STP Nuclear Operating Company

South Texas Project Electric Generating Station P.O. Box 289 Wadsworth, Texas 77483

May 12, 2003
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10CFR50

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852

South Texas Project
Units 1 & 2
Docket Nos. STN 50-498, STN 50-499
Responses to NRC Questions Regarding
Bottom Mounted Instrumentation Penetration Indications

On April 17, 2003, STP and the NRC held a conference call in which STP briefed the NRC about the status of the STP's investigation of the STP Unit 1 Bottom Mounted Instrumentation (BMI) penetration indications and STP's plans for further action. On May 1, 2003, STP met with the NRC at the NRC's offices in Rockville, Md. In the meeting, STP provided an overview of the BMI indications and briefed the NRC regarding STP's plans for non-destructive examination (NDE) and potential repair options. The NRC participants asked a number of questions during these interactions. The attachment to this submittal addresses those questions.

This letter is part of STP's ongoing commitment to keep the NRC informed as we work to resolve this issue. Additional detail on several of the topics covered in the attachment will be provided or made available for inspection, as appropriate, when the associated engineering, design, or analysis are completed. STP is currently developing a planned schedule for these deliverables.

Please call me at (361) 972-7206 or Steve Thomas at (361) 972-7162 if you have any questions.

M. A. McBurnett
Manager,
Quality and Licensing

Awh

Attachment: Responses to NRC Questions

cc:
(paper copy)

Ellis W. Merschoff
Regional Administrator, Region IV
U.S. Nuclear Regulatory Commission
611 Ryan Plaza Drive, Suite 400
Arlington, Texas 76011-8064

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852

Richard A. Ratliff
Bureau of Radiation Control
Texas Department of Health
1100 West 49th Street
Austin, TX 78756-3189

Cornelius F. O'Keefe
U. S. Nuclear Regulatory Commission
P. O. Box 289, Mail Code: MN116
Wadsworth, TX 77483

C. M. Canady
City of Austin
Electric Utility Department
721 Barton Springs Road
Austin, TX 78704

(electronic copy)

A. H. Gutterman, Esquire
Morgan, Lewis & Bockius LLP

L. D. Blaylock
City Public Service

Mohan C. Thadani
U. S. Nuclear Regulatory Commission

R. L. Balcom
Texas Genco, LP

A. Ramirez
City of Austin

C. A. Johnson
AEP Texas Central Company

Jon C. Wood
Matthews & Branscomb

Responses to NRC Questions

Questions from April 17, 2003 Conference Call:

1. What is the sample age and the confidence in its determination?

   Response:

   The average age of the samples indicates an average age of approximately 3.5 to 5 years for the deposit on Penetration #46 and an average age of approximately 3 to 4.5 years for the deposit on Penetration #1. The confidence in the cesium analysis is very high with a confidence interval of 95% (2 sigma). The analytical uncertainty is less than five percent for analysis of both isotopes in both samples.

   The error in the age estimation is much higher due to the uncertainties associated with this type of estimation. The sample collected is not likely an accurate representation of all the material present due to the likelihood of additional deposit in the annulus. Also the deposition could have occurred at different rates over time. In addition the cesium activity (not the ratio) present in the RCS can vary widely (factor of 100) over time so a small amount of relatively high cesium activity could mask periods of leakage with lower activity coolant. All of these factors will affect the dating of these deposits so the results of this dating should be used in a relative sense only.

2. What would be the effect of a mechanical nozzle seal assembly (MNSA) clamp on an axial crack? Could it cause it to become circumferential?

   Response:

   The MNSA clamp could stress an axial crack; however, STP has determined that the clamp will not be used as the repair method. STP will address the effect of a MNSA clamp on cracking should it be decided that a MNSA clamp will be used.

3. STP should develop a failure modes and effects analysis (FMEA) for failure of a penetration.

   Response:

   STP has modified a draft Material Reliability Program (MRP) Failure Modes and Effects Analysis (FMEA) provided by EPRI. The draft FMEA was originally constructed for through-wall flaws in Control Rod Drive Mechanism (CRDM) penetrations in the reactor upper head. The FMEA was modified to fit the specific configuration of the bottom head instrument penetrations.

   The modified FMEA is the basis for a logic template comparing possible failure scenarios with our NDE program and ultimate repairs. The intent is to ensure selected repair methods not only include identified defects but also cover credible defects that may not be discernable by non-destructive examination.

4. The FMEA needs to address how STP would eventually recover from a "perpetual ECCS" condition.

   Response:

   STP's preliminary assessment is that the largest leak path area is the ID of the penetration, or 0.6". This leak path area does not account for the likely presence of the 0.385" OD thimble tube in the penetration which would further reduce the leak area. More rigorous failure analyses will be performed to better define the potential break size.

   Flow through the 0.6" break is greater than the charging system make up capability. Consequently, an SI actuation and reactor trip would be expected. Preliminary STP evaluations indicate core uncovery would not occur and the 10CFR50.46 criteria would be satisfied.

   After the RCS is cooled down and depressurized, RCS inventory control would be transferred to normal charging, and decay heat removal via RHR.

   RCS inventory loss through this opening would result in a substantial amount of RCS inventory on the containment floor which would flow to the sumps. The flow rate would be reduced as the RCS was depressurized, eventually becoming only a few gallons per minute with the RCS at atmospheric pressure. The plant would be stable and there would be adequate time to assess the condition and develop procedures to process water from containment to enable access to the vessel bottom for inspection and evaluation for temporary repair of the leak. After the temporary leak repair is in place, it is expected that the core would be defueled to facilitate a permanant repair method.

   This recovery scenario is no different in concept from any other RCS break that occurs below the point of inventory injection.

5. The FMEA needs to address the potential for flooding equipment, particularly RHR.

   Response:

   The current flooding analysis bounds the break described above and shows RHR or other equipment important to safety will not be impacted by flooding.

6. Please assess the effectiveness of the stress relief of the J-groove weld residual stresses

   Response:

   An outline of fabrication steps and a copy of fabrication documentation was received from Westinghouse for the bottom head assembly. The fabrication sequence is described in more detail in the response to Question 10.

Based on the above fabrication sequence, the J-groove welds joining the BMI nozzles to the buttered J-groove weld preps were not subjected to elevated post weld heat treatment and therefore were not relieved of any welding stresses. This was a standard fabrication sequence/practice for installing the BMI nozzles in Westinghouse supplied reactor vessels fabricated by Combustion Engineering.

7. What is the effect on the penetration gap of the differential expansion of the penetration and the RPV? Would it affect how leakage manifests itself?

<u>Response:</u>

Based on CRDM head penetrations analysis performed in the industry, the designed free gap of the bottom mounted penetration assemblies may open further upon the deflection of the bottom head with RCS pressurization at normal operating temperature and pressure. Recent ASME code mean thermal growth properties are very similar for the carbon steel SA 533 Gr. B Cl.1 and the SB-166 BMI penetrations in the temperature range 70°F up to 600°F (ASME Section II 2001 Edition Part D[1]). The STP design cold leg temperature is 560°F so no differential thermal growth is expected. STP is pursuing reactor vessel specific bottom head gap and leak analysis and will continue to keep the NRC informed of these results upon completion.

8. Please describe how many of the access hatches around the BMI penetrations were opened in past inspections.

<u>Response:</u>

On 4/12/03, three access panels were opened to inspect the BMI penetrations. The three panels are approximately 120 degrees apart. Previous inspections for Unit 1 since 1992 used two panels approximately 180 degrees apart for the inspection.

<u>Inspection History</u>: Visual inspections of BMI penetrations are performed as part of the Boric Acid Corrosion Control Program, "0PGP03-ZE-0033", at the beginning of each refueling outage and selected forced outages. As of 2RE09, this inspection is also being conducted as part of the 0PSP15-RC-0015 surveillance at the end of each outage.

<u>Inspection Process</u>: During the inspection, insulation inspection panels are removed to provide visual access to the bottom of the vessel. Examination from two panels 180° apart provides visual access to all 58 penetrations. However, examination from three panels, 120° apart provides better coverage of each penetration. The panels overlap so that every other panel of the 12 removable panels is relatively easy to remove.

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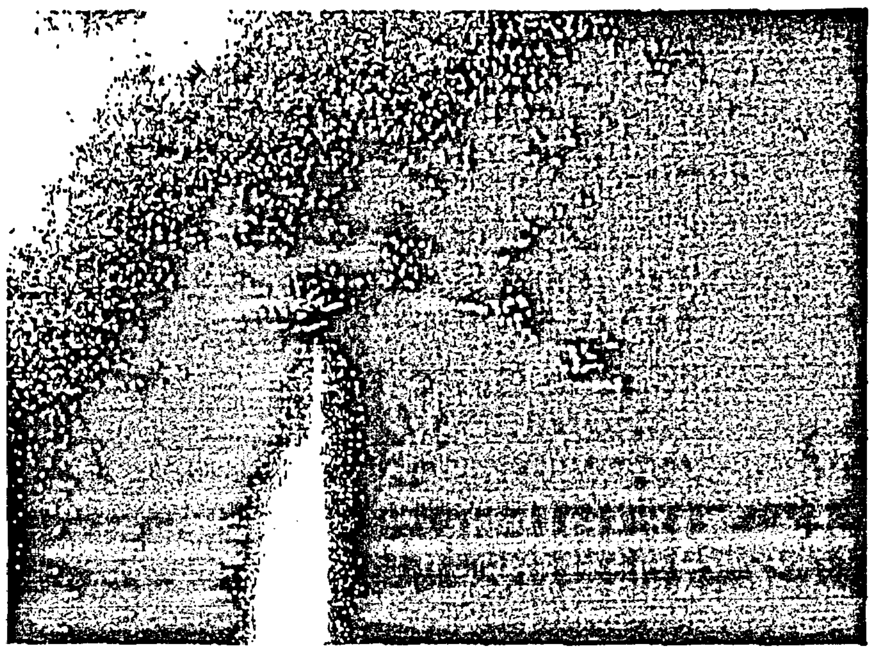
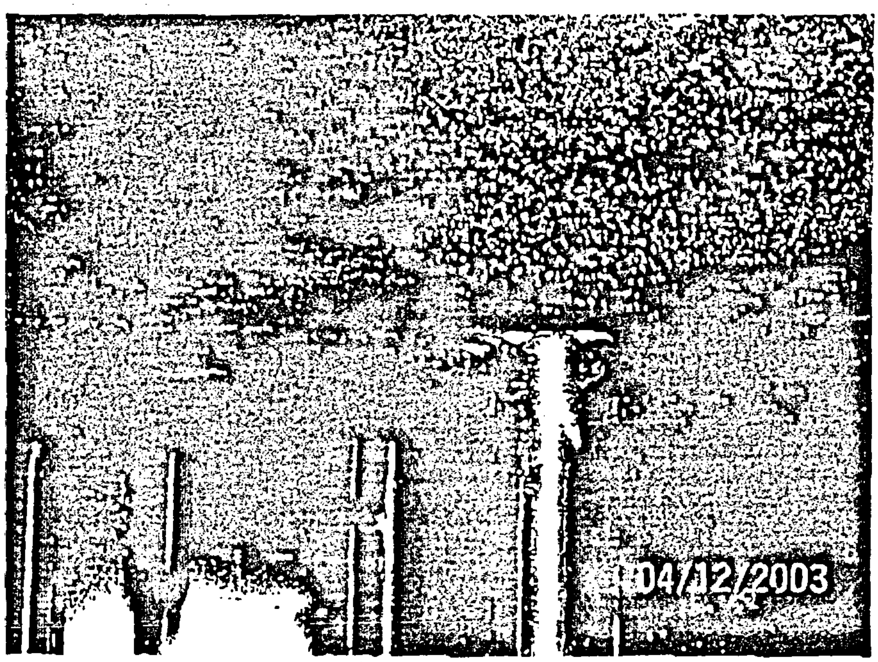
[1] Page 288 SA-533B line 36 defines material as Mn-1/2 Mo-1/2 Ni
Page 653 notes to table TE-1 defines Mn-1/2 Mo-1/2 Ni as Group(2) alloy
Page 648 Group (2) mean coefficient of thermal expansion 7.8E-06 for the temperature range of 70°F to 600°F
Page 366 gives SB-166 alloy number as N06600
Page 657 table TE-4 for N06600 gives a mean coefficient of thermal expansion B=7.8E-06 for the temperature range of 70°F to 600°F

Inspection Results: No indications of leakage were identified prior to the 04/12/03 Unit 1 observation of leakage indications.

9. Please explain the apparent groove or gap in the photograph of Penetration 1.

There is no groove or gap. A closeup photo from a video taken after the residue was removed shows a better view of Penetration 1. The penetration openings are chamfered. This photograph shows that the chamfer is still clearly defined. A photograph of Penetration 1 prior to cleaning is provided for comparison.





10. Is the manufacturing process for the STP penetrations the standard process for the industry?

<u>Response:</u>

An outline of fabrication steps and a copy of fabrication documentation was received from Westinghouse for the bottom head assembly.
The fabrication sequence provided by Westinghouse is standard for Westinghouse supplied reactor vessels manufactured by Combustion Engineering.

Fabrication Steps For The STP-1 Bottom Head BMIs:

- Form bottom head dome
- Form and weld long seams for bottom head torus
- Post-weld heat treat (PWHT) bottom head torus
- Weld girth seam between bottom head dome and torus
- PWHT bottom head assembly
- Clad ID of bottom head assembly
- PWHT bottom head assembly
- Set up and drill BMI pilot holes
- Cut base metal J-Preps using drill press and hand working
- Deposit first layer of buttering; grind as necessary and PT
- Deposit second layer of buttering
- Extend preheat on bottom head assembly
- Liquid penetrant examine (PT) final surface of buttering
- Weld bottom head assembly to completed lower shell assembly
- PWHT lower vessel assembly
- Final bore BMI penetrations
- Install BMI tubes in penetrations
- Tack weld tubes to J-Prep
- Deposit root pass of J-Weld, grind as necessary and PT
- Deposit first ½" of J-Weld, grind as necessary and PT last layer
- Cold straighten tubes as required to maintain perpendicularity
- Deposit remaining J-Weld, grind each layer as necessary, grind final contour and PT (Note: If this operation exceeded ½" in thickness, an additional PT was required for each ½" layer)
- Cold straighten tubes as required to maintain perpendicularity
- Weld completed lower vessel assembly to completed upper vessel assembly
- Local PWHT closing girth (Note: BMI penetrations did not see this PWHT since they were not contained in the local furnace)
- Set up vessel for hydro, check straightness of BMI tubes and cold straighten tubes as required to maintain perpendicularity

Note: Some of the PWHT steps may have actually been an extended preheat operation instead of actually going to the furnace; however, the one for the completed lower vessel assembly was in the furnace

Questions from May 1, 2003 Meeting:

11. Provide J-groove weld dimensions

    Response:

    See attached diagrams.

12. What welding process was used on the J-groove relative to how stress and alignment were controlled by the welding process?

    Response:

    The shielded metal arc welding (SMAW) process was used to deposit two layers of buttering with ENiCrFe-3. The minimum required buttering thickness was .130".
    A Bulls Eye level was used to check nozzle alignment throughout the J-groove welding operation. The SMAW process was used to make the J-groove weld with ENiCrFe-3. After depositing ½ of the J-groove weld, the nozzles were checked for alignment and, if required, were cold straightened. The nozzles were then welded out, ground to contour, checked for alignment, and if necessary, were cold straightened. Nozzle alignment was again checked after up-ending the vessel for hydro and, if necessary, the nozzles were cold straightened. The shop traveler specifies an allowance to cold straighten the nozzles at the points identified above. The traveler does not require recording of data related to cold straightening and does not provide information as to which nozzles were cold straightened.

13. What will the capability be for NDE of the repair?

    Response:

    The NDE for the repair will meet the ASME Section XI requirements, which is a surface examination. The partial penetration J-groove weld is configured for strength and minimization of stress intensification. Reconfiguring the weld to facilitate volumetric examination is not feasible. Having the weld on the outside of the vessel will, however, allow for future visual and surface examinations, if required.

14. NRC will expect a detailed analysis of moving the pressure boundary from inside the vessel to outside.

    Response:

    STP's analysis will assure that all pertinent ASME Code requirements are met. STP will provide the NRC with a description of the analyses and the results in support of the relief requests that are anticipated to be needed.

15. NRC requested detail on the analysis of the expansion of the vessel and opening of the penetrations during pressurization.

Response:

STP will provide the results of this analysis prior to restarting from this shutdown.

16. Please provide a detailed description of the fabrication and straightening process.

Response:

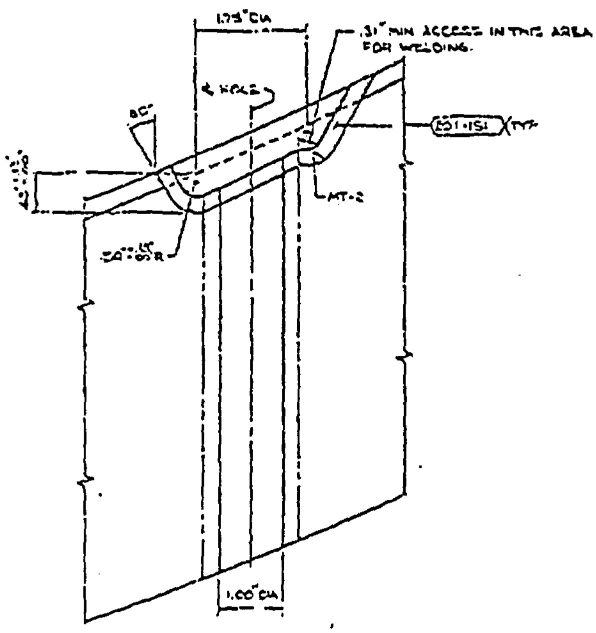
See the response to Question 10.

17. What are the loose parts implications of the repair?

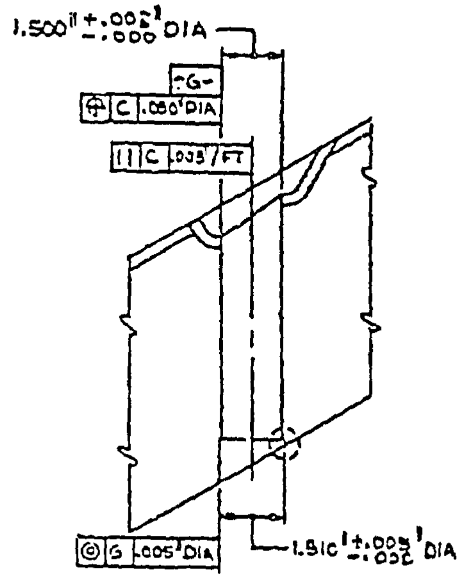
Response:

The only failures that have the potential to generate loose parts at the BMI penetration occur at or above the J-groove weld. STP plans to use the half-nozzle repair, which eliminates the direct connection to that upper part of the penetration. Overall, the selected repair method will have essentially no effect on the susceptibility of the current design for the generation of loose parts.

STP BMI J-groove weld dimensions from Question 11.



STP BMI Generic J-Groove Configuration



STP BMI Generic J-Groove Configuration (Final)