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ACRS-3057
PDR 8/11/97

CERTIFIED: May 1, 1997
issued: April 28, 1997

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
MINUTES OF ACRS SUBCOMMITTEE MEETING ON
MATERIALS AND METALLURGY
APRIL 15-16, 1997
ROCKVILLE, MARYLAND

The ACRS Materials and Metallurgy Subcommittee held a meeting on April 15-16 1997, at 11545 Rockville Pike, Rockville, Maryland, in Room T-2 B3. The purpose of the meeting was to hold discussions with representatives of the NRC staff and Consumers Energy concerning generic letters associated with steam generator tube inspection techniques, effective use of ultrasonic testing techniques in inservice inspection programs, degradation of steam generator internals, and degradation of reactor vessel head penetrations; and the status of issues related to reactor pressure vessel integrity. 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 1:00 p.m. on April 15 and adjourned at 2:40 p.m. on April 16, 1997.

ATTENDEES:

ACRS

W. Shack, Chairman
T. Kress, Member
R. Seale, Member

NRC STAFF

J. Strosnider, NRR
E. Sullivan, Jr., NRR
R. Hermann, NRR
S. Coffin, NRR
P. Rush, NRR
L. Lois, NRR
G. Carpenter, NRR
A. Lee, NRR
M. Mayfield, RES
J. Muscara, RES
C. Fairbanks, RES
D. Jackson, RES
E. Hackett, RES

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INDUSTRY REPRESENTATIVES

J. Hanson, Consumers Energy
K. Cozens, Nuclear Energy Institute
R. Snuggerud, Consumers Energy
S. Anderson, Westinghouse Electric Corporation

There were no written comments or requests for time to make oral statements received from members of the public. A list of meeting attendees is available in the ACRS office files. Dr. Shack had a conflict of interest regarding steam generator tube inspections, steam generator internals degradation, and inspection of reactor vessel head penetrations. He did not participate in the deliberations on these issues.

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INTRODUCTION:

Dr. William Shack, Materials and Metallurgy Subcommittee Chairman, convened the meeting at 1:00 p.m. on April 15, 1997, explained the purpose of the meeting, and called on Mr. Jack Strosnider, Office of Nuclear Reactor Regulation (NRR), to provide opening comments for the staff. Mr. Strosnider explained the reorganization of the Materials and Chemical Engineering Branch, noted that several important topic would be presented by the staff, and commented on the good cooperation and coordination between the Offices of Nuclear Regulatory Research (RES) and NRR in the area of materials and metallurgy.

PROPOSED GENERIC LETTER REGARDING DEGRADATION OF STEAM GENERATOR INTERNALS - Ms. Stephanie Coffin, NRR

Ms. Coffin stated that the purpose of the proposed generic letter concerning degradation of steam generator internals was to:

- communicate the types of damage found in foreign steam generators,
- emphasize the importance of examining steam generator internals, and
- request information concerning the conditions of steam generator internals.

Ms. Coffin presented information on the damage found in foreign steam generators, the significance of possible events that could result from damaged internals, and the foreign response to the damage. She explained the results of domestic steam generator inspections, the regulatory requirements for conducting inspections, and the information requested by the proposed generic letter. Ms. Coffin summarized the public comments on the proposed generic letter and the staff responses. She concluded that after the generic letter is issued, the industry is expected to provide coordinated industry responses though the vendor owners groups, the Nuclear Energy Institute, or the Electric Power Research Institute. The Subcommittee members and the staff discussed the types of damage identified, the root cause of the degradation, and what the staff will do with the industry responses to the proposed generic letter.

ULTRASONIC INSPECTION RELIABILITY AND PERFORMANCE DEMONSTRATION - Dr. Joseph Muscara, RES

Dr. Muscara presented the research program associated with the evaluation and improvement of nondestructive examination (NDE) reliability for inservice inspections at nuclear power plants. The objective of the program, which began in 1977, was to determine the reliability of ultrasonic inspections, recommend code changes, and formulate improved inservice inspection criteria. The results of the research program indicated that the ASME code prescriptive ultrasonic testing procedures were not providing adequate flow detection reliability. Consequently, during the 1980s the staff, its contractors, and industry developed ASME code, Section XI, Appendices VII and VIII, which require teams to demonstrate acceptable flaw detection capabilities before

performing field inspections. Dr. Muscara explained the Appendix VIII performance demonstration requirements for detection tests and crack-sizing tests, and the acceptance criteria for wrought austenitic stainless steel piping. Dr. Muscara's summary and conclusions included the following points.

- Even as improvements have been made to techniques and procedures, there is a large variability in the performance of NDE systems for similar procedures and equipment used by different inspectors.

- There is a need to qualify NDE systems, through performance demonstrations, to screen poor performers from the qualified pool of NDE systems that are used for inservice inspections.

- The acceptability of missing deep flaws in a passing detection test should be addressed.

- The inclusion of a criterion to the sizing qualification test for the maximum acceptable undersizing of deep flaws, in addition to the root mean square error requirement, should be considered.

The Subcommittee members and the staff discussed the following items:

- code requirements for ultrasonic testing examination of piping,
- development of software to improve inspections,
- differences between foreign and domestic inspection techniques,
- techniques used during round robin tests, and
- European performance demonstrations.

PROPOSED GENERIC LETTER REGARDING ULTRASONIC TESTING IN INSERVICE INSPECTION PROGRAMS - Mr. Robert Hermann, NRR

Mr. Robert Hermann, NRR, presented background information related to the technical and regulatory issues associated with the ultrasonic testing of pipes, feedwater nozzles, and reactor vessels. He explained the performance demonstration methods required by ASME code, Section XI, Appendix VIII. Mr. Hermann provided justification for issuing a generic letter requesting information on how licensees were using Appendix VIII in their inservice inspection programs. The Subcommittee members and the staff discussed the lack of a statistical basis for the performance demonstration acceptance criteria and the different contributors to the performance demonstration pass-fail rates.

PROPOSED GENERIC LETTER REGARDING STEAM GENERATOR TUBE INSPECTION TECHNIQUES - Mr. Phillip Rush, NRR

Mr. Rush explained that eddy current methods are the primary NDE technique for identifying steam generator tube defects. He noted that the technique has large uncertainties and in most cases is not qualified to size defects. Mr. Rush presented the regulatory requirements for controlling special inspection processes and for repairing identified defects. He provided examples of how

some licensees have used questionable inspection practices and noted the lack of information available to the staff concerning the industry steam generator tube inspection programs.

Mr. Rush stated that the purpose of the proposed generic letter concerning steam generator tube inspection techniques was to:

- notify licensees of the importance of using qualified inspection techniques,
- request information on sizing techniques and the basis for those techniques, and
- verify compliance with 10 CFR 50, Appendices A and B, and the technical specifications.

Mr. Rush summarized the public comments on the proposed generic letter and the staff responses. He stated that the generic letter would be issued in May 1997.

The Subcommittee members and the staff discussed the following items:

- how the staff will use the industry responses to the proposed generic letter,
- characterizing and sizing of defects,
- the importance of staff and industry interaction in developing risk-informed and performance-based regulatory criteria,
- the differences between degradation mechanisms found in the different steam generator designs, and
- the use of pulled-tube data to develop statistical bases for alternate repair criteria.

PROPOSED GENERIC LETTER REGARDING DEGRADATION OF REACTOR VESSEL CLOSURE HEAD PENETRATIONS - Mr. C. E. Carpenter, Jr., NRR

Mr. Carpenter presented background information on cracks identified in foreign reactor vessel control rod drive mechanism and other vessel closure head penetrations, and on domestic industry inspection experience. He noted that the nuclear steam supply system vendors have developed susceptibility models for reactor vessel penetrations, but have not submitted the models or the results of analyses to the staff. Mr. Carpenter stated that the purpose of the proposed generic letter was to:

- verify licensee compliance with regulatory requirements,
- determine if an augmented inspection program should be imposed, and
- request information concerning the potential for resin intrusion events.

Mr. Carpenter summarized the public comments on the proposed generic letter and the staff responses. He concluded that vessel head penetration cracking is not an immediate safety concern and that an integrated, long-term licensee program, including periodic inspections and monitoring, is necessary.

The Subcommittee members and the staff discussed the following items:

- other possible vessel inspection techniques besides eddy-current inspections,
- metallurgical structure of the identified cracks,
- the availability of the results of the susceptibility studies performed by owners groups, and
- whether all reactor vessel head penetrations should be inspected.

PALISADES: PRESSURE VESSEL FLUENCE REEVALUATION - Mr. Lambros Lois, NRR

Mr. Lois presented background information on and the staff position regarding a revised reactor vessel fluence analysis submitted by Consumers Energy for the Palisades reactor vessel. The Palisades reactor vessel is calculated to exceed the pressurized thermal shock screening limits prior to the expiration of its license. The licensee revised its fluence analysis based on a reevaluation of four existing surveillance capsules, recalculation of early cycle neutron sources, new geometric and temperature data, cavity dosimetry data, and a new statistical analysis method. The submittal requested a 25 percent reduction of the fluence accepted in the 1993 staff review of the Palisades pressure vessel fluence analysis.

The staff prepared a safety evaluation report (SER) on the licensee submittal. The staff accepted an 8 percent reduction due to the revised physical measurements of the plant. The staff, however, concluded that the licensee's requested 17 percentage reduction based on a reevaluated bias was unacceptable. The bias, which is used in calculating the reactor vessel fluence, is derived from calculations, dosimetry data, and spectral adjustments. The staff evaluation was based on the following concerns:

- no physical explanation for the requested deviations has been provided,
- plant-specific data are inconsistent, and
- spectral least square fitting does not represent a best-estimate value.

The current fluence value allows plant operation till 1999. The 8 percent reduction will allow plant operation through 2003. The Subcommittee members and the staff discussed the location of vessel capsules and the uncertainties associated with the measurement-to-calculation ratio of fluence bias.

DRAFT REGULATORY GUIDE DG-1053,"CALCULATIONAL AND DOSIMETRY METHODS FOR DETERMINING PRESSURE VESSEL NEUTRON FLUENCE" - Ms. Carolyn Fairbanks, NRR

Ms. Fairbanks explained that the purpose of the draft regulatory guide was to provide an acceptable state-of-the-art method for fluence determination and to standardize methodologies for determining vessel fluence. She presented the regulatory requirements for which the regulatory guide was developed, and summarized the schedule for issuance of the regulatory guide. Ms. Fairbanks noted that the present draft of the regulatory guide includes the application of Monte Carlo transport to pressure vessel fluence benchmark problems. The Subcommittee members and the staff discussed the relationship between surveillance capsule data and reactor vessel fluence.

PALISADES REACTOR VESSEL INTEGRITY STATUS - Mr. Jack Hanson, Consumers Energy

Mr. Hanson provided background on the licensee submittal regarding reactor vessel fluence. He presented the options available to Consumers Energy including vessel annealing, materials testing, regulatory guide 1.154 analysis, and early plant shutdown. He identified the location and number of in-vessel and ex-vessel capsules used to generate the fluence data. He noted that Monte Carlo calculations were performed to provide an independent evaluation of vessel fluence.

Mr. Hanson explained the use of the least squares adjustment procedure for calculating a best-estimate value for the measurement-to-calculation ratio of fluence bias. He compared the individual capsule biases for Palisades and the best-estimate bias for Palisades to average biases for other plants. Mr. Hanson concluded that a default conservative value, rather than a best-estimate value, places an undue burden on Consumers Energy.

The Subcommittee members, representatives of Consumers Energy, and the staff discussed the following items:

- types of material used in the dosimetry capsules,
- use of other basis besides fluence to extend plant operations,
- reasons for the 17 percent change in the calculated value for fluence,
- how plant-specific data can be taken into account without averaging,
- how damage to the reactor vessel is derived based on fluence, and
- whether the best-estimate value represents the true fluence.

NUREG-1411, SUPPLEMENT 1, "REACTOR PRESSURE VESSEL STATUS REPORT" - Ms. Andrea Lee, NRR

Ms. Lee explained that NUREG-1511, Supplement 1, "Reactor Pressure Vessel Status Report," incorporated information gathered from licensee responses to Generic Letter (GL) 92-01, Revision 1, Supplement 1, "Reactor Vessel Structural Integrity," and updated the NRC reactor vessel integrity database (RVID). She noted that Babcock & Wilcox and Combustion Engineering have not yet responded to Supplement 1 of the generic letter.

Ms. Lee presented the reasons for issuing the generic letter supplement, summarized the staff generic assessment of pressurized thermal shock based on the new data, and explained the features of the RVID. She stated that some planned staff activities included reviewing new best-estimate chemistry data, resolving discrepancies between the RVID and the industry database, and eventual approval of a database maintained by the industry with oversight from the staff.

Ms. Lee demonstrated the features of the RVID. She stated that the RVID would be made available to the industry and the public. Mr. Strosnider highlighted the magnitude of the industry and staff effort expended in developing the RVID.

DOE REACTOR VESSEL ANNEALING PROJECT UPDATE - Ms. Deborah Jackson, RES

Ms. Jackson presented the objectives and present status of the Department of Energy annealing demonstration project involving the Marble Hill and Midland reactor vessels. She showed and provided commentary on a video tape, which included selected activities associated with the Marble Hill reactor vessel annealing demonstration. Ms. Jackson stated that the demonstration of annealing the Marble Hill vessel with an indirect gas fired heating method was successful. She explained that the annealing of the Midland vessel had been delayed. The Subcommittee members, the staff, and Mr. Hanson, who had observed the vessel annealing demonstration, discussed the associated stress analyses, code cases, and procedures.

SUBCOMMITTEE COMMENTS

Dr. Kress stated that the details contained in the presentations were at the appropriate level. Dr. Seale expressed a desire to work in parallel with the staff in developing technical and policy issues instead of waiting until the issues became intractable. Dr. Kress questioned whether the Committee should review and comment on the staff position related to the reevaluation of reactor vessel fluence. Dr. Seale mentioned that vessel fluence is an interesting case since there are elements of risk in the regulatory decision.

FOLLOWUP ACTIONS

These presentations were provided as information briefings. No followup actions were identified.

SUBCOMMITTEE RECOMMENDATIONS

The Subcommittee decided that immediate Committee followup activities were unwarranted.

BACKGROUND MATERIAL PROVIDED TO THE SUBCOMMITTEE:

1. Memorandum dated December 23, 1996, from Thomas Martin, NRR, to David Meyer, OA, Subject: Notice of Opportunity for Public Comment for a Proposed Generic Communication Regarding Effectiveness of Ultrasonic testing Systems in Inservice Inspection Programs.
2. CRGR presentation slides, "UT Reliability/Performance Demonstration," dated November 19, 1996.
3. Memorandum dated December 23, 1996, from Thomas Martin, NRR, to David Meyer, OA, Subject: Notice of Opportunity for Public Comment for a Proposed Generic Communication Regarding Degradation of Steam Generator Internal.
4. CRGR presentation slides, "Degradation of Steam Generator Internals," dated November 19, 1996.
5. Memorandum dated December 23, 1996, from Thomas Martin, NRR, to David Meyer, OA, Subject: Notice of Opportunity for Public Comment for a Proposed Generic Communication Regarding Steam Generator Tube Inspection Techniques.
6. CRGR presentation slides, "Steam Generator Tube Inspection Techniques," dated November 19, 1996.
7. SECY-97-063, "Proposed NRC Generic Letter 97-##, 'Degradation of Control Rod Drive Mechanism and Other Vessel Closure Head Penetrations'," dated February 20, 1997.
8. Memorandum undated, Lambros Lois, NRR, to Robert Schaff, NRR, Subject: Safety Evaluation Report on Palisades: Pressure Vessel Fluence Reevaluation
9. U. S. Nuclear Regulatory Commission NUREG-1511, Supplement 1, "Reactor Pressure Vessel Status Report, October 1996

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NOTE: Additional details of this meeting can be obtained from a transcript of this meeting available in the NRC Public Document Room, 2120 L Street, N.W., Washington, D.C. 20006, (202) 634-3274, or can be purchased from Neal R. Gross and Company Incorporated, Court Reporters and Transcribers, 1323 Rhode Island Avenue, N.W., Washington, D.C. 20005, (202) 234-4433.

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