or snarls..........	☐	☐	☐	☐
(b) Rotation motor engaged with its shaft..........	☐			
(c) Vertical travel motor engaged with its gears..........	☐			
(d) Vertical travel limit switches not engaged..........	☐			
(e) All loose spatter removed from cup and contact tip..........	☐	☐	☐	☐
(f) Contact tip not worn or loose..........	☐	☐	☐	☐
(g) End of contact tip 1/16" inside end of cup..........	☐			☐
(h) Contact tip in center of cup (left and right) and 1/16" below center (up and down)..........	☐	☐	☐	☐
(i) (If short passes are to be run) Connect special control wire between tractor and and pendant..........	☐		☐	
2. Turn on power at machine and pendant and check:				
(a) Shielding gas flow is 40 to 50 cfh, and cylinder pressure at least 500 psi..........	☐	☐		
(b) Water pump running at 40 psi..........	☐	☐		
(c) No water leaks in torch, lines, or connections..........	☐	☐	☐	

	BEGINNING OF EACH SHIFT	AFTER MEAL BREAK	LOCATING ON NEW STUB TUBE	AFTER CLEARING UP "BIRDNEST"
3. Disengage wire feed rollers, press the weld start button, and allow the tractor to make exactly one revolution around the stub tube:				
(a) One revolution in 60 to 65 seconds (approximate setting on Rotation Speed dial = 5.50)........	☐	☐	☐	
(b) Rotation Speed dial locked........	☐	☐	☐	☐
(c) Torch moved upward exactly 9/64" in one revolution (approximate setting on Vertical Speed dial = 1.04)........	☐	☐	☐	
(d) Vertical Speed dial locked........	☐	☐	☐	☐
(e) Re-engage wire feed rollers, and tighten hand tight........	☐	☐	☐	☐
4. Turn Wire Feed switch to "FWD" and measure the amount of filler wire that emerges from the torch in exactly 15 seconds: (turn torch to side so that wire will not run into stub tube):				
(a) 99 to 100 inches in 15 seconds (approximate dial setting: 5.10)........	☐	☐		☐
(b) Wire Feed control dial locked........	☐	☐	☐	☐

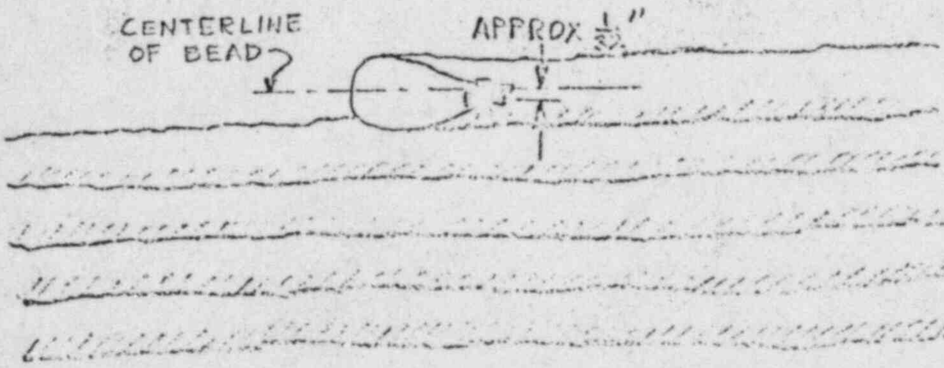
	BEGINNING OF EACH SHIFT	AFTER MEAL BREAK	LOCATING ON NEW STUB TUBE	AFTER CLEARING UP "BIRDNEST"
5. Clip filler wire approximately 1/4" from contact tip and adjust torch position as shown below..........	☐	☐	☐	☐



6. Tighten clamp to secure torch in place and recheck cup clearances..........	☐	☐	☐	☐
7. If welding short beads, place <u>Mode</u> switch in "AUTO INDEX" position. If welding complete circular beads, place in "OFF" position..........	☐	☐	☐	☐

BEGINNING OF EACH SHIFT | AFTER MEAL BREAK - IF REQ'D | LOCATING ON NEW STUB TUBE | AFTER CLEARING UP "BIRDNEST"

8. Position the tractor so that the end of the filler wire is pointing at the crater left by the previous pass, as shown below: (the tractor must be run in reverse beyond this point, then brought up to it in the forward direction to remove all backlash in the rotation gears).. ☐ ☐ ☐



9. Press the Weld Start button. The arc will start and the tractor will begin to move after the prepurge timers run out. Quickly check and adjust the following:

   (a) Weld bead overlapping previous bead approximately 1/16". Stop welding and adjust the tractor up or down with the Vertical Feed switch if overlap is incorrect.

   (b) Welding current reading 95 to 100 amps (stub tube cold) or 105 to 115 amps (stub tube hot), and the arc is running with a steady hissing sound with no rough crackling sounds and producing very little or no spatter. Adjust Wire Feed speed until this condition is reached, then relock dial. Make this adjustment while running.

FIGURE 6

RECORD OF STUB TUBE CLAD WELD

(Per General Electric Repair Procedure No. 6)

Stub Tube Location ____________ Date Started ____________

PART I - Automatic Clad Weld (Weld Procedure GE - 10V)

Welders: Name ____________ No. ______
Name ____________ No. ______
Name ____________ No. ______
Name ____________ No. ______

Gas pressure ______ psi, flow ______ cfh.
Amps: begin ______ middle ______ end ______

Maximum interpass temperature ______ °F
Ferrite present, by Severin Gage ____ % Date complete ______

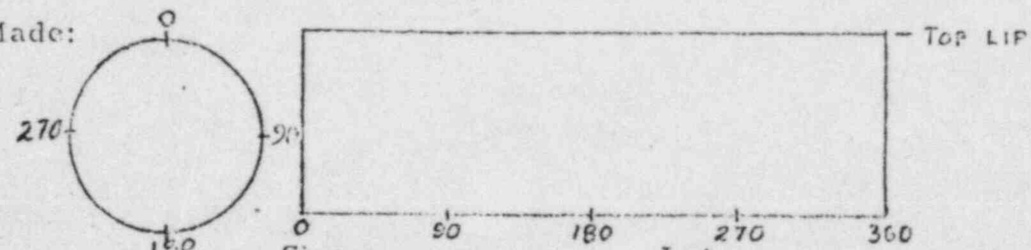
Checkout performed per form OCRPVR-13;
Yes ☐ No ☐

Filler Wire - Sandvik Hi-Sil ER 308 L, .030 dia.
Lot No. 7-53735

PART II - Repairs to Clad (Weld Procedure GE-3VA or -4VA)

Welders: Name ____________ No. ______ Procedure ______
Name ____________ No. ______ Procedure ______

Indicate Repairs Made:



Filler Wire: Type ______ Size ______ Lot ______
Shielding Gas: Type ______ Flow ______ cfh
Amps ______ DCSP , DCRP
Maximum Interpass Temperature ______ °F.
Ferrite present, by Severin Gage ______ %
Visual inspection o. k. ☐ Date complete ______

PART III - Repairs and Tie-in at Interface Between Stainless Steel and Inconel (Weld Procedure GE-5V)

Welders: Name ____________ No. ______
Name ____________ No. ______
Electrode (Inco E-182 T) Size ______ Lot No. ______
Amps ______
Maximum interpass temperature ______ °F. Date Complete ______

SIGN-OFF:

Part I complete
Part II complete (if required)
Part III complete
Inspection(s) complete and Inspection Records in Order

General Electric ____________
Combustion Engineering ____________

FIGURE 7

FINAL INSPECTION RECORD - Stub Tube Clad and Tie-in Weld

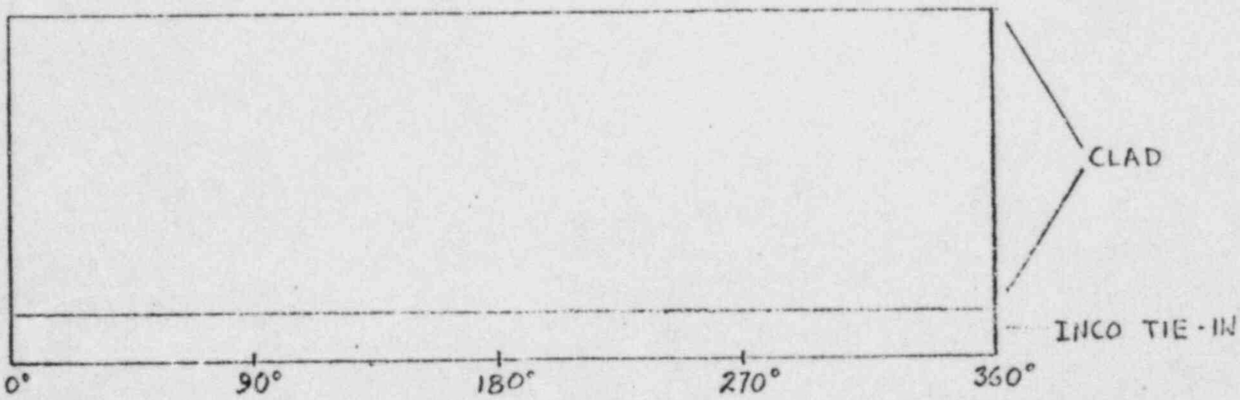
Stub Tube No.__________

First Inspection- Stainless Clad Complete. ☐
Inconel Buildup and Clad Complete. . . . . ☐
Inconel Tie-in to Shop Weld Complete . . . . ☐

1.0 Surface Examined By ; Liquid Penetrant ☐ , Other____________________
2.0 Discrepancies Found -
2.1 NONE. . . . . ☐

2.2 Type	Description	Quantity or Severity
1	Spatter or excess metal (Grind off).	____________
2	Slag (Remove; Reweld if necessary)	____________
3	Incomplete coverage (Weld up).	____________
4	Linear Indications (Grind and Reweld).........	____________
5	Porosity Indications (Grind and Reweld).......	____________
6	Other____________________	____________

2.3 Plot Discrepancies (indicate type and size):



3.0 Discrepancies Removed:
3.1 By grinding.................................... ☐
3.2 By welding*.................................... ☐
3.3 By grinding and rewelding*..................... ☐

* Form OCRPVR-14 completed.................... ☐

4.0 Final inspection made (Date)____________________.

All Discrepancies Removed / Repaired, Stub Tube Ready for Attachment of CRD Housing:

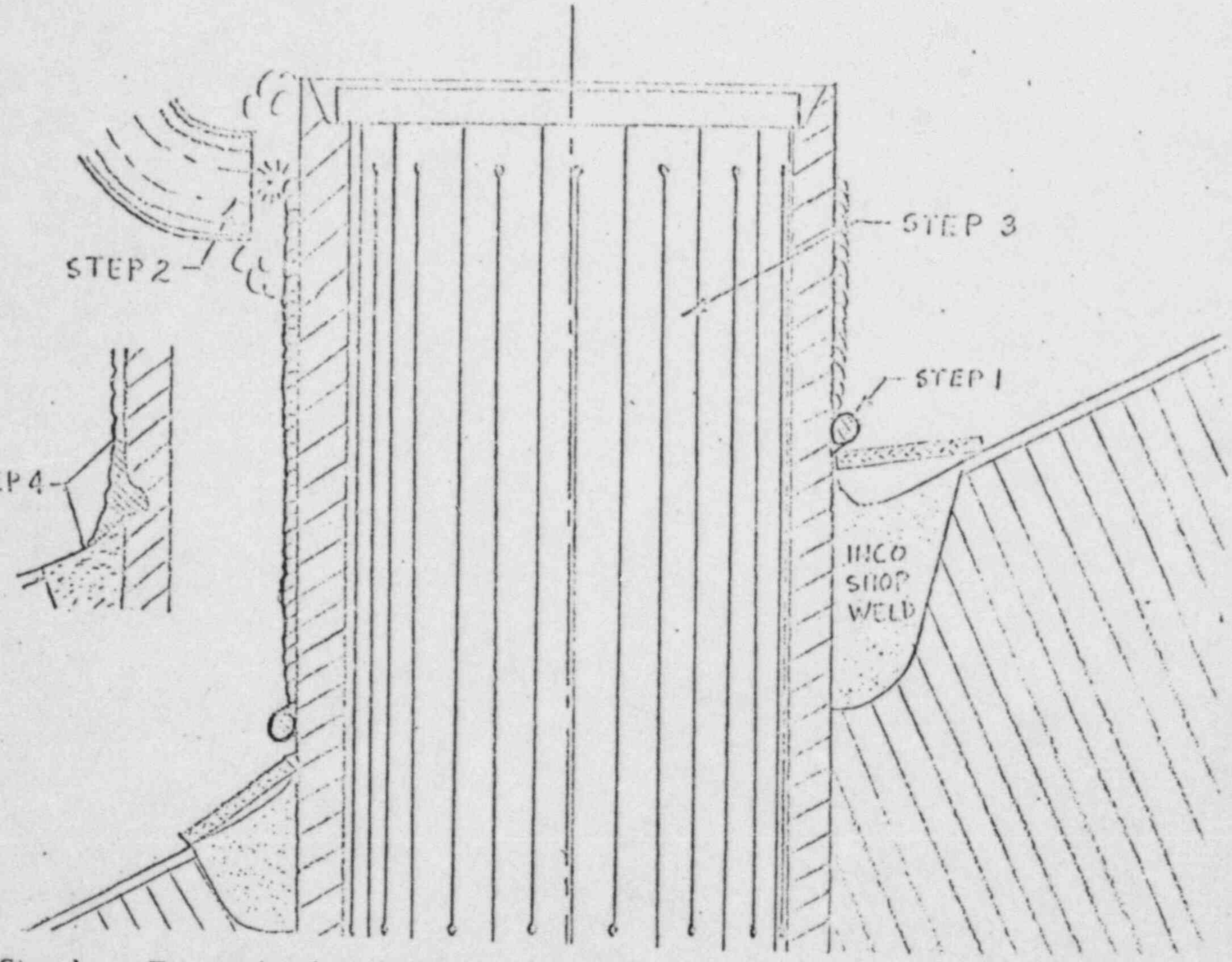
G. E.____________________

C. E.____________________

Date____________________

FIGURE 8

AUTOMATIC WELD OVERLAY OPTION



Step 1 - Protective barrier (see paragraph 3.2.2.3)

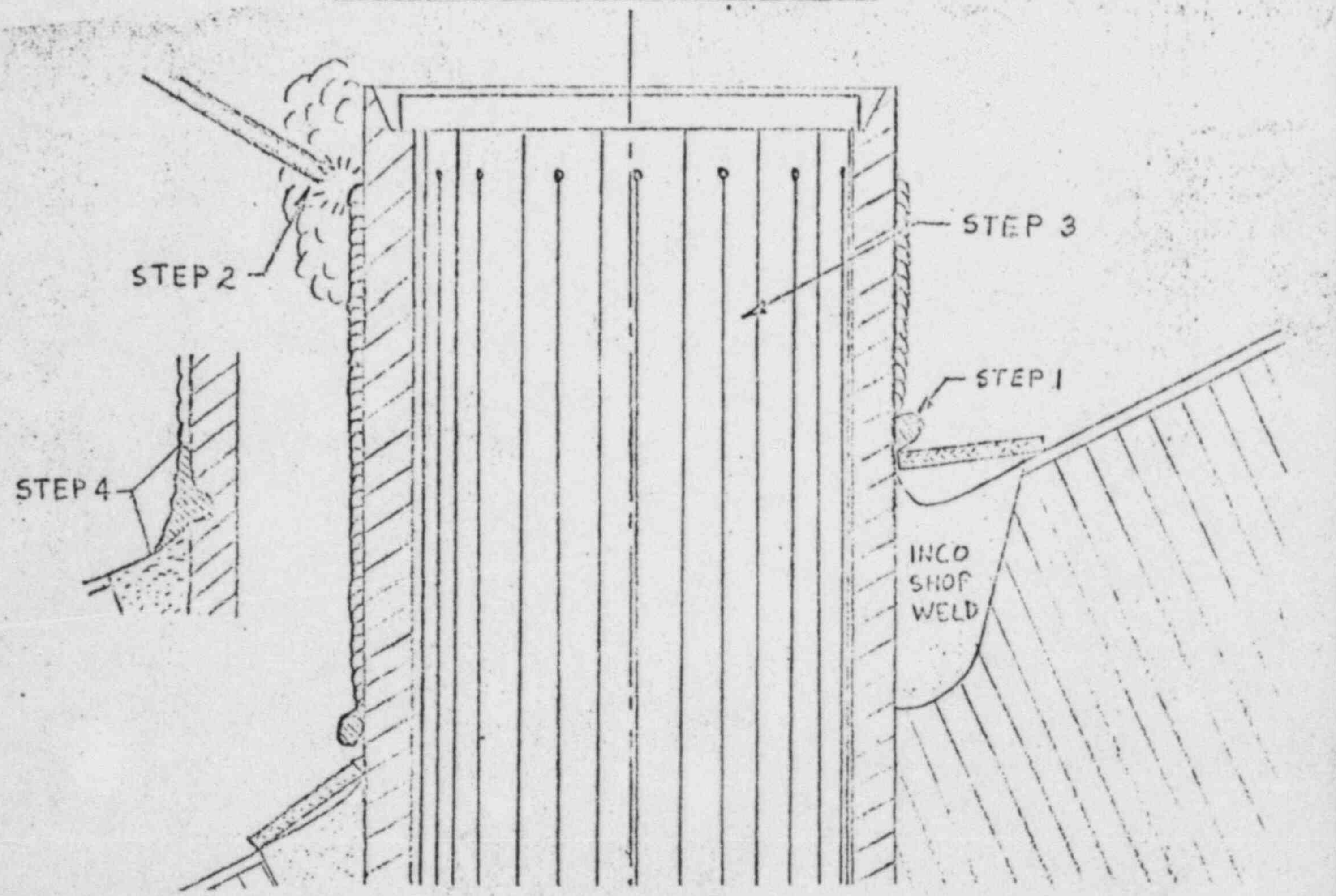
Step 2 - Applied next, by automatic GMAW using type ER308L filler. A minimum deposit thickness of 1/16 inch and a minimum overlap of 1/16 inch is required on each pass. The final as-deposited surface shall be suitably smooth or shall be smoothed by grinding or GTAW smoothing, in order to examine by dye penetrant to the accuracy established in Repair Procedure Number 1.

Step 3 - Remove the mandrel when the overlay has cooled to room temperature. Artificial cooling shall not be used without APED approval.

Step 4 - Using welding procedure GE-5V, fill any ground out areas in this location, and continue until the surface is flush with the remainder of the cladding and faired in smoothly with the shop weld. Grind smooth for subsequent dye penetrant examination.

FIGURE 9

MANUAL WELD OVERLAY OPTION



Step 1 - Protective barrier (see paragraph 3.2.2.3)

Step 2 - Applied next, by manual SMAW, using type E308L filler. A minimum deposit thickness of 1/16 inch is required with a minimum overlap of 1/16 inch on each pass. The final as-deposited surface shall be suitably smooth or shall be smoothed by grinding or GTAW smoothing, in order to examine by dye penetrant to the accuracy established in Repair Procedure No. 1.

Step 3 - Remove the mandrel when the overlay has cooled to room temperature. Artificial cooling shall not be used without APED approval.

Step 4 - Using welding procedure GE-5V, fill any ground out areas in this location, and continue until the surface is flush with the remainder of the cladding and faired in smoothly with the shop weld. Grind smooth for subsequent dye penetrant examination.

US NUCLEAR REGULATORY COMMISSION

REGION I

Report No. 50-220/M84-147

Docket No. 50-220

License No. DPR-63 Priority -- Category: C

Licensee: Niagara Mohawk Power Corporation

Facility Name: Nine Mile Point Unit 1

Meeting at: Air Rights Bldg., Bethesda, Maryland

Meeting conducted: April 10, 1984

NRC Personnel: [redacted] Reactor — 4/13/84 date signed

Approved by: J. P. Durr, Chief, Materials — 4/13/84 date signed

Meeting Summary

NMP #1 has identified two Leaking Control Rod Drive Mechanism Housings (CRDM) to vessel stub tubes and seven CRDM housings with rust deposits indicating that leaking may have occurred. Video optical examination of the area of the stub tube just below the CRDM to stub tube weld verified the presence of circumferential IGSCC cracking in the sensitized (by heat treatment) stub tube material on five of these. Cracking was noted by video examination on one of three other stub tubes that did not show evidence of leaking. The licensee is planning to mechanically expand (roll) the CRDM housing to the vessel head opening as the method to prevent leaking. Nine CRDM Housings are scheduled for expansion. The problem, evaluation, safety assessment and repair program are discussed in the attached. The repair program was presented by the Licensee as a 10 CFR 50 Part 50.59 condition, not an unreviewed safety question. While this may be true, the opinion of this NRC inspector is that an independent analysis of the problem and effect of the repair method on potentially different failure mechanisms is required. Specifically, to what extent and time frame is the CRDM heat affected zone subject to IGSCC either with or without housing expansion.

cc:
S. Hudson, SRI, NMP#1

8412120260

Harry
4/10/84

STATUS REPORT
NMP-1 CRD STUB TUBE
INSPECTION AND REPAIR

APRIL 10, 1984

April 5, 1984

OUTLINE OF NRC PRESENTATION
STATUS REPORT ON NMP-1 CRD STUB TUBE
INSPECTION AND REPAIR

I. Introduction - C. V. Mangan

   A. Purpose of Meeting - Brief NRC on results of inspections to date, results of safety assessment, future plans and NMPC licensing concerns

   B. Outline Topics To Be Discussed

II. NMP-1 CRD Penetration Design, Materials and Fabrication History - W. Schmidt

III. Results of Inspections/Examinations - T. Roman

   A. Visual inspections of lower head area and CRD housings

   B. Remote TV examinations from inside vessel

IV. Pre-Outage Evaluations and Contingency Planning by NMPC - W. Schmidt

   A. Related Experience at Other BWRs

   B. Alternative Repair Techniques Considered

   C. Comparison of Big Rock, Nuclenor, and NMP-1 CRD Penetration Parameters

   D. Results of Safety Assessments

   E. Conclusions and Recommendations

V. Evaluation of NMP-1 Stub Tube Cracks - B. W. Schmidt

A. Comparison with Experience Elsewhere

B. Cause of Cracks

VI. Safety Assessment of NMP-1 Stub Tube Cracks - R. Pasternak

A. Structural Integrity of RCS Boundary

B. Effects of Leakage

C. Effects on CRD Operability/Scram

D. Surveillance Capability

E. Conclusions

VII. Status of Repair Actions and Future Plans - L. Klosowski/W. McCurdy

A. Status of Procedure/Tooling Development and Personnel Training

B. Criteria for Rolling CRD Housings

C. Schedule

D. Development of Other Techniques

V. Evaluation of NMP-1 Stub Tube Cracks - W. Schmidt

   A. Comparison with Experience Elsewhere

   B. Cause of Cracks

VI. Safety Assessment of NMP-1 Stub Tube Cracks - R. Pasternak

   A. Structural Integrity of RCS Boundary

   B. Effects of Leakage

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   D. Surveillance Capability

   E. Conclusions

VII. Status of Repair Actions and Future Plans - L. Klosowski/W. McCurdy

   A. Status of Procedure/Tooling Development and Personnel Training

   B. Criteria for Rolling CRD Housings

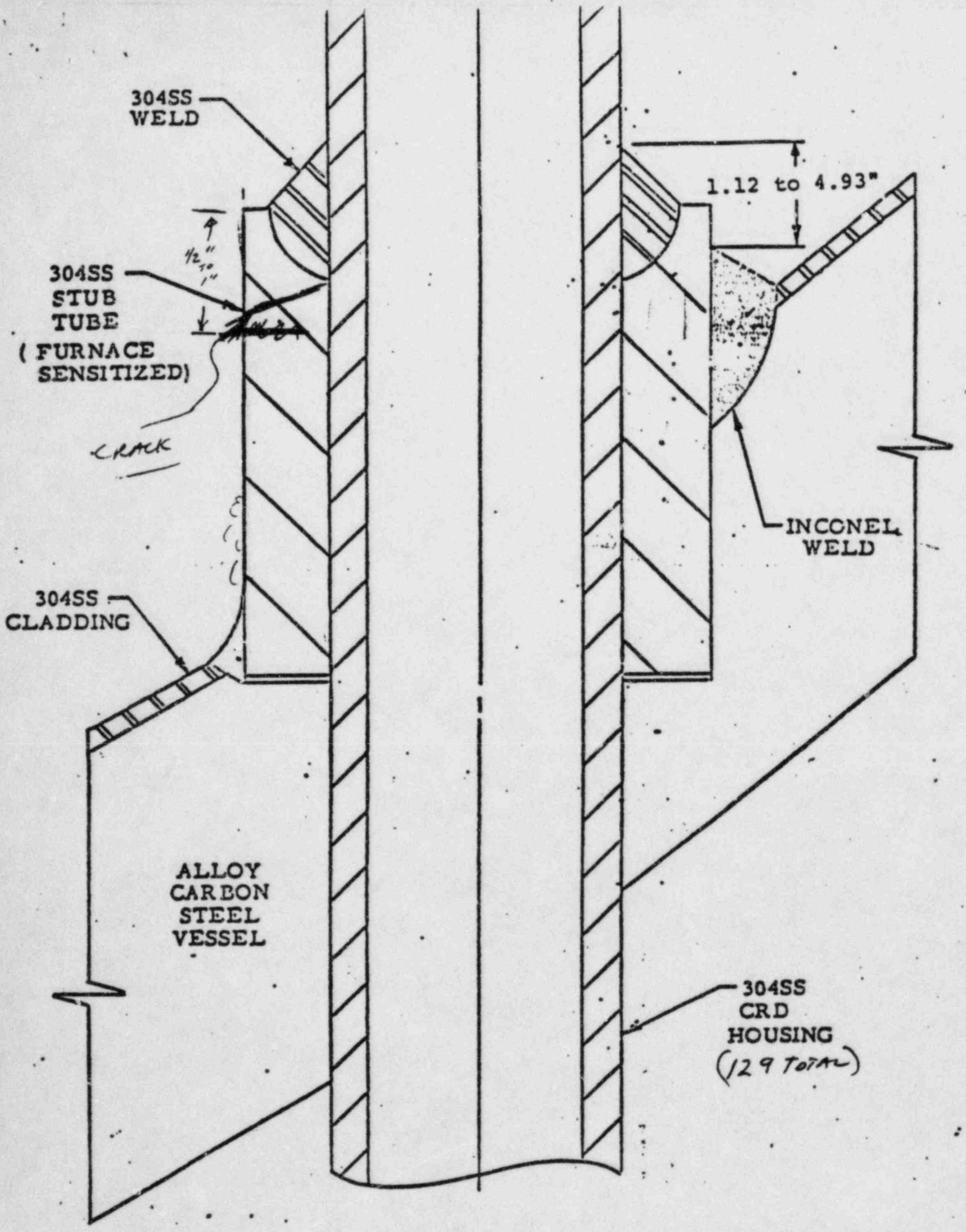
   C. Schedule

   D. Development of Other Techniques

NMP-1 CRD PENETRATION ASSEMBLY

- STUB TUBE INSTALLED IN SHOP, HEAT TREATED WITH VESSEL AND IS FURNACE-SENSITIZED TYPE 304 STAINLESS STEEL
- STUB TUBE-TO-VESSEL SHOP WELD IS INCONEL
- CRD HOUSINGS WERE INSTALLED IN THE FIELD AND ARE SOLUTION ANNEALED TYPE 304 STAINLESS STEEL
- HOUSING-TO-STUB TUBE FIELD WELD IS 304 STAINLESS STEEL
- STUB TUBES AND WELDS EXTENSIVELY EXAMINED PRIOR TO INITIAL START-UP IN 1969 (SUPPLEMENTS 3 AND 6 OF NMP-1 FSAR)

4/10/84



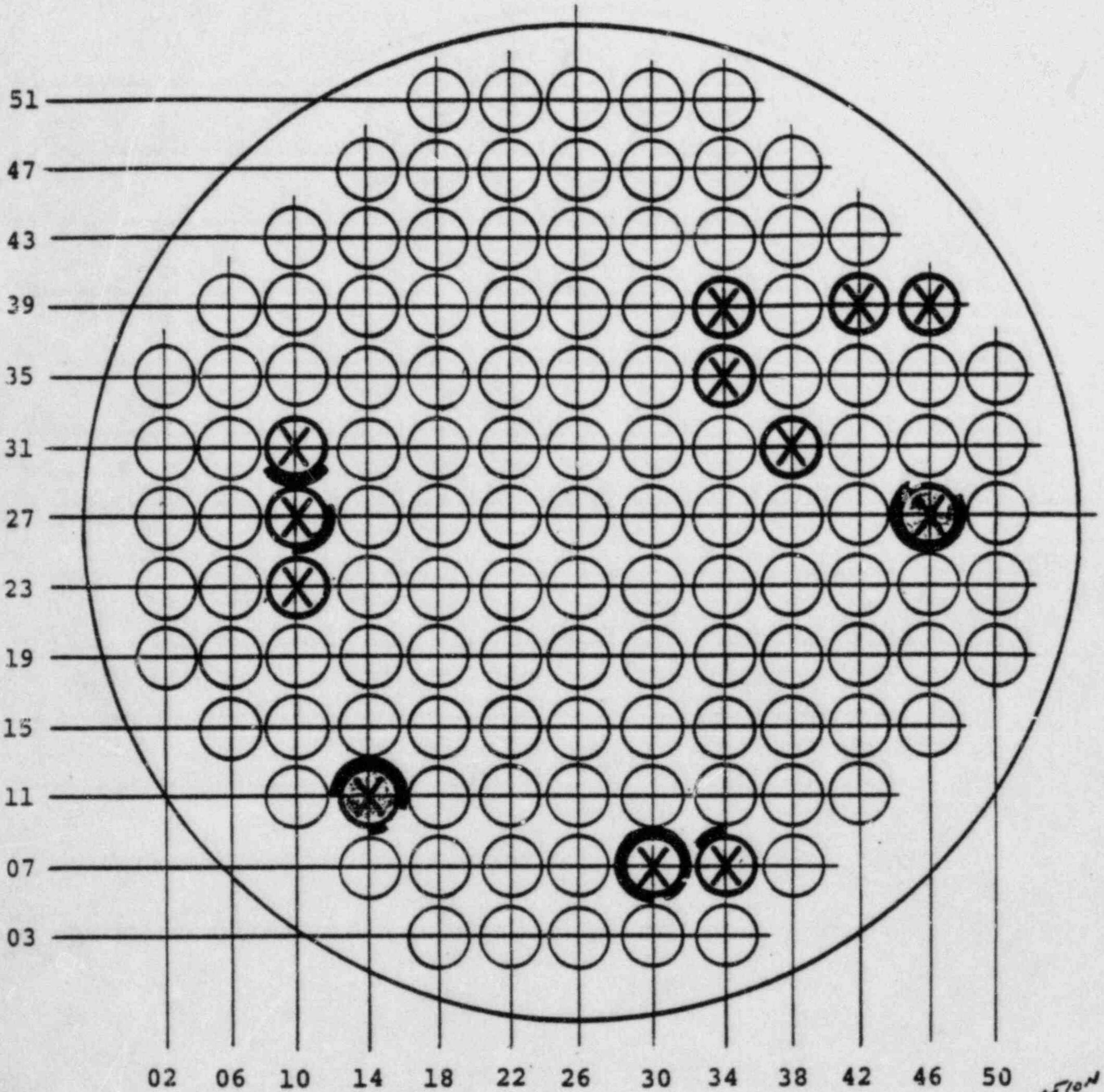
NMP-1 CRD
PENETRATION ASSEMBLY
(OUTER ROW)

RESULTS OF INSPECTIONS/EXAMINATIONS

- POST-SHUTDOWN INSPECTIONS IN MARCH, 1984 REVEALED TWO CRD PENETRATIONS WITH VISIBLE LEAKAGE
- SEVEN CRD PENETRATIONS SHOW SOME EVIDENCE OF PRIOR LEAKAGE
- VISUAL INSPECTIONS BY REMOTE TV OF THE 9 PENETRATIONS WITH LEAKAGE OR SUSPECTED LEAKAGE, PLUS THREE OTHERS, SHOW 6 STUB TUBES WITH CRACKS
- CRACKS ARE CONFINED TO FURNACE-SENSITIZED STUB TUBES, ARE LOCATED JUST BELOW THE CRD HOUSING-TO-STUB TUBE WELD, AND ARE TYPICAL OF NUCLENOR CRACKS

4/10/84

INSPECTION RESULTS



Legend:

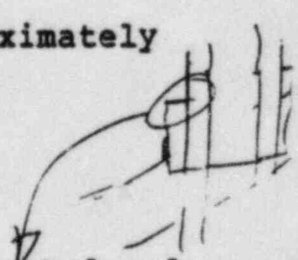
- (X) Inspected By CCTV & In Vessel TV Examination
- (X) Possible Evidence Of Prior Leak (Housing H_2O Mark)
- (X) Visible Leak
- (X) Crack Visible By CCTV

#4627 - 1st Noted Leaking
#1411 - 2nd " "

TABLE 1

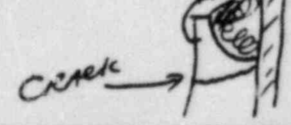
RESULTS OF INSPECTIONS AS OF
APRIL 4, 1984

HOUSING NO.	PRESENCE OF LEAKAGE	RESULTS OF TV INSPECTIONS
46-27	15 drops per minute leakage	Significant crack, 270° in extent
14-11	Evidence of leakage (wetness) around housing-head annulus	Significant 200°+ crack observed
30-07	Suspected of prior leakage	Tight crack approximately 330° around circumference observed
34-07	Suspected of prior leakage	35° long light crack
42-39	Suspected of prior leakage	No evidence of cracks
38-31	Suspected of prior leakage	No evidence of cracks
34-39	Suspected of prior leakage	No evidence of cracks
10-27	Suspected of prior leakage	Light crack approximately 100° long
46-39	Suspected of prior leakage	No evidence of cracks
34-35	No evidence of leakage	No evidence of cracks
10-23	No evidence of leakage	No evidence of cracks
10-31	No evidence of leakage	Light crack approximately 100° long



Note: Observed cracks were generally horizontally oriented and approximately 1/2 to 1 inch below the elevation of the CRD housing to stub tube field weld.

CRACKS - ON DOWNHILL SIDE



MPR ASSOCIATES, INC.

DECEMBER 20, 1983

NINE MILE POINT UNIT 1
CONTINGENCY PLAN FOR REPAIR OF POTENTIAL LEAKS IN REACTOR VESSEL STUB TUBE ASSEMBLIES

INTRODUCTION

1. CONCERN

THE CONCERN IS THAT INTERGRANULAR STRESS CORROSION CRACKING (IGSCC) OF THE CONTROL ROD DRIVE (CRD) PENETRATION STUB TUBES WILL OCCUR AT THE NINE MILE POINT PLANT

2. BACKGROUND

RELATED EXPERIENCE AT OTHER BWR PLANTS IS SUMMARIZED AS FOLLOWS:

- CRD STUB TUBE CRACKS FOUND AT OYSTER CREEK AND TARAPUR 1 AND 2 PLANTS PRIOR TO PLANT STARTUP

- CRD STUB TUBE CRACKS FOUND AT BIG ROCK POINT AND NUCLENOR PLANTS FOLLOWING PLANT STARTUP

- IN-CORE PENETRATION LEAKS FOUND AT OYSTER CREEK AND GARIGLIANO PLANTS FOLLOWING PLANT STARTUP

3. PURPOSE OF EVALUATION

THE PURPOSE IS TO:

- EVALUATE THE POTENTIAL FOR CRACKING OF THE NINE MILE POINT STUB TUBES BASED ON RELATED EXPERIENCE AT OTHER BWR PLANTS

- EVALUATE THE SAFETY IMPLICATIONS OF STUB TUBE CRACKS/LEAKS

- EVALUATE ALTERNATIVE CRD PENETRATION INSPECTION AND REPAIR TECHNIQUES USED AT OTHER PLANTS OR UNDER DEVELOPMENT BY VARIOUS ORGANIZATIONS

- DEVELOP CONTINGENCY PLAN FOR INSPECTION AND REPAIR OF NINE MILE POINT STUB TUBE ASSEMBLIES DURING THE NEXT (APRIL 1984) AND FUTURE PLANT OUTAGES

- IDENTIFY LONG LEAD MATERIALS AND TOOLING WHICH MAY BE REQUIRED

SUMMARY

1. DESCRIPTION OF RELATED EXPERIENCE

   - CRD STUB TUBE CRACKS AT OYSTER CREEK AND TARAPUR
   - IN-CORE PENETRATION CRACKS AT OYSTER CREEK AND GARIGLIANO
   - CRD STUB TUBE CRACKS AT BIG ROCK POINT AND NUCLENOR

2. DESCRIPTION OF INSPECTION TECHNIQUES

   - ULTRASONIC EXAMINATION FROM ID OF CRD HOUSING
   - ULTRASONIC EXAMINATION FROM OD OF STUB TUBE
   - VISUAL EXAMINATION FROM INSIDE OF VESSEL WITH TV CAMERA

3. DESCRIPTION OF REPAIR TECHNIQUES

- ROLLING OF CRD HOUSING INTO VESSEL HEAD
  - BIG ROCK POINT EXPERIENCE
  - NUCLENOR EXPERIENCE
- COMBUSTION ENGINEERING INTERNAL SLEEVE/PACKING INSTALLATION
- GENERAL ELECTRIC "LONG-TERM" FIX UNDER DEVELOPMENT FOR NUCLENOR
- OTHER POSSIBLE REPAIR ALTERNATIVES
  - EXTERNAL SEAL INSTALLATION
  - INTERNAL SEAL INSTALLATION
  - REPLACEMENT CRD HOUSING/STUB TUBE WITH INTERNAL FLEXITALLIC GASKET SEAL
  - REPLACEMENT CRD HOUSING/STUB TUBE WITH EXTERNAL FLEXITALLIC GASKET SEAL

4. COMPARISON OF NUCLENOR, BIG ROCK POINT AND NINE MILE POINT CRD PENETRATION PARAMETERS

- CRD STUB TUBE AND HOUSING CONFIGURATION

- STUB TUBE MATERIAL

5. EVALUATION OF SAFETY SIGNIFICANCE OF POTENTIAL STUB TUBE FAILURE MODES

6. RECOMMENDATION FOR CONTINUING EFFORT TO DEVELOP CONTINGENCY PLAN FOR NINE MILE POINT

DESCRIPTION OF RELATED EXPERIENCE

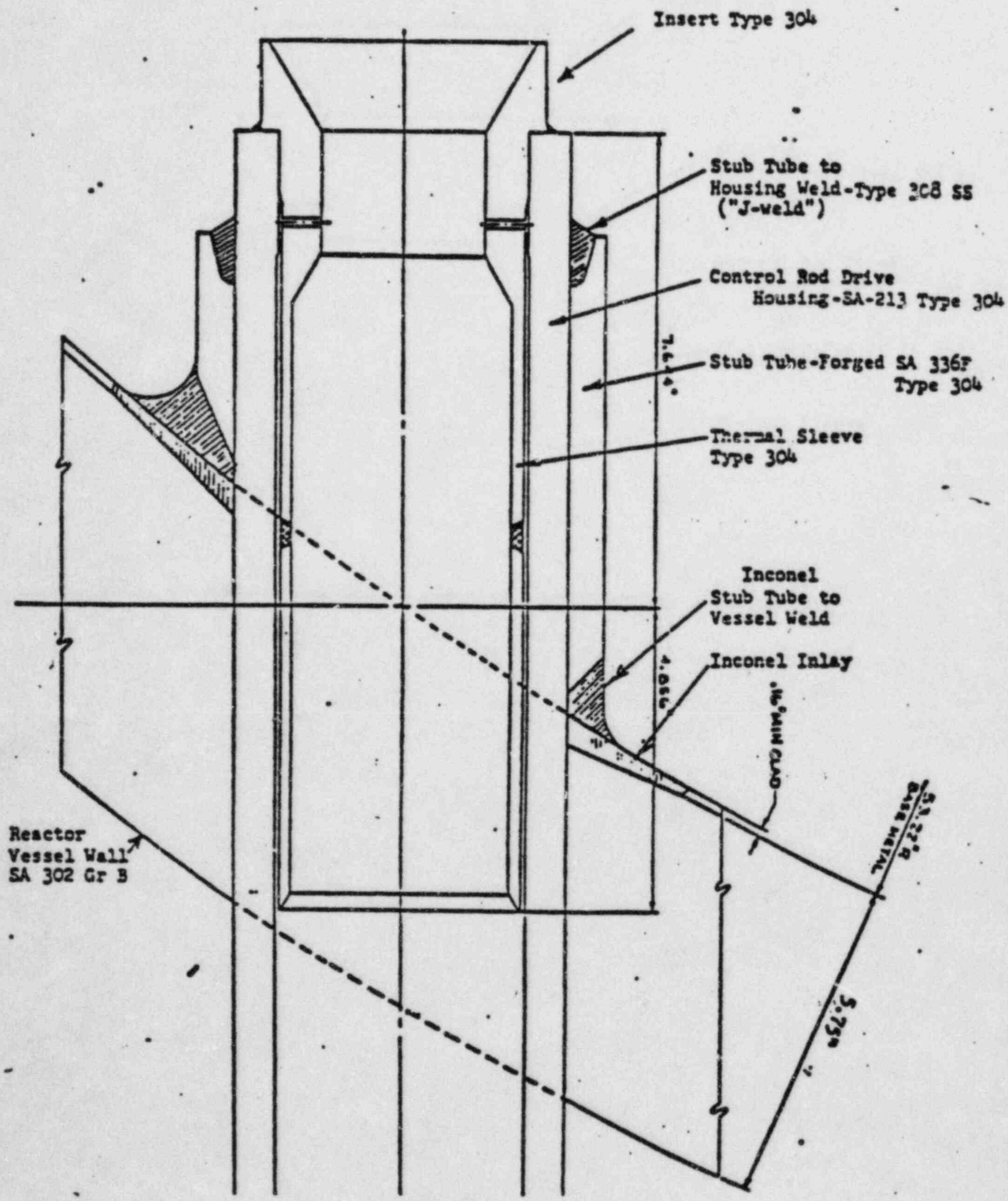
CRD STUB TUBE CRACKS PRIOR TO STARTUP

- AT OYSTER CREEK IN SEPTEMBER 1967
  - FOUND DURING FIELD HYDROSTATIC TEST
  - INTERGRANULAR CRACKING IN 123 OF 137 STAINLESS STEEL STUB TUBES ADJACENT TO INCONEL SHOP WELDS TO VESSEL BOTTOM HEAD
  - RANDOM DEFECTS FOUND ON THE OUTER SURFACE OF 43 STUB TUBES
  - POROSITY AND/OR LACK OF FUSION WELDING DEFECTS FOUND IN ALL 137 FIELD WELDS OF STUB TUBE TO THE CRD HOUSING

- AT TARAPUR 1 & 2 IN JANUARY 1968
  - FOUND WITH PT EXAMINATION AT SITE
  - AT THE JUNCTION OF THE SHOP WELD TO THE STUB TUBE 39 STUB TUBES WERE FOUND CRACKED IN UNIT 1 & 52 IN UNIT 2
  - 60 STUB TUBES HAD INDICATIONS ON UNIT 1 & 9 ON UNIT 2 AT VARIOUS LOCATIONS ON THE STUB TUBE OUTSIDE SURFACE

CRD STUB TUBE/HOUSING LEAKS AFTER PLANT STARTUP

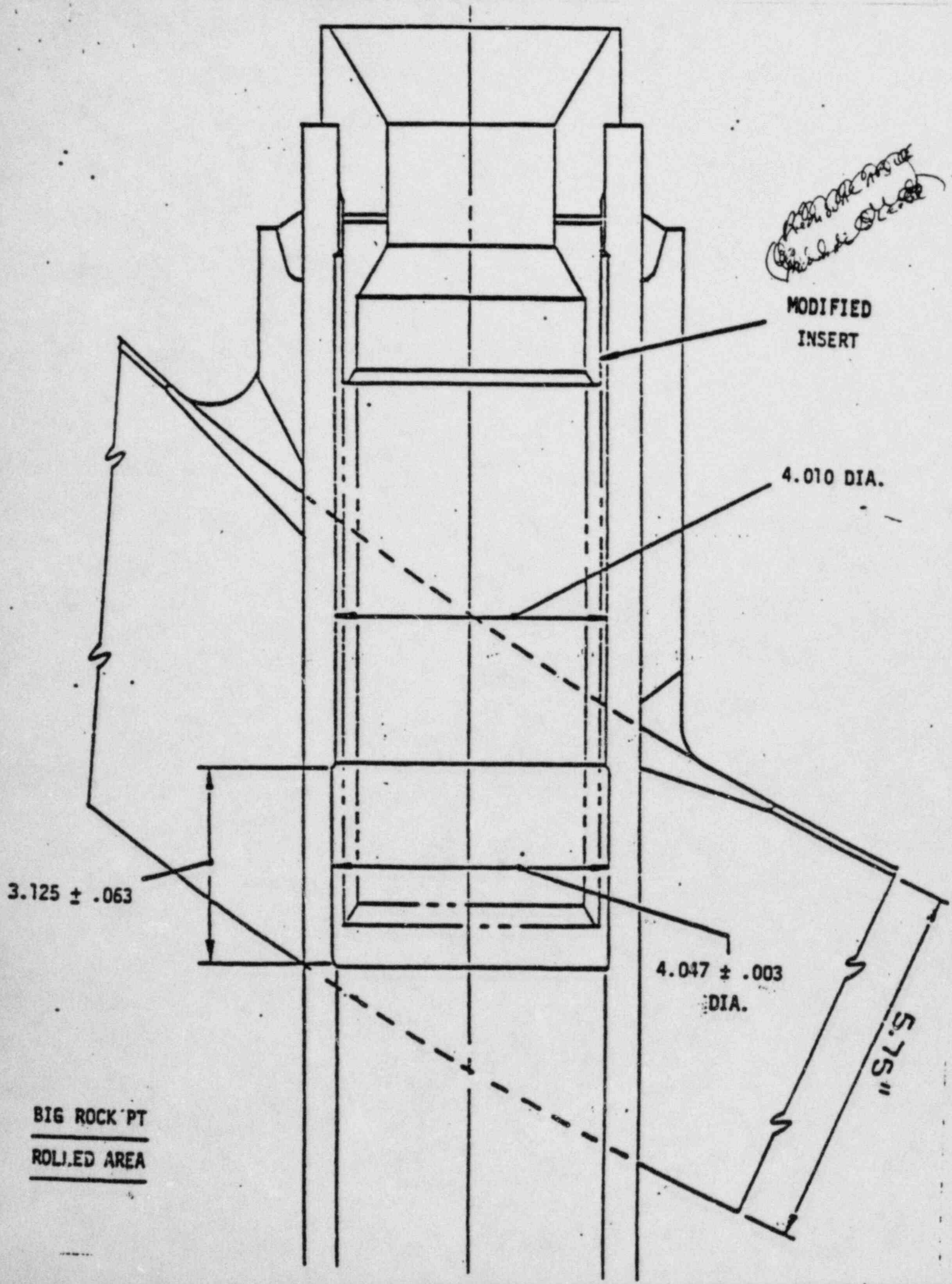
- BIG ROCK IN APRIL 1979
  - ONE OF THE OUTSIDE CRD STUB TUBES OUT OF 32 LEAKED
- SANTA MARIA DE GARONA (NUCLENOR) IN 1981
  - ONE STUB TUBE IN THE SECOND ROW WAS FOUND LEAKING AS A RESULT OF A STUB TUBE CRACK 1/4 INCH BELOW THE ROOT OF THE ATTACHING WELD TO THE CRD HOUSING
  - A SECOND STUB TUBE WAS FOUND TO BE LEAKING IN SEPTEMBER 1983 DURING A HYDROTEST
  - TO DATE 55 STUB TUBES OUT OF 97 HAVE BEEN EXAMINED AND 42 CONTAIN DEFECTS. ONLY THE TWO LEAKERS HAVE BEEN REPAIRED TO MINIMIZE LEAKAGE



BIG ROCK PT - CRD PENETRATION

ROLL REPAIR AT BIG ROCK POINT

- CRD HOUSING WALL THINNING WAS 3.25% (5% = S.G. | BOILER TYPICAL TUBE)
- LENGTH OF ROLLED BAND WAS 3.14 INCHES
- ROLLING EQUIPMENT PROCURED FROM AIRE-TOOL COMPANY CONSISTED OF FIVE ROLLERS, TWO INCHES LONG WHICH WERE RADIALLY EXPANDED BY A TAPERED MANDREL
- ROLL MOCK-UP AND PRESSURE AND THERMAL CYCLING TESTS PERFORMED
- POST REPAIR EXAMINATION PERFORMED OF ROLLED AREA USING ULTRASONIC INSPECTION
- ROLL REPAIR SUCCESSFULLY PERFORMED IN 1979
- ROLLED JOINT STILL EFFECTIVE AS OF DECEMBER, 1983


MODIFIED
INSERT
4.010 DIA.
3.125 ± .063
4.047 ± .003
DIA.
5.75"
BIG ROCK PT
ROLLED AREA

HISTORY OF LEAKAGE AT NUCLENOR

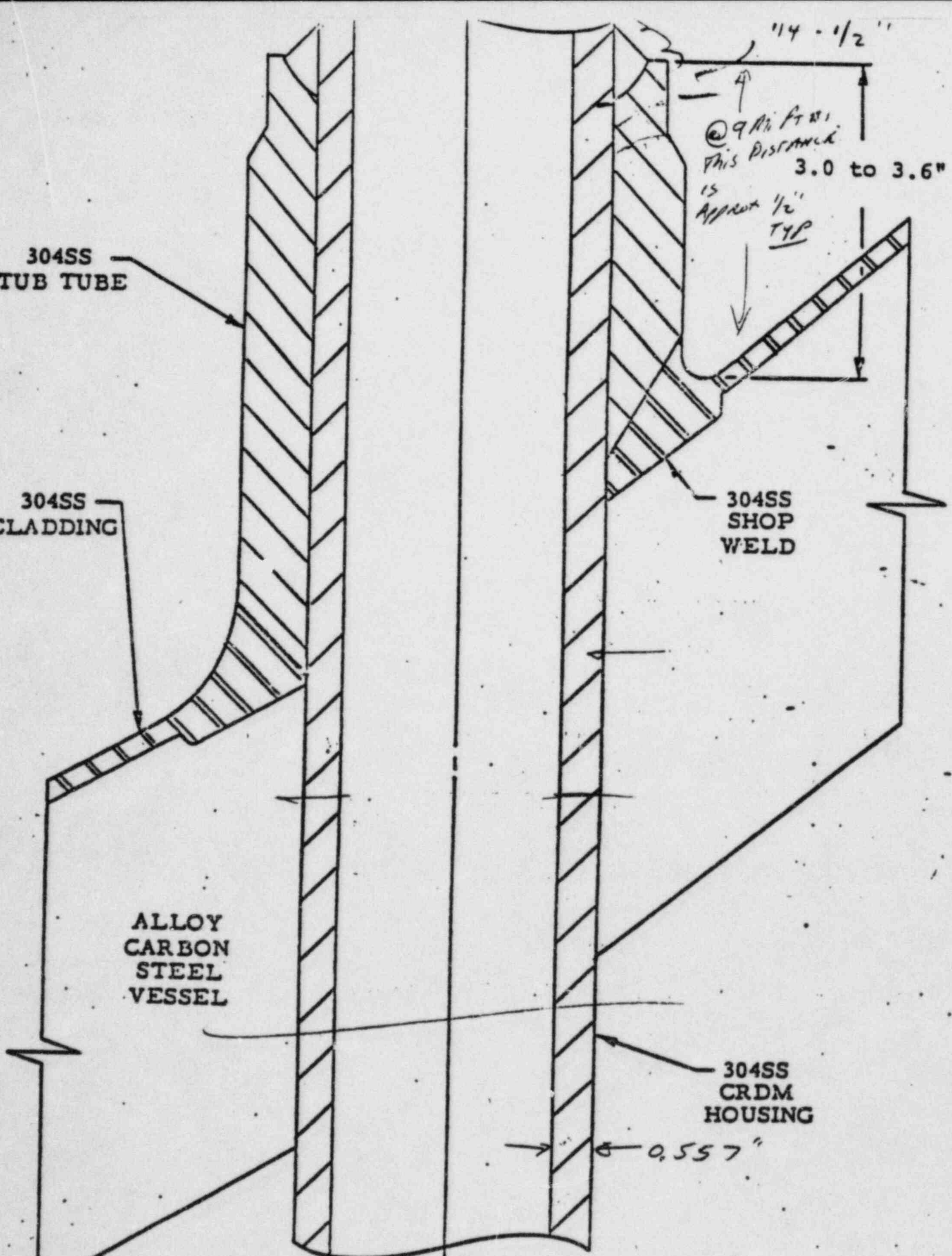
- FEB. 81	o	OBSERVED LEAKAGE FROM PENETRATION
	o	INSTALLED TV MONITORS
	o	INSTALLED COLLECTOR/MEASURING SYSTEM
- JUL. 81 THROUGH SEPT. 81	o	MEASURED 720 LITERS/DAY (L/D) LEAK RATE
	o	ROLLED HOUSING
	o	HYDROTEST INDICATED NO LEAKAGE
	o	MEASURED 500 L/D a OPERATING CONDITION
	o	MEASURED 70 L/D a OPERATING CONDITION WITH COOLING WATER OFF (due to SS higher coef. of exp.)
- OCT. 81	o	LEAKAGE REPORTED STOPPED
- NOV. 81	o	SMALL LEAKAGE OBSERVED
- DEC. 81	o	FOLLOWING SCRAM TRANSIENTS LEAKAGE INCREASED
- JUL. 82	o	MECHANICAL SEAL INSTALLED
- FALL 83	o	SECOND SEAL INSTALLED on another CRD housing

CRD PENETRATION COMPARISON

	NUCLENOR	NMP-1	BIG ROCK POINT
STUB TUBE OD	7.44 ± .010	7.500 + .000 - .002	6.500 ± .010
STUB TUBE ID	5.945 + .002 - .001	5.995 + .005 - .000	5.160 + .002 - .003
HEIGHT OF STUB TUBE (SHORT SIDE)	3.0 TO 3.6	1.12 TO 4.93	2.3 TO 4.2
STUB TUBE MATERIAL	ASTM A-336 TYPE F8 FURNACE SENSITIZED .016/.038% CARBON	SA-182 F304 FURANCE SENSITIZED .064/.056/.055%	SA-336 F8 FURNACE SENSITIZED
NUMBER OF STUB TUBES	97	129	32
CRD HOUSING OD	5.940 + .000 - .002	5.975 + .000 - .005	5.160 + .002 - .000
CRD HOUSING ID	4.86	4.86	4.00
RADIAL GAP (STUB TUBE TO HOUSING)	MINIMUM .002 MAXIMUM .0045	.010 .015	-0.003 +0.000

Minor Rolling Pressure Closes Gap

5.975
4.860
1.115
.557



PLANT	REACTOR CONTRACTOR	VESSEL SUPPLIER	COMP. DATE
NUCLENOR	GE	ROTTER-DAM DRYDOCK	1969

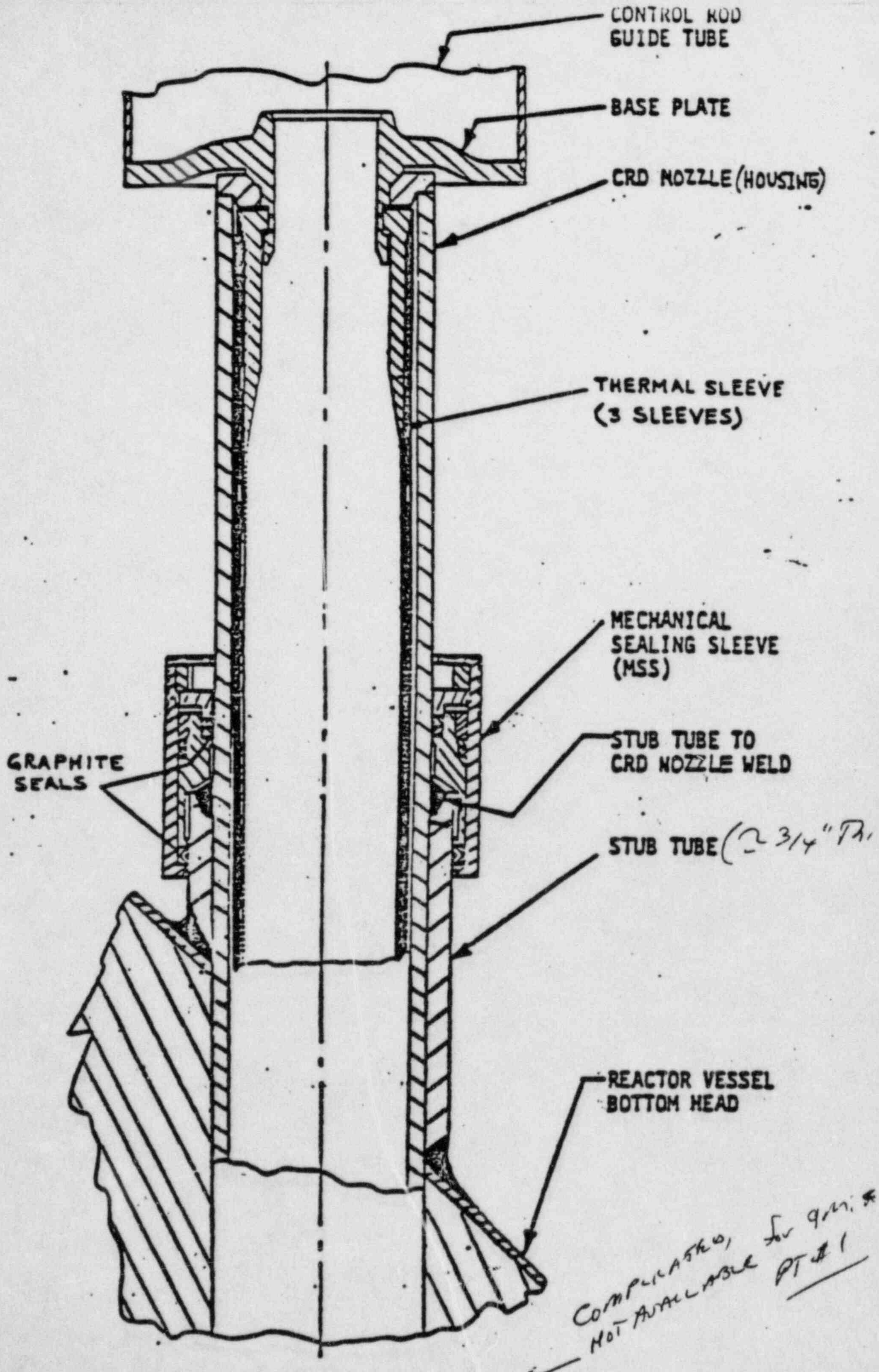
Aim to minimize ...

DETAILS OF ROLL REPAIR AT NUCLENOR

- STRAIN IN CRD HOUSING LIMITED TO 3-1/4 PERCENT
- EFFECTIVE STRAIN FOR SEALING WAS 2.8 PERCENT (Less than Big Rock
- ROLLED AREA WAS 1.95 IN. IN LENGTH (Compared to 3" at Big Rock
- ROLL COMPLETED WITH ONE EXPANSION OF ROLLERS
- ROLLED AREA WAS VISUALLY INSPECTED, RT AND UT EXAMINED AFTER ROLLING
- CRACK WAS MONITORED VISUALLY DURING ROLLING OPERATION
- LEAKAGE WAS REDUCED AND EVENTUALLY STOPPED FOR A PERIOD OF TWO TO THREE MONTHS FOLLOWING THE ROLLING REPAIR
- FOLLOWING SEVERAL SCRAM TRANSIENTS, THE LEAKAGE INCREASED TO NEAR THE INITIAL VALUE
- POSSIBLE REASONS FOR LACK OF SUCCESS AT NUCLENOR:
  - WAS ALLOWED TO LEAK FOR A NUMBER OF MONTHS BEFORE ROLL REPAIR ATTEMPT (some internal cutting?)
  - MAY NOT HAVE ACHIEVED SUFFICIENT WALL THINNING AND CONTACT PRESSURE OVER SUFFICIENT LENGTH

NUCLENOR MECHANICAL SEAL REPAIR

- o MECHANICAL SEAL DEVELOPED AND TESTED OVER APPROXIMATELY 1 YEAR PERIOD
- o SEAL ASSEMBLY TAILOR-FIT TO STUB TUBE-HOUSING ASSEMBLY; STUB TUBE AS-BUILTS, OD CLEAN-UP AND POSSIBLY OD MACHINING REQUIRED
- o SEAL LIMITS LEAKAGE; IS NOT POSITIVELY LEAK TIGHT
- o SEAL NOT SUITABLE FOR LARGE PERCENTAGE OF NMP-1 STUB TUBES AS PRESENTLY DESIGNED BECAUSE OF STUB TUBE LENGTH
- o SEAL OFFERS LITTLE ADVANTAGE OVER ROLLED JOINT; IS SUBSTANTIALLY MORE COMPLICATED AND DIFFICULT TO INSTALL



NUCLENOR - MECHANICAL SEALING SLEEVE

INCORE PENETRATION LEAKS

- GARIGLIANO IN 1966
  - ONE OUTER INCORE PENETRATION STUB TUBE LEAKED
  - HOUSING WAS ROLLED; NO FURTHER LEAKS
- OYSTER CREEK IN 1974
  - ONE OUTER INCORE PENETRATION LEAKED THROUGH THE WELD ATTACHING THE INCORE HOUSING TO THE VESSEL BOTTOM HEAD
  - HOUSING WAS ROLLED; NO FURTHER LEAKS

POTENTIAL FOR CRACKING OF NINE MILE POINT STUB TUBE

o BASED ON RELATED PLANT EXPERIENCE AND OTHER DATA:

- CRACKING IS MOST LIKELY TO OCCUR IN THE STUB TUBE JUST BELOW THE STUB TUBE-TO-CRD HOUSING (FIELD) WELD

- CRACKING IS POSSIBLE IN THE STUB TUBE IN THE VICINITY OF THE SHOP WELD ATTACHING THE STUB TUBE TO THE VESSEL

- CRACKING IN THE FIELD AND SHOP WELDS OR IN THE STUB TUBE BELOW THE SHOP WELD IS NOT LIKELY TO OCCUR

- CRACKING IN THE SOLUTION ANNEALED CRD HOUSING IS UNLIKELY (ALTHOUGH IT CONTAINS A WELD-SENSITIZED ZONE)

OTHER REPAIR ALTERNATIVES

— LONG TERM FUTURE POSSIBILITY

- GENERAL ELECTRIC WELDING DEVELOPMENT EFFORT - INVOLVES REMOTE MACHINING OF STUB TUBE AND LOWER HEAD, INSTALLATION OF DRY CAISSON, COMPUTER-CONTROLLED REMOTE WELDING OF STUB TUBE SLEEVE - LONG TERM DEVELOPMENT

- OTHER MECHANICAL PACKING/GASKET REPAIRS INVOLVING REMOTE BORING OF PENETRATION AREA - LONG TERM DEVELOPMENT

COMPARISON OF BIG ROCK, NUCLENOR, AND NMP-1 CRD PENETRATION PARAMETERS

SAFETY ASSESSMENT OF NMP-1
STUB TUBE CRACKS

- o PREVIOUS SAFETY ASSESSMENTS OF CRD STUB TUBE CRACKS ARE APPLICABLE TO NMP-1 AND REMAIN VALID
  - LEAKAGE LIMITED
  - CRD HOUSING EJECTION NOT POSSIBLE
  - STRUCTURAL INTEGRITY OF RCS BOUNDARY NOT AFFECTED
  - NO EFFECT ON CRD OPERATION/SCRAM
- o TUBE ROLLING OPERATION FURTHER MINIMIZES ANY LEAKAGE AND PROVIDES ADDITIONAL HOUSING SUPPORT; DOES NOT CHANGE SAFETY ASSESSMENT
- o EXISTING DRYWELL LEAKAGE MONITORING CAPABILITY IS EXCELLENT AND ADEQUATE TO MONITOR PENETRATION LEAKAGE IN SERVICE
  - LEVEL RATE-OF-RISE IN DRYWELL FLOOR DRAIN TANK (CR ALARM AND RECORDER, 1/4 GPM SENSITIVITY)
  - PUMP-OUT TIMER (CR ALARM AND RATE, SENSITIVITY 5 GPM IN 18 MIN., 0.5 GPM IN 180 MIN., ETC.)
  - INTEGRATED FLOW TO WASTE DISPOSAL IS MONITORED

SAFETY SIGNIFICANCE OF STUB TUBE CRACKS

CRACKS IN THE CRD PENETRATION STUB TUBES ARE NOT CONSIDERED TO BE SIGNIFICANT FROM A SAFETY STANDPOINT BECAUSE OF THE FOLLOWING:

- THE EXPECTED COOLANT LEAKAGE RATE FROM A STUB TUBE CRACK WOULD BE SMALL AND COULD BE MONITORED DURING FUTURE PLANT OPERATION TO DETECT ANY SIGNIFICANT INCREASE

- THE CRD HOUSING CANNOT BE EJECTED FROM THE REACTOR VESSEL BECAUSE:

  - THE CRD HOUSING AND J-WELD HAVE BEEN TESTED AND FOUND TO BE STRUCTURALLY SOUND

  - THE STUB TUBE IS ADEQUATE FOR SUPPORT OF THE CRD HOUSING SINCE THE STUB TUBE IS LOADED IN COMPRESSION AND CANNOT BE FORCED THROUGH THE VESSEL HEAD PENETRATION

  - A MECHANICAL RESTRAINT SYSTEM IS PROVIDED UNDERNEATH THE LOWER VESSEL HEAD TO PREVENT EJECTION OF THE CRD MECHANISM OR HOUSING

- VERTICALLY UPWARD LOADS DURING SCRAM ARE SMALL

- MAXIMUM MISALIGNMENT OF HOUSING WILL NOT AFFECT CRD OPERATION/SCRAM

APPLICABLE SAFETY EVALUATIONS DOCKETED FOR OYSTER CREEK, BIG ROCK POINT AND NUCLENOR

CONCLUSIONS OF CONTINGENCY PLANNING IN DECEMBER 1983

- o EVENTUAL CRACKING OF NMP-1 STUB TUBES LIKELY; CONSISTENT WITH OTHER EXPERIENCE, ANY CRACKS SHOULD BE LIMITED TO FURNACE-SENSITIZED STUB TUBES

- o STUB TUBE CRACKING DOES NOT CONSTITUTE A SAFETY PROBLEM

- o BECAUSE OF RELIABILITY CONSIDERATIONS, ACTION SHOULD BE TAKEN TO:

  - INSPECT CRD PENETRATIONS FOR LEAKAGE DURING SPRING 1984 OUTAGE

  - PROCURE LONG-LEAD EQUIPMENT AND MOCK-UPS AND START PROCEDURE DEVELOPMENT FOR TUBE ROLLING

  - FOLLOW EXPERIENCE, INSPECTION TECHNIQUES AND REPAIR DEVELOPMENT WORK ELSEWHERE

EVALUATION OF NMP-1 STUB TUBE CRACKS

EVALUATION OF NMP-1 STUB TUBE CRACKS

- o CRACKS ARE LIMITED TO FURNACE-SENSITIZED STUB TUBE MATERIAL, AS EXPECTED
- o CRACK LOCATIONS CONSISTENT WITH THOSE OF NUCLENOR AND PRESENT UNDERSTANDING OF CRACK MECHANISM
- o CRACKS ATTRIBUTED TO:
  - HEAVILY SENSITIZED 304 MATERIAL
  - HIGH (PLASTIC) RESIDUAL STRESSES DUE TO HOUSING FIELD WELD
  - BWR WATER CHEMISTRY
- o ONCE CRACKING RELIEVES RESIDUAL STRESSES, NO SIGNIFICANT ADDITIONAL PROPAGATION IS EXPECTED; STUB TUBE SERVICE STRESSES ARE NOMINALLY COMPRESSIVE (DEAD WEIGHT + PRESSURE)

4/10/84

NMP-1 POST-CRACK SAFETY ASSESSMENT

STATUS OF REPAIR ACTIONS

STATUS OF PROCEDURE/TOOLING DEVELOPMENT

- MEETING WITH COMBUSTION ENGINEERING, CHATTANOOGA ON JANUARY 5, 1984 TO DISCUSS ROLLING TOOL DEVELOPMENT AND PARAMETERS. LETTER OF INTENT AND PURCHASE ORDER WHERE ISSUED SHORTLY THEREAFTER TO BEGIN PROCUREMENT OF MATERIAL AND EQUIPMENT.

- WITNESSED ROLLING AND HYDROTEST AT 1875 PSIG OF MOCK-UP ON MARCH 30 , 1984. HYDROTEST WAS SUCCESSFUL (SOME WEEPAGE OCCURED).

- MOCK-UP WAS THERMAL CYCLED TO 550°F at 50° PER 15 MINUTES HEAT-UP AND COOL DOWN. RE-HYDROTESTED AT 1875 PSIG ON APRIL 3, 1984. SOME WEEPAGE OCCURED (ONE DROP DURING THE ONE HOUR TEST). CONSIDERED SUCCESSFUL ROLL.

- A PREVIOUSLY ROLLED MOCK-UP WAS DESTRUCTIVELY EXAMINED TO MEASURE ACTUAL WALL THINNING. RESULTS INDICATED 4% WALL THINNING HAD BEEN ACHIEVED.

- DESTRUCTIVE EXAMINATION OF THE MOCK-UP AFTER PRESSURE TEST REVEALED WALL REDUCTION OF APPROXIMATELY 4%.

- C-E FIELD ENGINEERING PERSONNEL HAVE PERFORMED 4 ROLLS OF THE MOCK-UPS.

- C-E FIELD ENGINEERING WILL BE PROVIDING DIRECT TECHNICAL SUPERVISION OF PLANT MAINTENANCE PERSONNEL.

- C-E FIELD ENGINEERING WILL OPERATE THE ROLLING TOOL. PLANT PERSONNEL TO REMOVE AND INSTALL CRDM AND ASSIST IN THE INSTALLATION OF THE ROLLING TOOL.

- 4 ADDITIONAL MOCK-UPS ARE BEING FABRICATED TO BE USED FOR ADDITIONAL TESTING AND FOR TRAINING OF PLANT PERSONNEL.

- THERE WILL BE A TOTAL OF 3 COMPLETE SETS OF TOOLS AVAILABLE AT THE SITE AS WELL AS ADDITIONAL SPARE PARTS. ONE COMPLETE SET OF TOOLS WILL REMAIN IN A CLEAN AREA FOR TRAINING.

- PROCEDURES HAVE BEEN DEVELOPED AND USED DURING THE LAST MOCK-UP ROLL. THESE PROCEDURES WILL BE USED FOR ALL FUTURE TRAINING AND TESTING ROLLS.

Mockups- No Corrosion Products in Hole Before mockup Te
Later " will have " " " " " Test. to Evalu

CRITERIA FOR ROLLING CRD HOUSINGS

- BASED ON PREVIOUS EXPERIENCES OF CRD HOUSING ROLLS AT BIG ROCK POINT, NUCLENOR AND ROLLING OF IN-CORE PENETRATION AT OYSTER CREEK.

- ACHIEVE 3 to 3-½% WALL REDUCTION AS A MINIMUM.

- LIMIT COLD REDUCTION (WALL REDUCTION) TO 5 TO 6%.

- ROLL BAND TO BE AT LEAST 3 INCHES IN HEIGHT.

- PLAN TO ROLL HOUSING WHICH LEAK OR SHOW EVIDENCE OF PREVIOUS LEAKAGE.

SCHEDULE

- FIRST CREW OF VENDOR PERSONNEL ON SITE APRIL 11, 1984 TO BEGIN RADIATION PROTECTION TRAINING.
- SECOND CREW OF VENDOR PERSONNEL TO BRING MOCK-UPS AND TOOLS WITH THEM, TO BE ON SITE APRIL 13, 1984 FOR RADIATION PROTECTION TRAINING.
- FIRST CREW WILL CONSTRUCT MOCK-UP TOWER AND TRAIN SITE PERSONNEL.
- PERFORM FIRST ROLL ON APRIL 16, 1984.
- START-UP HYDROTEST WILL BE USED TO CHECK FOR ANY ADDITIONAL LEAKS. (MID MAY)
- PLUGS WHICH CAN BE INSERTED FROM CRD FLANGE ARE BEING PROCURED SUCH THAT REPAIRS COULD BE PERFORMED AFTER HYDROSTATIC TEST.

Plan. To Roll 10 (3½ Man Rem Per Roll)

Exp = ≈ 200 MR/hr

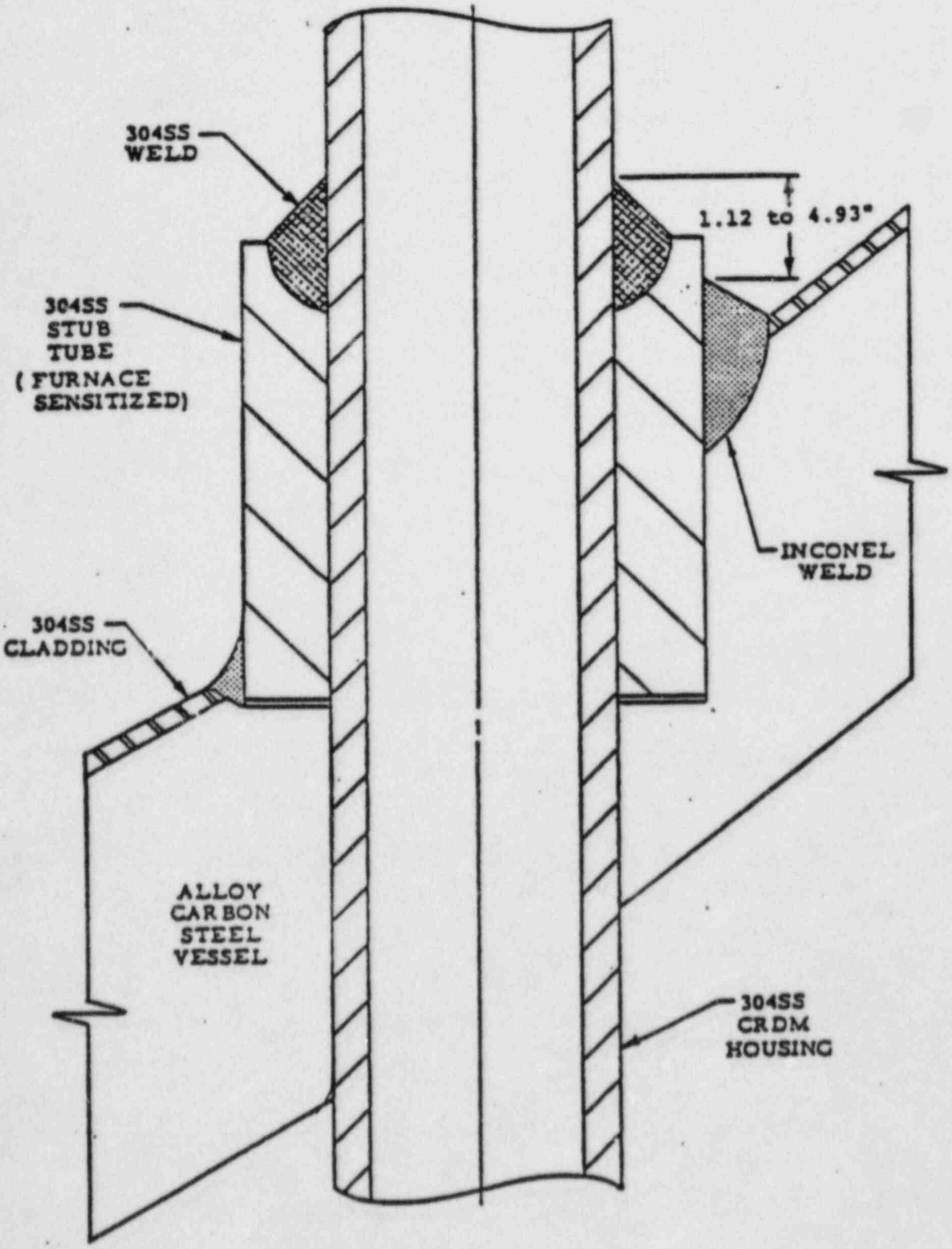
FUTURE PLANS

- INVESTIGATE ALTERNATIVE REPAIRS.

- INVESTIGATE AND EVALUATE LONG TERM REPAIR METHODS (G.E.), EPRI, INCLUDING POSSIBLE JOINT VENTURE WITH NUCLENOR.

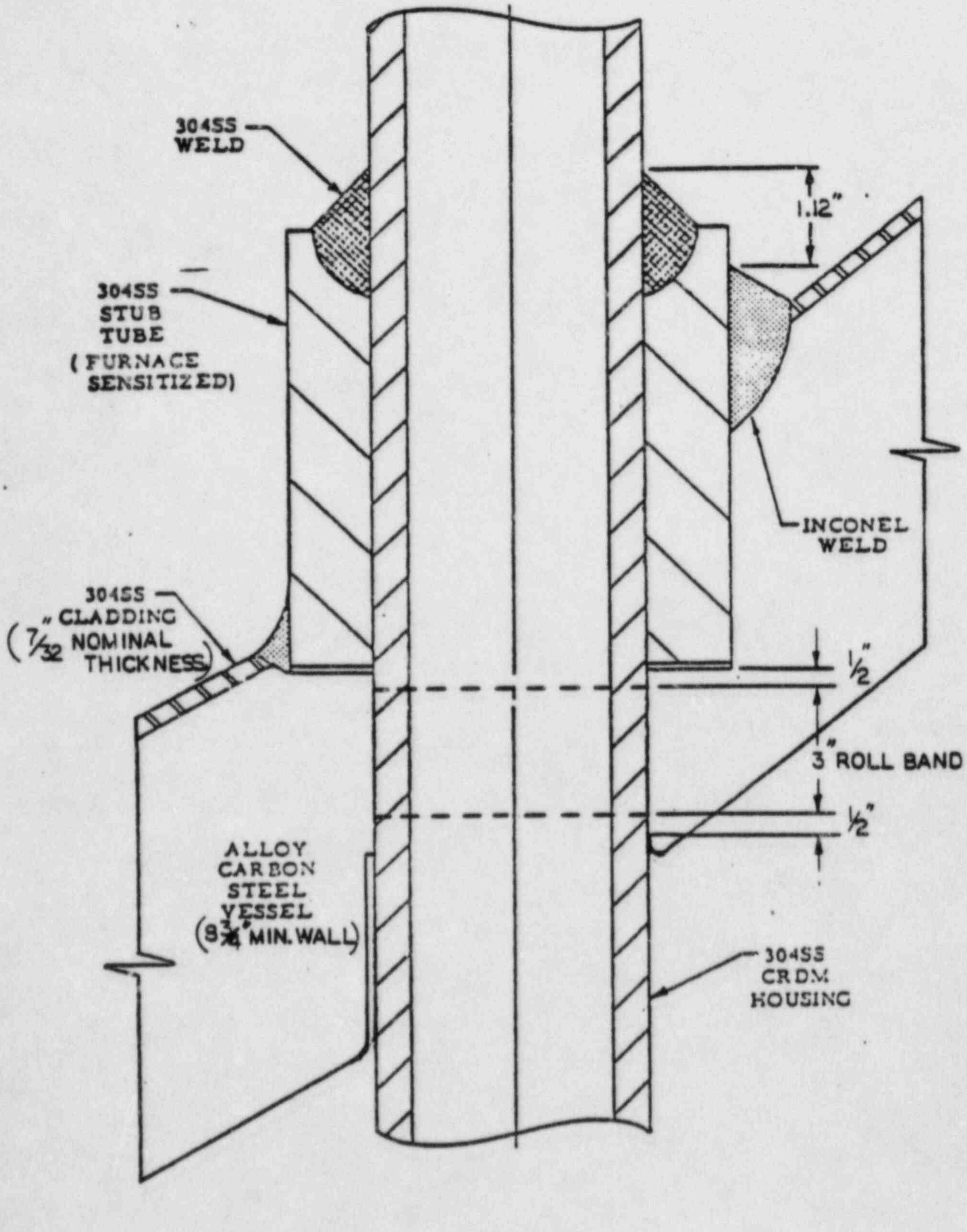
- EVALUATE U.T. EQUIPMENT CAPABLE OF INSPECTING STUB TUBE INTEGRITY IN THE CRACKED AREA.

- CURRENTLY INVESTIGATING HYDROGEN ADDITION TO MITIGATE WATER CHEMISTRY EFFECTS.



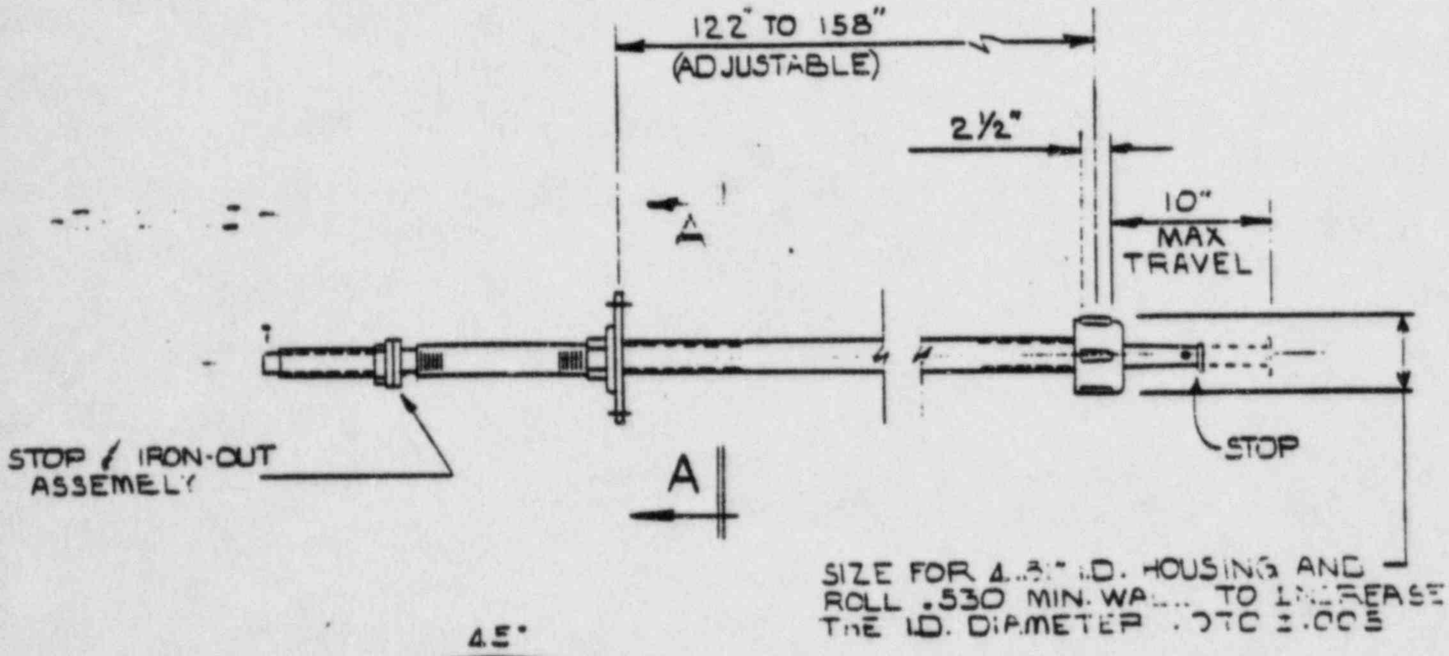
CRD PENETRATION CONFIGURATION
AT NINE MILE POINT

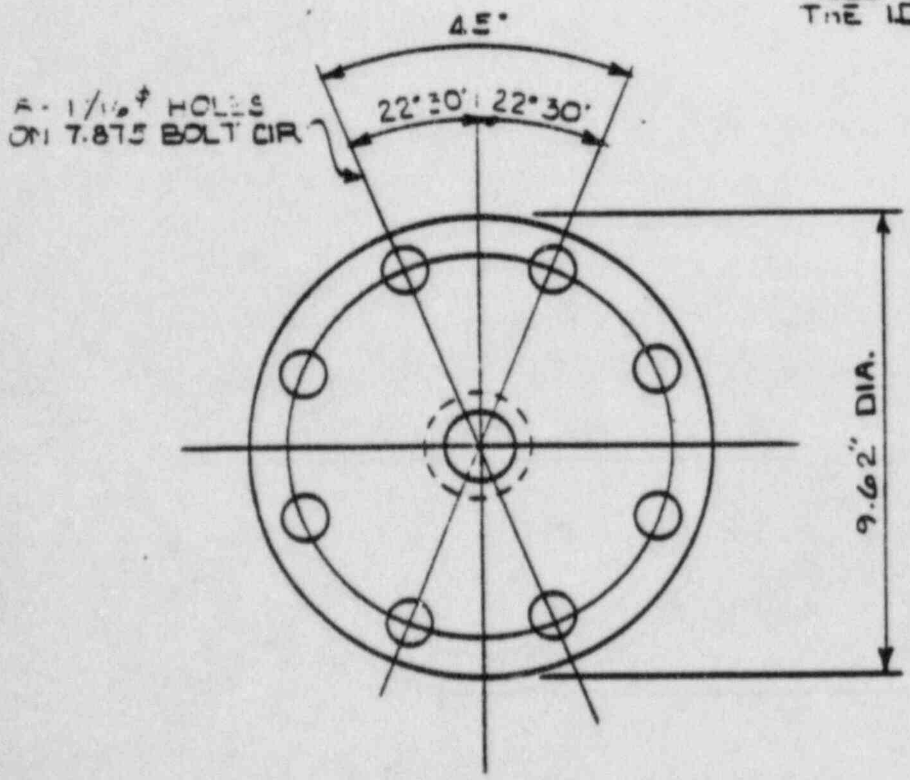
FIGURE 1-1



OUTER ROW
CRD PENETRATION CONFIGURATION
AT NINE MILE POINT

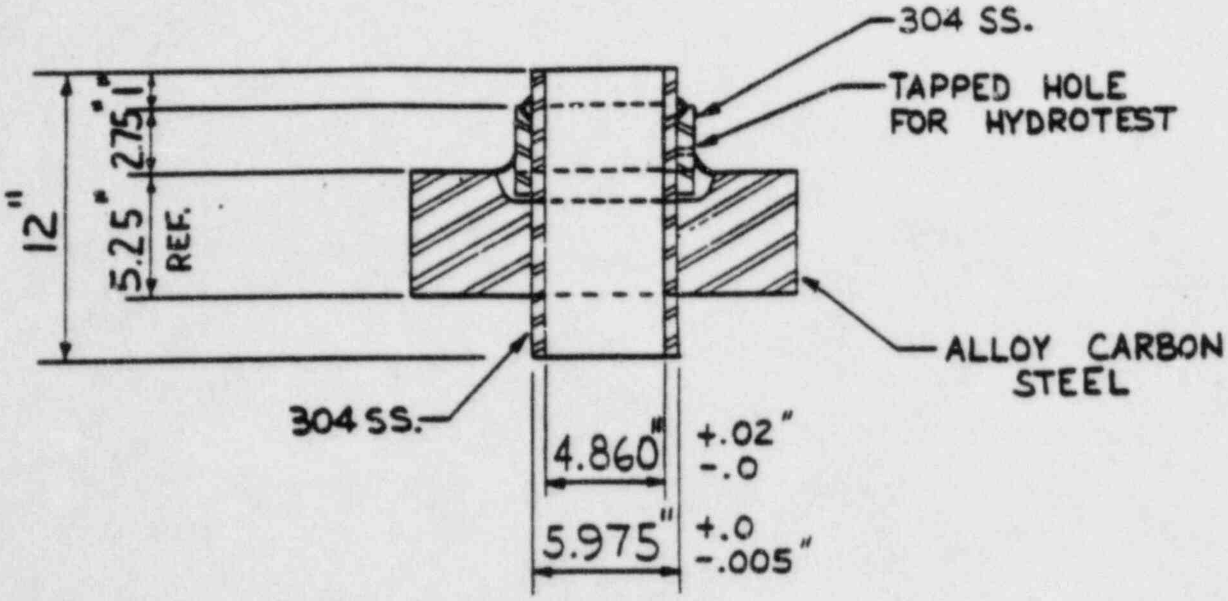
CRD HOUSING ROLLING TOOL



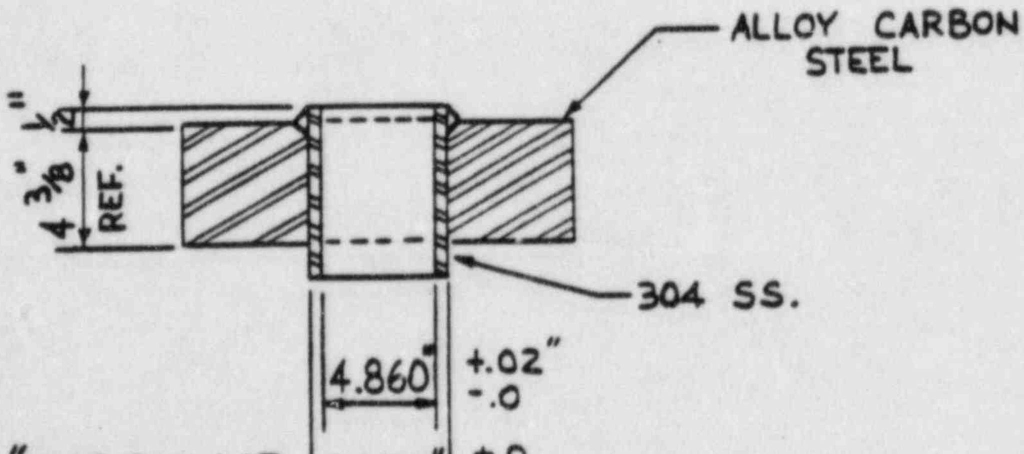


SECTION "A"

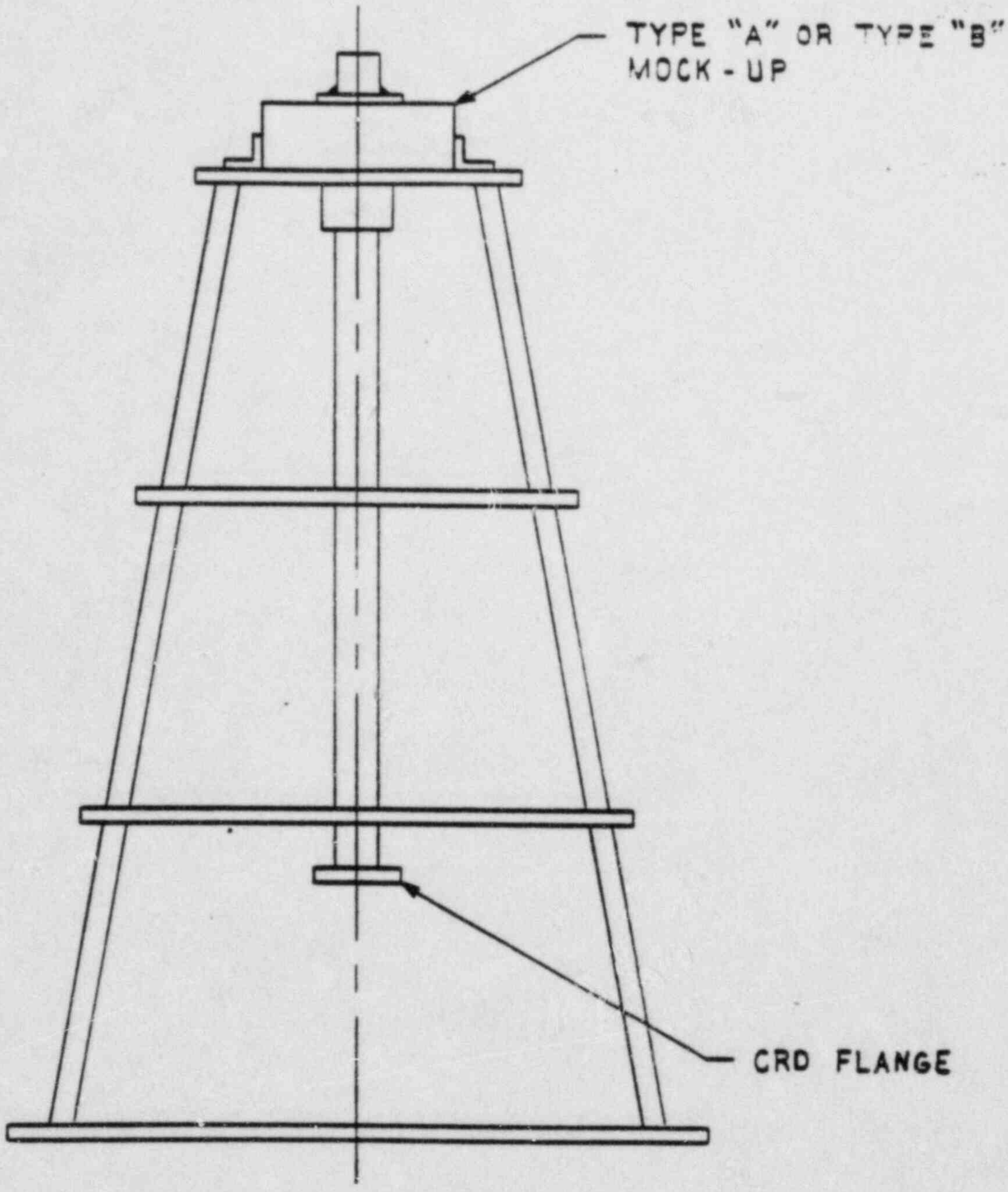
NMP-1 CRD HOUSING MOCK-UP ASS'YS



TYPE "A" MOCK UP
(USED FOR HYDROTESTING)



TYPE "B" MOCK-UP
(USED FOR TRAINING AND PROCEDURE DEVELOPMENT)



MOCK-UP TOWER ASSEMBLY

RJH 4/9/84

ROUTING AND TRANSMITTAL SLIP

Date 3/29

TO: (Name, office symbol, room number, building, Agency/Post)	Initials	Date
J. Durr		
2.		
3.		
4.		
5.		

	Action		File		Note and Return
	Approval		For Clearance		Per Conversation
	As Requested		For Correction		Prepare Reply
	Circulate		For Your Information		See Me
	Comment		Investigate		Signature
	Coordination		Justify		

REMARKS

W. Collins (492-9630) called me w/ info. on previous drive tube leaks at BWRs including repair methods.

Harold G. may want to talk w/ him to get some background info. (see attached)*

tm

DO NOT use this form as a RECORD of approvals, concurrences, disposals, clearances, and similar actions.

FROM: (Name, org. symbol, Agency/Post)	Room No.—Bldg.
	Phone No.

5041-102

OPTIONAL FORM 41 (Rev. 7-76)
Prescribed by GSA
FPMR (41 CFR) 101-11.206

☆ GPO : 1982 O - 361-529 (220)

3/27 2:53 pm.

- By looking in viewing ports, no others seen
  pulling manways
  ≈ 15 dpm

- Charles Rossi 4924944
- GE and NPR evaluating repair
  - O.C. early in plant life ≈ 1970
  - Big Rock Point ← repair by rolling CRD housing against RV bottom head
  - Spanish BWR - 1981 (Nuclenor) 250°F around J-weld (top)

3/28 - suspect area 14-11

- Oyster Creek found 9/67 prior to initial crit., weld overlay of surface cracks
- Big Rock Pt. 4/79, tube roll technique for repair
- Spanish Plant -
- Ultrasonic technique to examine stub tube from inside

- core ≈ 60% off loaded, will completely defuel

3/28 - at least 4 housings indicate rust (100% sample not complete) *

- 5 incident most recent Big Rk Pt (1979) Consumers Power
  Safety Evaluation & repair method available
  7-leak analysis
  UT from inside (GE)

301-492-9630 - W. (Joe) Collins

3/27 2:53 p.m.

- By looking in viewing ports, no others seen
  pulling manways
  ≈ 15 dpm

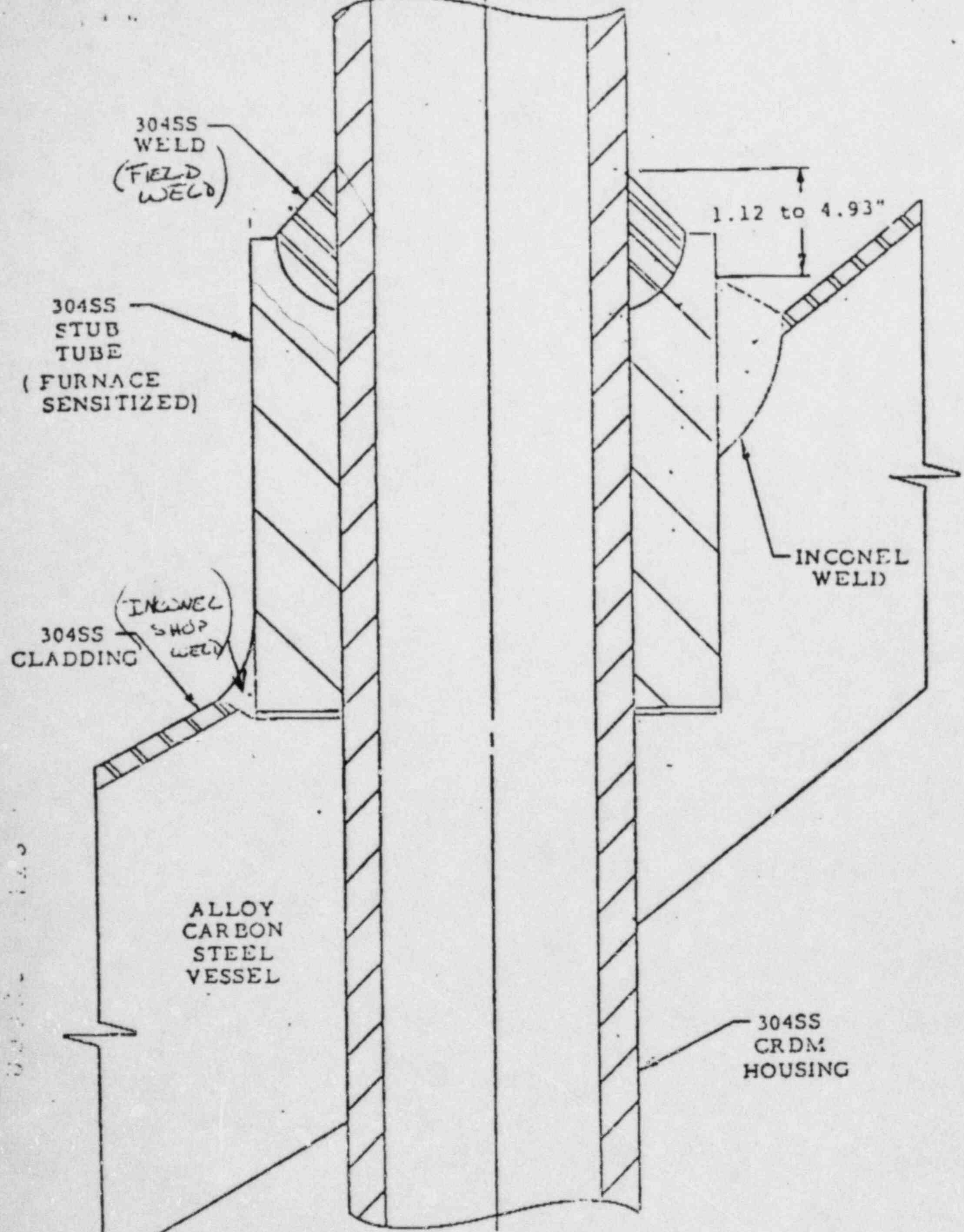
- Charles Rossi 4924944
- GE and NPR evaluating repair
  - O.C. early in plant life ≈ 1970
  - Big Rock Point ← repair by rolling CRD housing against RV bottom head
  - Spanish BWR

3/28 suspect area 14-11 → found OK

- Oyster Creek found 9/67 prior to initial crit., weld overlay of surface cracks
- ✱ Big Rock Pt. 4/79, tube roll technique for repair
- Spanish Plant → ?
  Ultrasonic technique to examine stub tube from inside

- core ≈ 60% off loaded, will completely defuel

NMP-1



PLANT	REACTOR CONTRACTOR	VESSEL SUPPLIER	COMP DATE
OYSTER CREEK	GE	CE	1969
[illegible]	GE	CE	1969

4/2 (S Hudson) 10:30 a.m

completed under RV and above insulation visual (w/ TV tape) inspection

1 leak 46·27

1 weep 14·11

7 additional suspect based on rust, etc. (no liquid present)

(other 120 no visual indication of moisture)

visual insp from refuel floor (3/31 a.m.) using TV camera w/ tape, 8·10 hrs. each
very good resolution (found screwdriver, metal bar, clip (or flake)

leaker 46 27 visual indication 270° around stub tube ≈ 1 - 1½" below upper weld

weeper 14·11 visual indication 300° around stub tube ½" below upper weld

suspect
- 30·07 " " 270° " " " ≈1" " " "
- 34·07 " " 90° " " " ≈1" " " "
- 42·39 clear no indication
- 10·27
- 38·31
- 34·39
- 46·39

PRIORITY ATTENTION REQUIRED

MORNING REPORT - REGION I

PRIORITY ATTENTION REQUIRED

DATE 3/30/84

Licensee/Facility	Notification/Subject	Description of Items or Events
Maine Yankee 50-309	SRI Fax	At 2:37 a.m. during a snow storm, a tower guard reported what appeared to be a steam leak in the vicinity of the Refueling Water Storage Tank (RWST). The operators determined there was a 40 gpm leak on the RWST return line from the outlet of the steam heater used to control RWST temperature. The leak was caused by a failed flange gasket. The leak flowed into a nearby storm sewer which drains into the plant discharge canal. A sample of the RWST showed only two elements above maximum permissible concentrations (MPC); CS-137 at 2.69 E-5 uc/ml (limit: 2.0 E-5 uc/ml) and Sb-125 at 1.83 E-4 uc/ml (limit 1.0 E-4 uc/ml). Allowing for 420,000 gpm dilution in the dishcarge canal actual release concentrations were Cs-137 at 2.37 E-9 uc/ml and 1.61 E-8 uc/ml. At 5:30 a.m., the licensee had tightened the flange and wrapped it with with rubber gasket material. This slowed the leak to approximately 2-3 gpm. A 55 gallon drum was placed under the leak and a coffer dam constructed to capture the leakoff. Arrangements are being made to transfer the leakoff to waste processing. As of 5:30 a.m., the total release was calculated to be 0.008 curies. The Technical Specification annual release limit is 5 curies. The SRI is on site following the licensee's actions, and a health physics inspector will arrive on site tomorrow. The plant will be shutdown tonight in accordance with the planned refueling outage scheduled to begin on April 1, 1984.

J. Durr - advance copy
/tcm

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION I
631 PARK AVENUE
KING OF PRUSSIA, PENNSYLVANIA 19406

APR 0 3 1984

MEMORANDUM FOR: Darrell G. Eisenhut, Director, Division of Licensing, NRR

FROM: Richard W. Starostecki, Director, Division of Project and Resident Programs, Region I

SUBJECT: NINE MILE POINT UNIT 1 CRD STUB TUBE CRACKS: TRANSFER OF LEAD OFFICE AND REQUEST FOR ASSISTANCE (TIA)

During conversations between Region I and R. Herrmann of ORB 2, we have agreed on the action plan described below to resolve the issues associated with the Nine Mile Point Unit 2 CRD stub tube cracks. It is requested that NRR be designated as lead office, and that a TIA be issued as soon as possible describing the proposed action plan.

ACTION PLAN:

Region I:

1. Perform inspections of implementation of the approved crack repair program

2. Review the test results from the licensee's inspection program

3. Provide information, as required, to NRR for incorporation into SER

NRR:

1. Designate Lead Project Manager to assign TACS and coordinate correspondence meetings and reports (ORB #2/R. Herrmann)

2. Evaluate the acceptability of the licensee's repair method and issue an SER.

IE:

1. Prepare generic correspondence (Notice or Bulletin) if required

for H B Foster
Richard W. Starostecki, Director
Division of Project and Resident Programs

cc:
R. Wessman, NRR
D. Pickett, NRR
R. Herrmann, NRR
S. Collins, RI
H. Kister, RI
W. Lazarus, RI
S. Ebneter, RI

4/10 Mtg. NMPC & NRC re: NMP-1 vessel CRDM / stub tube & inst. dry tube cracks

Licensee wants to handle via 50.59 review

Not tech. issue: 1) rod can't eject

2) rod will not be inoperable

3) lkg. can be monitored

waiting for NRR mtg., Denton / Case w/ Don V. to discuss issues

Bob Herman to call S. Hudson w/ results

Repair: roll 2 leaking CRDM tubes (not leak tight repair, minimize lkg.)

" 7 w/ rust indications

Quest. - what about CRDM that has crack but no lkg. indication?

- no further inspections?

CE at site today (4/10) for training (repair party)

NRR seems concerned about impacting licensee's outage schedule

Retest following repair?

* J. Durr will call B. Herman w/ recommendations:

- Sample insp. of remaining stub tubes, then Sect. 11 insp. if req'd.
- Analysis to show that if tube rolled then stub tube fails rod will not fall out
- reason for not rolling CRDM w/ crack

First roll sched. for 4/16 (Monday)

CRD Stub Tubes

4/10/84

Morgan, Roman, Pasternak, Lee Kolcowski

MPR - Dehnold, Dr. ~~[illegible]~~ McCurdy

PSC - Jim ~~Keattley~~

NRC - Vassallo, Hermann, Joe Collins, Harold Gray

CM - 10CFR 50.59 approval } 3 days of critical path
amendment not necessary } lost during recirc pipe job

TV results - 6 of 12

46-27	-270°	significant
14-11	200°+	"
30-07	330°	~~tight~~
34-07	35°	light
10-27	100°	light
10-31	100°	light

all are ½" to 1" below the fillet weld

no evidence of prior leakage

MPR -

some of MPR people involved in Big Rock Point repair

Roll repair - minimize leak rate
does not guarantee "zero leakage"

No safety significance -
(1) leak rate very small and could be monitored
(2) rod can not be ejected

(3) maximum misalignment of housing will not affect CRD operation

RSP - Previous safety assessments for Big Rock Point + Oyster Creek are applicable

Roll Repair

- ~~all 2 leakers ones~~ plan any ~~that~~ show signs of rust - 7 total

- first roll April 16, 1984

- 3½ man rem / roll - much of this in pulling the drive

- Do not plan to roll 10-31 ~~that~~ shows a 100° crack

- hydro @ 1100# prior to start-up

[Operating Events Meeting today] with Denton or Case

Hermann - you will hear from us shortly

C.M. - O.K. Do you want anything on the docket?

Hermann - no. not now

TASK INTERFACE AGREEMENT

TASK NO.: 84-26
DATE: APRIL 13 1984
PA#: 1161 - 54628

PROBLEM: Nine Mile Point 1 - CRD Stub Tube Cracks

LEAD OFFICE: ____ I&E __X__ NRR ____ REGION ____ JOINT

REFERENCES: Memo to DEisenhut fm RStarostecki dated 04/03/84 subject; Nine Mile Point Unit 1, CRD Stub Tube Cracks Transfer of Lead Office and request for assistance (TIA)

ACTION PLAN:

NRR: Evaluate the acceptability of the licensee's repair method and issue an SER. Due date for completed SER - May 7, 1984. (MTEB)

Region I:
1. Perform inspections of implementation of the approved crack repair program.
2. Review the test results from the licensee's inspection program
3. Provide information, as required, to NRR for incorporation into SER

IE: Prepare generic correspondence (Notice or Bulletin) if appropriate.

NRR: Designate Lead Project Manager to assign TACs and coordinate correspondence, meetings, and reports (ORB#2 R. Hermann). Prepare transmittal memorandum to Region I for DL signature.

OFFICE COORDINATORS:

Gary Holahan (x27415) 4/6/84

R. Vollmer (x27207) 4/10/84

G. Lainas 4/11/84 (x27817)

APPROVED:

E. Jordan (I&E) A Dromerick for telecon 4/13/84

NA R. Starostecki (Region I)

F. Miraglia (x27492) 4/13/84

cc:
V. Stello, ROGR
Regional Adms.
J. Heltemes, AEOD
N. Grace, IE
J. Taylor, IE
E. Jordan, IE
R. Baer, IE
G. Rossi, IE
S. Collins, R-I
H. Kister, R-I
W. Lazarus, R-I
S. Ebneter, R-I
H. Thompson, DHFS
T. Speis, DST
R. Mattson, DSI
D. Eisenhut, DL
R. Vollmer, DE
F. Miraglia, DL
G. Lainas, DL
T. Novak, DL
E. Case, NRR
R. Wessman, DL
G. Holahan, DL
D. Vassallo, OR2
J. Collins MTEB
B.D. Liau MTEB

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION I
631 PARK AVENUE
KING OF PRUSSIA, PENNSYLVANIA 19406

APR 0 3 1984

MEMORANDUM FOR: Darrell G. Eisenhut, Director, Division of Licensing, NRR

FROM: Richard W. Starostecki, Director, Division of Project and Resident Programs, Region I

SUBJECT: NINE MILE POINT UNIT 1 CRD STUB TUBE CRACKS: TRANSFER OF LEAD OFFICE AND REQUEST FOR ASSISTANCE (TIA)

During conversations between Region I and R. Herrmann of ORB 2, we have agreed on the action plan described below to resolve the issues associated with the Nine Mile Point Unit 2 CRD stub tube cracks. It is requested that NRR be designated as lead office, and that a TIA be issued as soon as possible describing the proposed action plan.

ACTION PLAN:

Region I:

1. Perform inspections of implementation of the approved crack repair program
2. Review the test results from the licensee's inspection program
3. Provide information, as required, to NRR for incorporation into SER

NRR:

1. Designate Lead Project Manager to assign TACS and coordinate correspondence meetings and reports (ORB #2/R. Herrmann)
2. Evaluate the acceptability of the licensee's repair method and issue an SER.

IE:

1. Prepare generic correspondence (Notice or Bulletin) if required

for Richard W. Starostecki, Director
Division of Project and Resident Programs

8412120268

cc:
R. Wessman, NRR
D. Pickett, NRR
R. Herrmann, NRR
S. Collins, RI
H. Kister, RI
W. Lazarus, RI
S. Ebneter, RI

Facility: NHP-1 4/16/84

Subject: CRD Housing Exams

The licensee agreed to perform UT exams of the CRD housings after discovering cracks in the stub tubes. The exams were made in the area of the J-welds, stub tube to CRD housing. These exams were made to determine if there has been any degradation of the J-weld heat affected zone of the housing.

Nine housings were removed and eight of the nine UT inspected. CE used 0° and 45° searches employing a 2.25 MHz, ½" ϕ transducer calibrated on 10% OD and ID notches. The search is made 360° and advanced axially ~.1" after each scan. No indications have been noted.

Roller expansion of the stub tubes will take approximately 5 days (1 per shift).

J. Durr

CC: Ebneter

McBrearty

Collins

I. Dirr 5282

NMP-1 4/16

S.H.
CRD housing UT - no ind. of cracking in 9 housings

- predict no impact on outage

Repair Sched. - start p.m. 4/16
≈ 1 wk. duration
rolling 9 : 2 w/ lk.
7 w/ ind. of past lkg.
1 wk indication but no visible lkg not being rolled

CS sparger insp. compl. no new indications
1981 outage 1 crack, no further growth

- SRM/IRM dry tubes
GE analysis. OK to use for 1 cycle
long-term → replace

4/13/84

Facility: NMP-1

Subject: Examination of CRD Housings

Phonecon participants:

J. Durr   J. Hawksley

R. Hermann   R. Pasternak

- Discussed the licensee's forthcoming ultrasonic examination of the J-weld on the CRD housing to stub tube. This exam is to show that IGSCC has not degraded this pressure boundary weld.

- Exams to take 4-6 hours per weld.
- Exams to begin on or about Sunday
- Licensee to conference call with above participants on Monday at 11:00 to discuss preliminary results.
- Licensee is doing "L" and "S" wave exams.
- Trying to locate baseline data (L-wave)

J. Durr

CC: Ebneter
Collins
McBrearty

4/10 Mtg. NMPC & NRC re: NMP-1 vessel CRDM / stub tube & inst. dry tube cracks

Licensee wants to handle via 50.59 review

Not tech. issue: 1) rod can't eject
2) rod will not be inoperable
3) lkg. can be monitored

waiting for NRR mtg., Denton/Case w/ Don V. to discuss issues
Bob Herman to call S. Hudson w/ results

Repair: roll 2 leaking CRDM tubes (not leak tight repair, minimize lkg)
" 7 w/ rust indications

Quest. - what about CRDM that has crack but no lkg. indication?
- no further inspections?

CE at site today (4/10) for training (repair party)
NRR seems concerned about impacting licensee's outage schedule
if NMPC doesn't provide timely input - need enough time to review
Retest following repair?

* J. Durr will call B. Herman w/ recommendations:
- Sample insp. of remaining stub tubes, then Sect. II insp. if req'd.
- Analysis to show that if tube rolled then stub tube fails rod will not fall out
- reason for not rolling CRDM w/ crack

First roll sched. for 4/16 (Monday)

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

April 6, 1984

Docket No. 50-220

MEMORANDUM FOR: Domenic B. Vassallo, Chief
Operating Reactors Branch #2
Division of Licensing

FROM: Robert A. Hermann, Project Manager
Operating Reactors Branch #2
Division of Licensing

SUBJECT: FORTHCOMING MEETING WITH NIAGARA MOHAWK POWER CORPORATION (NMPC) (Nine Mile Point, Unit No. 1)

Time & Date: Tuesday
April 10, 1984
10:00 a.m.

Location: Room 2242
Air Rights Building
Bethesda, Maryland

Purpose: To discuss inspection results of and repair options for CDR housings and stub tubes.

Participants:

NMPC
R. J. Pasternak
C. V. Mangan
T. W. Roman
L. Klosowski, etc.

MPR
W. Schmidt
W. McCurry

NRC
R. A. Hermann
C. D. Sellers
M. Caruso
S. Hudson
J. Durr
B. D. Liaw
D. B. Vassallo
W. Hazelton
W. J. Collins

Robert A. Hermann

Robert A. Hermann, Project Manager
Operating Reactors Branch #2
Division of Licensing

cc: See next page

8404230180

PRIORITY ATTENTION REQUIRED | MORNING REPORT - REGION I | PRIORITY ATTENTION REQUIRED

DATE 4/9/84

TO: James Blaha, Director, Program Support and Analysis Staff
FROM: Thomas E. Murley, Regional Administrator, Region I

Licensee/Facility	Notification/Subject	Description of Items or Events
Shoreham 50-322	Emergency Diesel Generator Update	EDG-101: Reassembly is complete. The diesel is running at 75% load. The 23 start qualification test will begin today. EDG-102: Reassembly is complete; plans are to conduct post-outage retesting today. EDG-103: The 23 start qualification test is in progress and should be completed tomorrow. Difficulty in reaching 3900 KW has not been resolved.
Beaver Valley Unit 1 50-334	4/9 SRI Fax/Plant Shutdown	On 4/8, the heater drain tank normal level control valve stem failed. Power was reduced to about 40 percent to allow shutdown of the heater drain pumps for valve isolation. After the power reduction, secondary chemistry samples indicated that a main condenser tube leak had occurred. Because steam generator conductivity approached 17 umhos/cm, power was reduced to less than 5 percent thermal (Mode 2) on 4/9, in accordance with plant operating guidelines. Condenser tube plugging activities are continuing.
Nine Mile Point Unit 1 50-220	4/9 SRI phone	Status update, inspection of control rod drive mechanism (CRDM) stub tubes and incore instrumentation: -The licensee has completed an underwater TV inspection of selected CRDM stub tubes. Six of twelve stub tubes inspected had cracks near the stub tube to CRDM housing weld. On 4/10 the licensee will meet with NRR to discuss the licensee's findings and proposed repair procedure. - SRM/IRM dry tube cracks. On 4/3 the licensee detected cracks in ten of twelve SRM/IRM dry tubes. The cracks are in the vicinity of the spring/spring plunger assembly. General Electric is evaluating the licensee's video tapes of the dry tubes. Licensee evaluation of repair and acceptance criteria continues. Region I will continue to follow licensee actions.

00009 0500

1.XH-

CONT. BLADE MAP

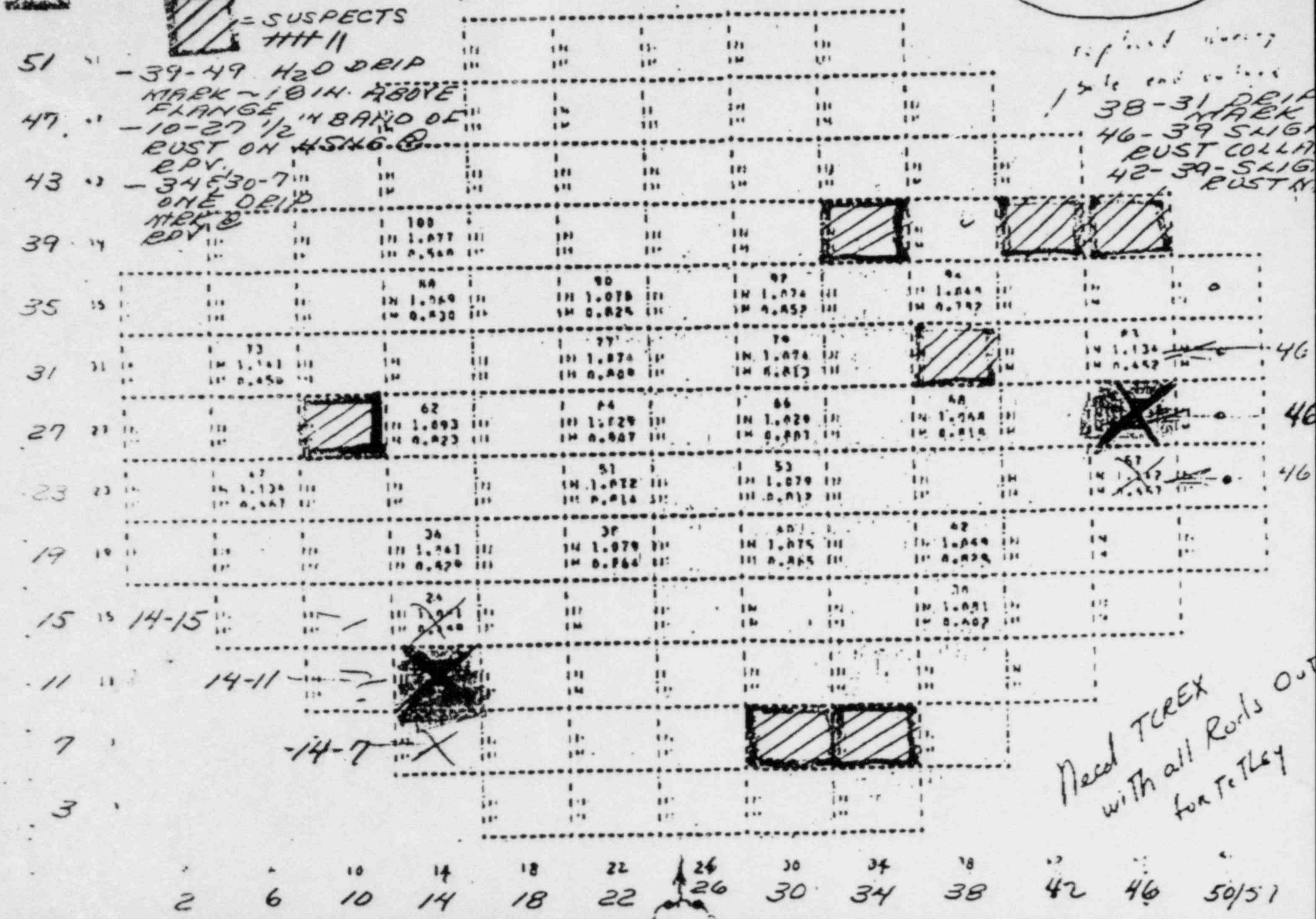
CYCLE EXPOSURE 111192.2 MWD/ST
CONTROL BLADE MAP
23 BLADES THAT WILL EXCEED NUCLEAR LIFETIME

[X box] = LKRS. 11

[hatched box] = SUSPECTS HH 11

51 — 39-49 H2O DRIP MARK ~18 IN. ABOVE FLANGE
47 — 10-27 1/2 IN BAND OF RUST ON HSNG. @ RPV.
43 — 34 & 30-7 ONE DRIP MARK @ RPV

38-31 DRIP MARK
46-39 SLIGHT RUST COLLAR
42-39 SLIGHT RUST M



Need TCREX with all Rods Out for TcTLey

To: Sam Collins

7/2/84

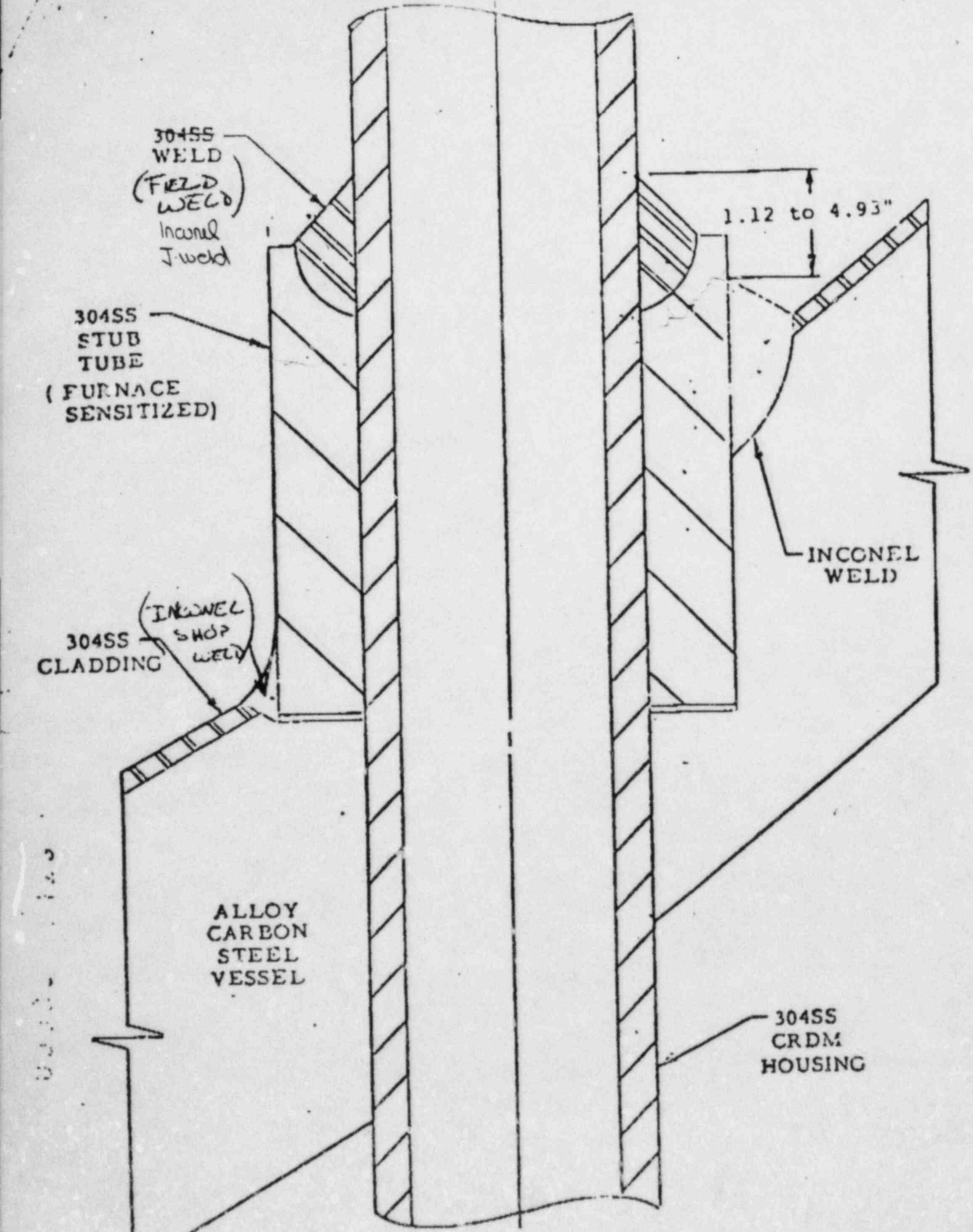
Proposed Inspections
For NMP-1
RPV Stub Tube Leaks

1. The licensee should perform ultrasonic examinations of the CRD housing in the area of the upper stub tube to CRD housing welds to assure the integrity of the housing. This should be supplemented by a visual examination of that area.

2. Remote visual examinations should be made of a representative sample of the remaining stub tubes*. If defects are noted, the sample should be increased per ASME XI requirements.

   * Using the techniques which originally detected this condition.

3. An elevated pressure leakage test should be performed to assure all leakers have been identified



PLANT	REACTOR CONTRACTOR	VESSEL SUPPLIER	COMP. DATE
OYSTER CREEK	GE	CE	1968
[illegible]	[illegible]	CE	1968

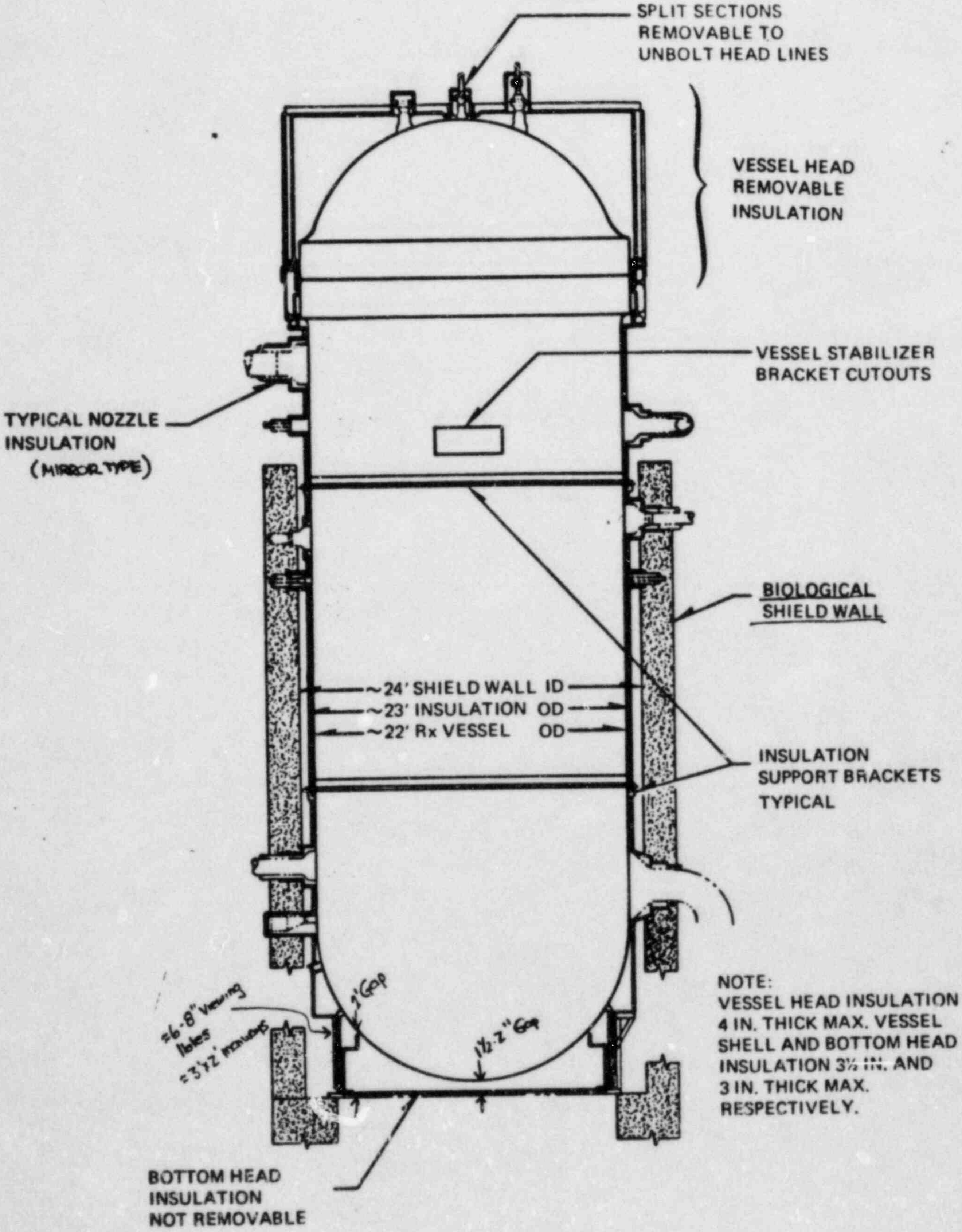
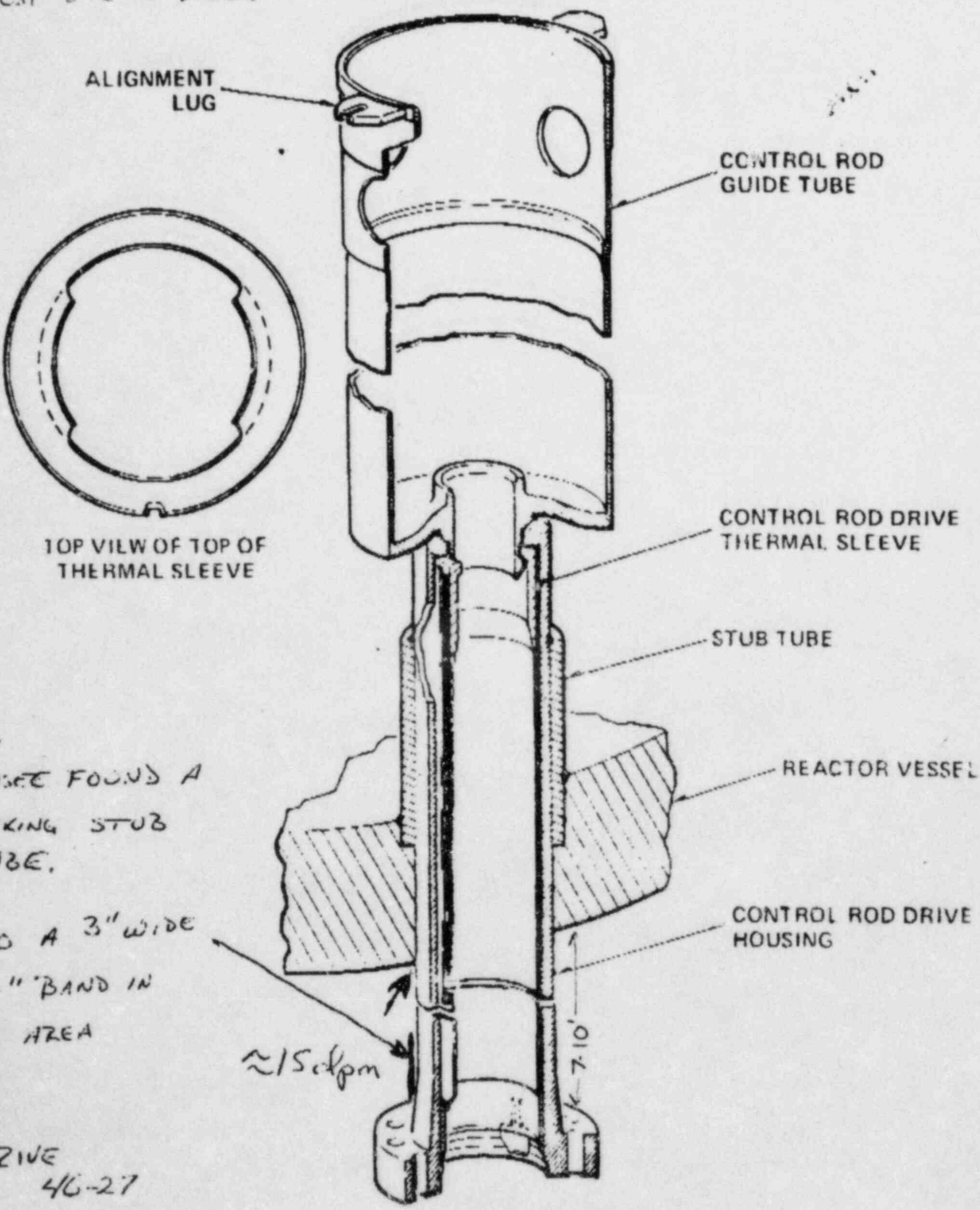


FIGURE 2.1–4 Reactor Vessel Insulation

To: Sam Collins

From Steve Hudson

3/27/84



Sam,

Licensee found a leaking stub tube.

Also a 3" wide "rust" band in this area

Drive 46-27

FIGURE 2.1-9 Control Rod Guide Tube to Control Rod Drive Housing Attachment

Licensee will make Red Phone call. I'll be in the drywell.

0280

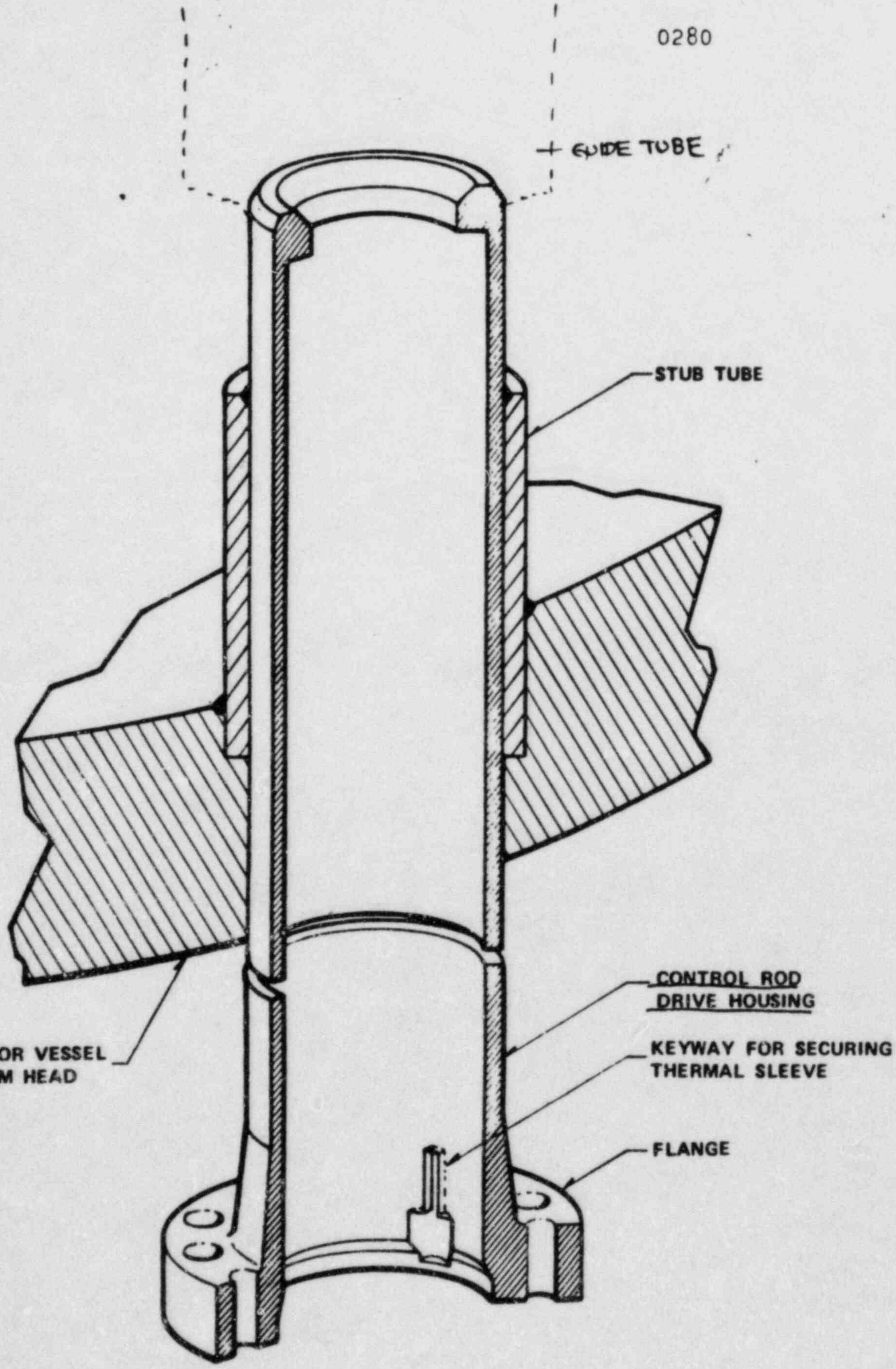


Figure 2.1–7 CONTROL ROD DRIVE HOUSING

4/2 Conf. call:
B. Herman, NRR — W. Kister, S. Collins
J. Durr, MPS — B. Lazarus,

- Big Rock 79, not Stress Corrosion
  Stub tube / RV weld
  Staff SE bought roll fix w/ 50.59 determination

- TIA
  Scope of Insp — UT, V, (Hydro.) ?

4/2 (S Hudson) 10:30 a.m

completed under RV and above insulation visual (w/ TV tape) inspection

1 leak 46-27

1 weep 14-11

7 additional suspect based on rust, etc. (no liquid present)

(other 120 no visual indication of moisture)

visual insp. from refuel floor (3/31 a.m.) using TV camera w/ tape, 8-10 hrs. each

very good resolution (found screwdriver, metal bar, clip (or flake)

leaker 46-27 visual indication 270° around stub tube $\approx$ 1-1½" below upper weld

weeper 14-11 visual indication 300° around stub tube ½" below upper weld

suspect
- 30-07 " " 270° " " " $\approx$1" " " "
- 34-07 " " 90° " " " <1" " " "
- 42-39 clear no indication
- 10-27
- 38-31
- 34-39
- 46-39

4/4 Status: 10 inspected so far

visual ind. on 5

will increase sample size by 10 = 20 total

also inspecting 12 inst. tube penetrations

4/6 10 out of 12 inst tube, visual ind. of cracks by TV remote inside RV

cracked in area of spring $\approx$ 40' long, crack $\approx$ 1' down, worst 90° $\approx$270° crack

happened @ Oyster Creek, were replaced

3/27 2:53p.m.

- By looking in viewing ports, no others seen
  pulling manways
  ≈ 15 dpm

- Charles Rossi 4924944
- GE and MPR evaluating repair
  - O.C. early in plant life ≈ 1970
  - Big Rock Point ← repair by rolling CRD housing against RV bottom head
  - Spanish BWR - 1981 (Nuclenor) 250°F around J-weld (top)

3/28 - suspect area 14-11

- Oyster Creek found 9/67 prior to initial crit., weld overlay of surface cracks
- Big Rock Pt. A/79, tube roll technique for repair
- Spanish Plant
  Ultrasonic technique to examine stub tube from inside

- core ≈ 60% off loaded, will completely defuel

3/28 - at least 4 housings indicate rust (100% sample not complete)

- 5 incident, most recent Big Rk Pt (A/79) Consumers Power
  Safety Evaluation & repair method available
  Teledyne analysis
  UT from inside (GE)

301-492-9630 -W. (Joe) Collins

3/29. ACRS Al Igne ACRS tech. support

4/2, (J. Durr) Hydro to ident. lk. areas
UT/visual inside tubes
don't want to depend on rod catcher

PRIORITY ATTENTION REQUIRED   MORNING REPORT - REGION I   PRIORITY ATTENTION REQUIRED

DATE 3/30/84

TO: James Blaha, Chief, Program Support Branch, IE
FROM: Thomas E. Murley, Regional Administrator, Region I

Licensee/Facility	Notification/Subject	Description of Items or Events
Shoreham 50-322	Emergency Diesel Generator Update	EDG-101: Engine reassembly is in progress. Snow storm impact on craft availability may delay April 2, 1984, scheduled reassembly completion date. EDG-102: Reinspection of cylinder liner landing area cracks revealed no growth in these cracks from completion of the 100 starts testing. Two apparently new cracks, barely visible using dye penetrants, were recorded at cylinder nos. 1 and 3 in the liner landing area. EDG-103: Cylinder head reinstallation continues in preparation for the 22 hour rated/2 hour overload test.
Nine Mile Point Unit 1 50-220	3/29/84 SRI fax	Status update, inspection of control rod drive (CRD) housing area. In addition to leakage noted at CRD housing position 46-27 noted on 3/27/84, the licensee is examining 4 additional areas, one of which has slight weepage (position 14-11) and three others which have rust on the CRD housing at the housing/reactor vessel transition. The licensee will perform a videotaped inspection of the bottom reactor vessel area on 3/30 with an in-vessel TV camera inspection of selected stub tube welds scheduled for 3/31 - 4/1/84. A mockup demonstration was conducted at the C.E. facility in Chattanooga, Tennessee, on 3/29. The licensee retained a consultant in December 1983, to investigate possible repair methods of stub tube/CRD housing leakage on a contingency basis due to previous experience with their furnace sensitized reactor vessel. Repair methods being discussed at this time include a tube roll technique and possible UT inspection of the stub tube welds. It is projected that repairs will take approximately 5 days and be performed from under the reactor vessel in a radiation field of 30-100 millirem/hr. At this time repairs are estimated to commence in approximately two weeks. The core will be off loaded during the repair. The Region I senior resident is following the licensee's actions on site. NRR has been apprised and is being kept informed as developments occur.
Peach Bottom Unit 3 50-278	3/29 SRI Fax	During the performance of a surveillance test, a short in an indicator light socket caused a blown fuse. As a result, power was lost to logic circuitry which caused the loss of Core Spray System II and the 2 psi drywell start signals to the emergency diesel generators (Nos. 2 and 4). The systems were restored in about 20 minutes and the licensee reported the event in accordance with 50.72.

Region I Form 94
(Rev. June 83)

3/29/84

To: Sam Collins, Chief, RPS-2C

From: Steve Hudson, SRI, Nine Mile Point, Unit 1

Subj: Repair / Inspection of CRD Stub Tubes

1. Background
   - (a) CRD 46-27 leaking 15 dpm.
   - (b) CRD 14-11 has very slight weep and rust on the CRD housing under the vessel.
   - (c) 3 other CRD's have rust on their housings joint under the vessel

2. Inspection
   - (a) The area above the reactor vessel lower head insulation where the CRD penetrates the vessel has not been routinely inspected since initial plant start-up.
   - (b) A complete video taped inspection above the reactor vessel insulation to be performed 3/30/84
   - (c) An in-vessel TV camera inspection of selected stub tubes welds to be performed 3/31 - 4/1/84.
   - (d) Licensee still investigating UT inspection of stub tubes.

(3) Repair

(a) Contingency package with MPR Associates/ Combustion Engineering since Dec. 83

(b) Primary choice - roll repair
Was successful at Big Rock Point, Apr 1979

(c) Licensee to examine a mock-up today at C.E. facility in Chattanooga

(d) Repair will take ≈ 5 days. Performed from under the vessel.

(e) Radiation level near CRD flanges ≈ 75-100 mr/hr
general area under the vessel 30-40 mr/hr.

(f) Expect to start repair in 2 weeks ≈ 4/13/84

(g) Other techniques (either internal or external seals are being evaluated)

(h) Licensee has not yet determined how many tubes need to be repaired

(i) The core will be off-loaded during the repair

REGION I DUTY OFFICER LOG

DUTY OFFICER: Ebe McCabe

DATE	TIME	LOG
3/27	0944	HQDO called. Maine Yankee potential tampering concern. The licensee informed the HQDO that the open breaker was an accidental situation, & that the resident had agreed with that.
	1219	HQDO called. 9 Mile reported a 50.72 event occurring @ 1030. 4-hr. report. Control Rod 46-27 stub tube housing leaking 15 drops/min where housing penetrates vessel. Found during ISI. Resident GE engineer notified. GE will repair. MPR will consult. No releases. No contamination problem. (MPR: Engineering consultant) SEE ME Harry

SIGNATURE

REGION I Form 226
(July 83)

4/13/84

Facility: NMP-1

Subject: Examination of CRD Housings

Phonecon participants:

J. Durr — T. Hawksley

R. Hermann — R. Pasternak

- Discussed the licensee's forthcoming ultrasonic examination of the J-weld on the CRD housing to stub tube. This exam is to show that IGSCC has not degraded this pressure boundary weld.

- Exams to take 4-6 hours per weld.
- Exams to begin on or about Sunday
- Licensee to conference call with above participants on Monday at 11:00 to discuss preliminary results.
- Licensee is doing "L" and "S" wave exams.
- Trying to locate baseline data (L-wave)

J. Durr

CC: Ebneter
Collins
McBrearty
Gray

Facility: NHP-1 4/16/84

Subject: CRD Housing Exams

The licensee agreed to perform UT exams of the CRD housings after discovering cracks in the stub tubes. The exams were made in the area of the J-welds, stub tube to CRD housing. These exams were made to determine if there has been any degradation of the J-weld heat affected zone of the housing.

Nine housings were removed and eight of the nine UT inspected. CE used 0° and 45° searches employing a 2.25 MHz, ½" φ transducer calibrated on 10% OD and ID notches. The search is made 360° and advanced axially ~.1" after each scan. No indications have been noted.

Roller expansion of the stub tubes will take approximately 5 days (1 per shift).

J. Durr

CC: Ebneter
McBrearty
Collins

NIRS

Nuclear Information and Resource Service
1346 Connecticut Avenue NW, 4th Floor, Washington, D.C. 20036 (202) 296-7552

April 24, 1984

FREEDOM OF INFORMATION ACT REQUEST
FOIA-84-318
Rec'd 4-27-84

Director
Office of Adminstration
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

FREEDOM OF INFORMATION ACT REQUEST

To whom it may concern:

Pursuant to the Freedom of Information Act, 5 U.S.C. 522, as amended, the Nuclear Information and Resource Service requests the following documents regarding the recent discovery of failure of the furnace-sensitized stub tubes at Nine Mile Point-1. Please consider "documents" to include reports, studies, test results, correspondence, memoranda, meeting notes,meeting minutes, working papers, graphs, charts, diagrams, notes and summaries of conversations and interviews, computer records, and any other forms of written communication, including internal NRC Staff memoranda. The documents are specifically requested from, but not limited to, the Office of Inspection and Enforcement (I&E); Office of Nuclear Regulatory Research (Research); Office of Nuclear Reactor Regulation (NRR); Generic Issues Branch of the Division of Safety Technology, NRR; and the Operating Reactors Branches of the Division of Licensing. In your response, please identify which documents correspond to which requests below.

Pursuant to this request, please provide all documents prepared or utilized by, in the possession of, or routed through the NRC related to:

1. The recent failure (cracking) of furnace-sensitized stub tubes at the Nine Mile Point-1 plant (including staff evaluations of licensee justifications for limiting the inspection and repair efforts);

2. The repair of cracked stub tubes at the Oyster Creek and Big Rock Point plants;

3. The failure of stub tubes at the Nucleonor reactor in Spain;

In our opinion, it is appropriate in this case for you to waive copying and search charges, pursuant to 5 U.S.C.

~~8412120236~~

552(a)(4)(A) "because furnishing the information can be considered as primarily benefiting the general public." The Nuclear Information and Resource Service is a non-profit organization serving local organizations concerned about nuclear power and providing information to the general public.

Sincerely,

Nina Bell
Nuclear Safety Analyst

cc: File