October 10, 2001

MEMORANDUM TO: ACRS Members

FROM: Noel Dudley, Senior Staff Engineer
ACRS\ACNW

SUBJECT: CERTIFICATION OF THE MINUTES OF THE ACRS SUBCOMMITTEE MEETING ON MATERIALS AND METALLURGY CONCERNING THE STEAM GENERATOR ACTION PLAN, SEPTEMBER 26, 2001-ROCKVILLE, MARYLAND

The minutes of the subject meeting, issued on October 4, 2001, have been certified as the official record of the proceedings of that meeting. A copy of the certified minutes is attached.

Attachment: As stated

cc: Technical Support Branch
Operations Support Branch (3 copies)

cc via e-mail:
J. Larkins
S. Bahadur
ACRS Fellows and Technical Staff
E. Barnard

Issued: 10/4/01
Certified: 10/5/01

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
MINUTES OF SUBCOMMITTEE MEETING ON
MATERIALS AND METALLURGY
THE STEAM GENERATOR ACTION PLAN
SEPTEMBER 26, 2001
ROCKVILLE, MARYLAND

The ACRS Subcommittee on Materials and Metallurgy met on September 26, 2001, to hold discussions with the NRC staff concerning the Steam Generator Action Plan, including issues related to the differing professional opinion and South Texas Unit 2 steam generator leakage issues. The entire meeting was open to public attendance. Mr. Noel Dudley was the cognizant ACRS staff engineer for this meeting. The meeting was convened at 8:30 a.m. and adjourned at 12:30 p.m.

ATTENDEES

ACRS

P. Ford, Chairman
W. Shack, Vice Chairman
M. Bonaca, Member
T. Kress, Member
J. Sieber, Member
D. Powers, Member
N. Dudley, ACRS Staff

NRC REPRESENTATIVES
W. Bateman, NRR
E. Sullivan, NRR
E. Murphy, NRR
M. Banerjee, NRR
C. Boyd, RES
K. Karwoski, RES
J. Muscara, RES
C. Tinkler, RES
S. Bajorek, RES

NUCLEAR ENERGY INSTITUTE
James Riley, NEI

There were no written comments or requests for time to make oral statements received from members of the public. No members of the public attended the meeting. Approximately 4 members of the public attended the meeting. A list of meeting attendees is available in the ACRS office files.

INTRODUCTION

Dr. F. Peter Ford, Chairman of the Materials and Metallurgy Subcommittee, stated that the purpose of the meeting was to gather information regarding the status of the Steam Generator Action Plan and the South Texas, Unit 2, steam generator tube leakage issue. Dr. Ford noted that the staff issued the Steam Generator Action plan on November 16, 2000 and updated the Plan on May 11, 2001 to include items associated with the differing professional opinion (DPO) associated with steam generator tube integrity. He called upon Mr. Edmund Sullivan, Jr., Office of Nuclear Reactor Regulation (NRR), to begin.

STATUS OF THE STEAM GENERATOR ACTION PLAN

Mr. Edmund Sullivan, Jr., NRR, introduced the staff's presentation. Ms. Maitri Banerjee, NRR, presented an overview of the recent history of the Steam Generator Action Plan. She described the purpose, scope, and status of the Plan. Ms. Banerjee identified the following items as Steam Generator Action Plan significant activities:

- issue a regulatory issues summary on the lessons learned;
- provide guidance for NRC inspectors;
- consider steam generator performance indicators;
- provide guidance for reviewing steam generator tube inspection results;
- hold a steam generator workshop with stakeholders;
- provide guidance for license amendment reviews;
- prepare a safety evaluation for the latest revision of NEI 97-06;
- develop milestones for activities addressing ACRS recommendations on DPO issues;
- develop milestones for resolving GSI 163, GSI 188, and DG-1073; and
- establish a Steam Generator Action Plan web page.

Ms. Banerjee described how the resolution of the Steam Generator Action Plan items would be managed.

Mr. Sullivan provided background information concerning the staff's initiative to revise the regulatory framework for steam generator tube inspections and repairs. He presented an overview of the development of the Nuclear Energy Institute's (NEI) steam generator generic change package, which includes revised technical specifications and new administrative technical specifications. Mr. Sullivan explained that licensees are developing steam generator inspection programs in accordance with NEI 97-06, "Steam Generator Program Guidelines." He noted that NEI 97-06 references sub-tier Electric Power Research Institute (EPRI) guideline documents, which the staff had not intended to review.

Mr. Sullivan explained that in response to the NEI's proposal to extend the interval for steam generator tube inspections to 22 EFPY, the staff reviewed portions of the EPRI guidelines that are critical to the effectiveness of condition monitoring. During its review, the staff identified a number of issues related to industry practices. Mr. Sullivan concluded that the staff can proceed with its review of the generic change package provided appropriate regulatory restrictions are maintained on the length of the inspection interval. He outlined the milestones necessary for the staff to complete its review of the generic change package.

The Subcommittee members and the staff discussed why the staff review of NEI 97-06 was put on hold and why the target dates were slipping.

Dr. Powers, ACRS, questioned why the staff decided not to include a performance indicator for steam generator integrity, given that steam generator tube ruptures are risk dominate at most plants. The staff explained that three performance indicators were considered. The staff rejected the proposed performance indicators associated with tube degradation assessments and condition monitoring since these indicators would not provide early indication of loss of tube integrity. The staff rejected the proposed performance indicator for primary to secondary leakage since it was a continuously monitored parameter that had no correlation to risk.

Mr. Sieber, ACRS, stated that steam generator tube integrity is a measurable quantity and that exceeding the performance criteria will not result in an off-site release. Mr. Emmett Murphy, NRR, replied that exceeding the structural integrity performance criteria could result in exceeding a risk thresholds, which would be unacceptable.

The Subcommittee members and the staff discussed the following aspects of the administrative technical specifications:

- establishing performance criteria,
- identifying defects,
- determining crack growth rate,
- staff control over licensees' selection of tubes to be pulled, and
- required actions when the condition monitoring results exceed the operational assessment predictions.

The Subcommittee members and the staff discussed long term protocols, such as, the basis for extending the inspection frequency for new materials like 690 stainless steel and the inability of some licensees to incorporate industry experience into their programs. They also discussed when the staff's review of NEI 97-06 would be provided to the ACRS for its review.

SOUTH TEXAS UNIT 2 STEAM GENERATORS

Mr. Kenneth Karwoski , NRR, described the steam generator design and operating experience at South Texas, Unit 2. He summarized the implementation of the voltage-based repair criteria at South Texas Unit 2 and described the license's actions in response to steam generator tube operation leakage. Mr. Karwoski presented a comparison of the number of predicted and observed indications of tube defects over the last three operating cycles. He concluded by explaining the staff's activities and noting that the steam generators are scheduled for replacement in December 2002.

The Subcommittee members and Mr. Karwoski discussed the difference between carbon and stainless steel tube support plates, the reliability of burst technology, the use of the 3 volt alternate repair criteria, the probability of detection of tube defects, and use of average growth rates in the operational assessment.

RESPONSE TO ACRS RECOMMENDATIONS

Mr. Karwoski addressed the ACRS recommendation that the 7/8" tube leakage database needs to be greatly improved to be useful. He agreed with the ACRS recommendation and noted that licensees had committed to periodically remove tubes for destructive examination. He conceded, however, that there were no regulatory requirements to force licensees to remove additional tubes beyond their present commitments.

In response to Subcommittee members' questions, Mr. Karwoski explained that the voltage-based correlation for 7/8" tubes is not improving as additional data is added the database. He speculated that if the correlation did not improve the staff may have to conclude that the probability of tube leakage is independent of voltage readings.

Mr. Karwoski addressed the ACRS recommendation that the staff establish a program to monitor the prediction of flaw growth for systematic deviations from expectations. He explained that the staff will continue to review licensees' 90 day reports and is formalizing its review of inspection summary reports.

Dr. Joseph Muscara, RES, addressed the ACRS recommendation concerning crack propagation in steam generator tubes from pressure and main steamline-break loads. He described the planned calculations and analyses, which are intended to estimate what loads would be required to propagated a range of axial and circumferential cracks. He explained that the staff would conduct tests of degraded tubes under pressure to validate the analytical results. In response to questions, Dr. Muscara explained that the test results would be used to validate and not develop the calculational model.

Dr. Muscara addressed the ACRS recommendation for evaluating damage progression via jet cutting. He presented initial test results that indicated low erosion rates. Dr. Muscara indicated that the testing would be completed and draft reports would be available at the end of December 2001.

Dr. Muscara addressed the ACRS recommendation concerning use of a constant probability of detection. He presented the result of round robin tests at the Argonne National Laboratory mockup. Complete analysis and documented research results from the round robin will be available at the end of December 2001.

Dr. Ford, ACRS, questioned how the staff correlated crack growth rates that are linear to those that are non-linear over time. He also stated that voltage and crack growth are not related. Dr. Muscara agreed that there are problems associated with measuring crack growth rates. He noted that better measurement techniques are being developed in the laboratory but that it will be years before these techniques are available for use in the field.

Dr. Muscara addressed the ACRS recommendation concerning developing a better understanding of stress corrosion cracking. He presented plans to conduct tests and described the use of these test results and operating experience to develop models for predicting cracking behavior of steam generator tubes in operating environments.

Mr. Charles Tinkler, RES, addressed the ACRS recommendation concerning the development of a better understanding of the behavior of degraded steam generator tubes under severe accident conditions. He identified the analytic codes and data that the staff plans to use in its research efforts. He listed the severe accident issues to be analyzed and indicated whether the issues would be evaluated using analyses, test results, or both.

Mr. Stephen M. Bajorek, RES, addressed the DPO contentions concerning the effect of blowdown forces caused by the depressurization of the reactor coolant system during a main steamline break and the affect of tube support plate lift during a steam generator depressurization. He presented the background and evaluation plan associated with these concerns.

Mr. Christopher Boyd presented his analysis of steam generator inlet plenum mixing using computational fluid dynamics (CFD). He summarized the background and advantages of CFD

and showed qualitative and quantitative results of inlet mixing predicted by CFD. Mr. Boyd explained that the CDF predictions of parameters are generally within experimental uncertainty of experimental data. He concluded by summarizing the staff's plans for further analysis of mixing in the inlet plenum during main steamline breaks.

SUBCOMMITTEE COMMENTS, CONCERNS, AND RECOMMENDATIONS

None.

STAFF AND INDUSTRY COMMITMENTS

None.

SUBCOMMITTEE DECISIONS

The Subcommittee requested that the staff present at the October 4, 2001 ACRS meeting, an abbreviated version of its presentation concerning research programs that address ACRS recommendations related to DPO issues.

FOLLOW-UP ACTIONS

The Subcommittee requested the opportunity to review and comment on the staff's assessment of the revised NEI 97-06 when it becomes available.

PRESENTATION SLIDES AND HANDOUTS PROVIDED DURING THE MEETING

The presentation slides and handouts used during the meeting are available in the ACRS office files or as attachments to the transcript.

BACKGROUND MATERIAL PROVIDED TO THE SUBCOMMITTEE:

1. NRR Director's Quarterly Status Report on Generic Activities, Action Plans, and Generic Communication and Compliance Activities, dated April 5, 2001, "Steam Generators," pp. 5-23.
2. Memorandum dated May 11, 2001, from Samuel Collins, Director NRR, and Ashok Thadani, Director RES, to William D. Travers, Executive Director for Operations, NRC, Subject: Steam Generator Action Plan Revision to Address Differing Professional Opinion on Steam Generator Tube Integrity.
3. Memorandum dated March 23, 2001, from John A. Zwolinski, NRR, et. al., to Brian Sheron and R. William Borchardt, NRR, Subject: Steam Generator Action Plan Revision and Completion of Items Nos. 1.1, 1.2, 1.3, 1.4, 1.7, 1.8, 1.15, 2.1 and 2.2.
4. Memorandum dated November 16, 2000, from Brian Sheron and Jon Johnson, NRR, to Samuel Collins, Director NRR, Subject: Steam Generator Action Plan.
5. Memorandum from dated April 30, 2001, from Jack Strosnider, NRR, to Brian Sheron and Jon Johnson, NRR, Subject: Steam Generator Action Plan Item 1.11A – Review and Revise the Baseline Inspection Program Related to Steam Generator Inspections.
6. Memorandum from dated April 30, 2001, from Jack Strosnider, NRR, to Brian Sheron and Jon Johnson, NRR, Subject: Steam Generator Review Guidance (milestones 1.10 and 1.12).

7. Memorandum dated April 12, 2001, from John A. Zwolinski, NRR, et. al., to Brian Sheron and R. William Borchardt, NRR, Subject: Steam Generator Action Plan Item No. 2.3.
8. Memorandum dated April 3, 2001, from Bruce Boger, NRR, to Brian Sheron and R. William Borchardt, NRR, Subject: Steam Generator Action Plan Revision and Completion of Item Nos. 2.4 and 2.5.
9. Memorandum dated March 30, 2001 from Jack Strosnider, NRR, to Brian Sheron and R. William Borchardt, NRR, Subject: Steam Generator Action Plan Item 1.9 – Guidance to Inspectors Overseeing Facilities with Known Steam Generator Tube Leakage.
10. Memorandum dated June 1, 2001, from William D. Travers, Executive Director for Operations, to Chairman Meserve, NRC, Subject: Differing Professional Opinion on Steam Generator Tube Integrity Issues.
11. Memorandum dated June 24, 2001, from J. Hopenfeld, RES, to the Commissioners, Subject: Differing Professional Opinion Steam Tube Integrity Issues.
12. Memorandum dated March 5, 2001, from William D. Travers, Executive Director for Operations, to Joram Hopenfeld, RES, Subject: Differing Professional Opinion on Steam Generator Tube Integrity Issues.
13. Memorandum dated March 5, 2001, from William D. Travers, Executive Director for Operations, to Samuel J. Collins, NRR, and Ashok C. Thadani, RES, Subject: Differing Professional opinion on Steam Generator Tube Integrity.
14. Letter dated February 1, 2001, from D.A. Powers, Chairman, ACRS Ad Hoc Subcommittee, to William D. Travers, Executive Director, Subject: Differing Professional Opinion on Steam Generator Tube Integrity.
15. Letter dated June 28, 2001, from Mark E. Kanavos, South Texas Project Nuclear Operating Company, to Document Control Desk, NRC, Subject: Steam Generator Tube Voltage-Based Repair Criteria 90-Day Report.
16. Letter dated June 7, 2001, from T. J. Jordan, South Texas Project Nuclear Operating Company, to U.S. Nuclear Regulatory Commission Document Control Desk, Subject: Steam Generator Tube Burst and Accident Leakage Information Requested by NRC.
17. South Texas Project, Unit 2, Slides presented at the NRC Meeting April 19, 2001.
18. Meeting Summary dated May 15, 2001, Subject: Summary of Meeting with STPNOC/Westinghouse Regarding Results of Steam Generator Tube Inspections and In Situ Tube Pressure Tests Conducted During End-of-Cycle 8 Refueling Outage for South Texas Project Unit 2.

••

NOTE: Additional details of this meeting can be obtained from a transcript of this meeting available in the NRC Public Document Room, One White Flint North, 11555 Rockville Pike, Rockville, MD, (301) 415-7000, downloading or viewing on the Internet at "http://www.nrc.gov/ACRSACNW," or can be purchased from Neal R. Gross and Co., 1323 Rhode Island Avenue, NW, Washington, D.C. 20005, (202) 234-4433 (Voice), 387-7330 (Fax), e-mail: nrgross@nealgross.com.

••