UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

November 3, 2008

MEMORANDUM TO: ACRS MEMBERS

FROM: Michael Benson, Staff Engineer **/RA/**
Reactor Safety Branch A

SUBJECT: CERTIFICATION OF THE MINUTES OF THE ACRS MATERIALS, METALLURGY, AND REACTOR FUELS SUBCOMMITTEE MEETING, OCTOBER 1, 2008 – ROCKVILLE, MARYLAND

The minutes of the subject meeting, issued on October 20, 2008, have been certified as the official record of the proceedings for that meeting. A copy of the certified minutes is attached.

Attachment: As stated

cc via e-mail: E. Hackett
C. Santos
A. Dias

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MEMORANDUM TO: Michael Benson, Staff Engineer
Reactor Safety Branch A, ACRS

FROM: William J. Shack, Chairman
Materials, Metallurgy, and Reactor Fuels Subcommittee

SUBJECT: CERTIFICATION OF MINUTES OF THE ACRS MATERIALS, METALLURGY, AND REACTOR FUELS SUBCOMMITTEE MEETING, OCTOBER 1, 2008 – ROCKVILLE, MARYLAND

I hereby certify, to the best of my knowledge and belief, that the minutes of the subject meeting on October 1, 2008, are an accurate record of the proceedings for that meeting.

/RA/

William J. Shack, Chairman
Materials, Metallurgy, & Reactor
Fuels Subcommittee

October 24, 2008
Dated

DRAFT Issued on October 20, 2008
CERTIFIED by W. Shack on October 24, 2008

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
MINUTES OF ACRS MATERIALS, METALLURGY, AND REACTOR FUELS
SUBCOMMITTEE MEETING
OCTOBER 1, 2008
ROCKVILLE, MARYLAND

The Advisory Committee on Reactor Safeguards (ACRS) Materials, Metallurgy, and Reactor Fuels Subcommittee held a meeting on October 1, 2008, in Room T-2B3, 11545 Rockville Pike, Rockville, MD. The purpose of this meeting was to review issues related to the proposed rule amendment to Title 10, Code of Federal Regulations (CFR) 50.61: "Fracture Toughness Requirements for Protection against Pressurized Thermal Shock Events." Michael Benson was the Designated Federal Official for this meeting. The Subcommittee received no written statements or requests for time to make oral statements from the public. The Subcommittee Chairman convened the meeting on October 1, 2008 at 8:30 a.m. and adjourned at 5:19 p.m.

Attendees:

ACRS Members

William Shack, Chairman	Mario Bonaca
Dana Powers	J. Sam Armijo
Said Abdel-Khalik	Otto Maynard
Michael Corradini	Dennis Bley
George Apostolakis	Charlie Brown
John Stetkar	

ACRS Staff
Michael Benson, Designated Federal Official
Edwin Hackett, Director

NRC Staff

Veronica Rodriguez, NRR	Barry Elliot, NRR
Mark Kirk, RES	Matthew Mitchell, RES
Stephen Dinsmore, NRR	Robert Hardies, RES
Geary Mizuno, OGC	Mike Case, NRR

Other members of the public attended this meeting. A complete list of attendees is in the ACRS Office File and is available upon request. The presentation slides and handouts used during the meeting are attached to the office copy of these minutes.

Opening Remarks and Objectives:

Dr. William Shack, Chairman of the ACRS Materials, Metallurgy, and Reactor Fuels Subcommittee, convened the meeting at 8:30 a.m. The purpose of this meeting was to review and discuss the proposed rule amendment to 10 CFR 50.61. The presenters included representatives from the Nuclear Regulatory Commission's (NRC) Offices of Nuclear Reactor Regulation (NRR) and Nuclear Regulatory Research (RES). The Subcommittee gathered information, analyze relevant issues and facts, and formulate proposed positions and actions,

as appropriate, for deliberation by the full Committee. The rules for participation in the meeting were announced as part of the notice of the meeting previously published in the *Federal Register*. The Committee did not receive written statements or requests for time to make oral statements from members of the public.

Discussion of Current PTS Rule (10 CFR 50.61):

Mr. Michael Case, NRR, introduced the presentations by saying that his office wants to know of any issues with the supplemental rule, so that it can be implemented in a timely manner.

Current PTS Rule Overview

Mr. Barry Elliot, NRR, described Pressurized Thermal Shock (PTS) as an event that is beyond design basis. PTS is not an issue for boiling water reactors (BWRs). The current rule was developed using 1980s technology. If a licensee finds that it will not meet the requirements of the current rule, then the prescribed corrective actions are costly to implement.

Current PTS Rule Provisions

Mr. Elliot described the current method of calculating the ductile-to-brittle transition temperature, which must meet the screening criteria for the most limiting material for a plant to remain in compliance with 10 CFR 50.61. The transition temperature is the sum of the unirradiated transition temperature, the shift in transition temperature due to irradiation effects, and a margin term to account for uncertainties in the estimate of the shift. The shift can be estimated based on surveillance data or Regulatory Guide (RG) 1.99 Rev. 2.

Current PTS Rule Impact on Licensees

Mr. Elliot stated that ten plants are in danger of exceeding the screening criteria of 10 CFR 50.61 at the end of their extended license.

Motivation for and Objective of Research

Mr. Elliot summarized the motivations behind the research effort on PTS. The research provides a technical basis for the supplemental rule, which is expected to reduce burden on licensee and regulator.

Technical Basis for the Rulemaking:

Background

Mr. Mark Kirk, RES, stated that research has shown that unnecessary conservatism exists in the old rule. The research addresses some issues that were not considered in the original rulemaking and provides a technical basis for a revised rule that removes unnecessary conservatism.

Approach

Mr. Kirk described how the risk limit on through-wall cracking frequency (TWCF), 10^{-6} per reactor year, was established. TWCF was conservatively assumed to be equivalent to large early release frequency (LERF). Thus, the limit on TWCF can be considered to be consistent

with the RG 1.174 limits on changes in core damage frequency and LERF for changes in the licensing basis. Overall, the PTS model combines event sequence analysis, thermal hydraulic (TH) analysis, and probabilistic fracture mechanics (PFM) analysis to calculate the yearly TWCF. One outcome of this work is that, out of the hundreds of events that were analyzed, only a few were determined to have significant impact on the TWCF. Uncertainties were classified (i.e., aleatory or epistimic) and appropriately treated. Some uncertainties were not numerically quantified, but were incorporated through application of a conservative model. The Oconee, Beaver Valley, and Palisades nuclear power plants were specifically studied in this work. Five more pressurized water reactors (PWRs) were considered in order to provide a basis for the generalization of the supplemental rule to the entire fleet.

Model

Mr. Kirk discussed the probabilistic risk assessment (PRA) event sequence analysis. The goal of this work was to define a universe of potential PTS overcooling sequences to be incorporated into the TH analysis. Examples of these events included loss-of-coolant accidents (LOCAs), loss of offsite power, and steam generator tube rupture. Operator actions were also considered. Plant-specific models were constructed for Oconee, Beaver Valley, and Palisades.

Mr. Kirk described the TH analysis, which utilized the RELAP5 code with a bin representation of similar fault sequences. The TH model uncertainties were considered negligible compared to the uncertainties in the frequencies of the events and the associated uncertainty in the TH boundary conditions, when implementing the bin representation. Many more events and TH bins were considered in the current analyses than in the 1980s analyses. Since the TH analysis for a bin is based on the bounding sequence in the bin, this has the result of reducing the conservatisms associated with the TH analysis.

Mr. Kirk discussed the PFM analysis. The incorporated flaw distribution (i.e., density, size, orientation, and location) was developed through destructive and nondestructive experimental data and expert elicitation. The flaw distributions in the 1980s analyses were much more conservative; in particular in the earlier analyses all the flaws were assumed to be located on the inner surface of the vessel. The neutronics submodel accounted for axial and azimuthal fluence variation rather than a bounding fluence as in the 1980s analyses. The crack initiation submodel was based upon a best-estimate master fracture toughness curve. This approach reduced the epistemic uncertainty inherent in the irradiated reference temperature. The crack initiation submodel accounted for warm prestress, where the stress intensity factor must be increasing in time and greater than the fracture toughness to initiate crack growth.

Mr. Kirk described the through-wall cracking model. This model accounted for the linkage among three fracture toughness relationships: crack initiation toughness, crack arrest toughness, and upper shelf toughness.

Results

Mr. Kirk stated that flaw distribution and spatial variation of the vessel toughness were significant contributors to the TWCF. The TWCF in axial weld flaws was higher than that for flaws in plate or circumferentially-welded material. The transients that most affected the TWCF included primary side pipe breaks, stuck-open primary valves, and main steam line breaks.

Mr. Kirk stated that plant-specific features from five PWRs were considered to determine if the proposed rule could be generalized to include a large number of PWRs. Plant-specific fluence

maps were overlaid on the vessel to determine the reference-temperature shift. Flaws in axial welds were shown to have the greatest affect on TWCF compared to flaws in circumferential welds or plate material.

The transients that had a dominant effect on TWCF were large and medium pipe breaks and stuck-open valves (that later reclose) on the primary side. The effect of internal and external initiating events was considered during this portion of the work. TH and PFM sensitivity studies were performed. Most of these studies showed little effect, but some results from the external initiating event and PFM studies were considered when establishing the reference-temperature screening limits. Three issues were found to significantly affect results: vessel wall thickness, plants with forgings, and stuck-open valves. With a few modifications, the baseline results may be used to determine screening limits for all PWRs.

Mr. Kirk stated that, during the detailed studies of the three plants, the results showed that only the most challenging transients contributed significantly to the TWCF. The next step was to determine the generality of the results by considering five other PWRs. The generalization studies began by considering the effects of large-break LOCAs, stuck-open valves, and main steam line breaks on the TWCF for the five plants The TWCF due to stuck-open valves was found to be underestimated by a factor of 2.5, which was accounted for when determining the reference temperature limits. Next, the effect of external initiating events was found to be insignificant in a coping analysis. Finally, TH and PFM sensitivity studies showed that no model changes were necessary. The two areas of caution for general applicability were vessel wall thickness and screening limits for forgings. Thicker walls led to higher thermal stresses, which increased the crack-propagation driving force. Plants with forgings were of concern because different flaw populations (e.g., the existence of underclad flaws) exist in forgings compared to plate material.

Reference Temperature Limits

Mr. Kirk described the process by which the new regulatory limits for the transition temperatures were determined. The process accounted for stuck-open valves, vessel wall thickness, and subclad cracks.

Surveillance

Mr. Kirk stated that 10 CFR 50.61 requires that the generic embrittlement trend curve be modified if plant-specific surveillance data is available. A surveillance check was required because the trend curve at high fluences is not reliable, according to limited data from test reactors or foreign power reactors. The proposed supplemental rule retained the surveillance checks. To account for different ways in which the surveillance data can deviate from the master curve, the resulting data is to be analyzed by the mean test, slope test, and outlier test. If one of these statistical tests on the surveillance data fails, then the licensee submits a recommended treatment to the NRC for approval.

Inspection

Mr. Kirk explained that flaw sizes and densities determined for a specific plant through inservice inspection (ISI) should be compared to the flaw distribution used in the model. This process is important because the input flaw distribution was shown to have a significant impact on the calculated TWCF.

Discussion of Alternate PTS Rule (10 CFR 50.61a):

Overview

Mr. Barry Elliot, NRR, stated that PWR licensees can voluntarily choose to apply the requirements of the alternate rule.

Provisions

Mr. Elliot explained that analysis of ISI flaw distribution data is an entry condition for the alternate rule. The American Society for Mechanical Engineers (ASME) code was adopted for inspection and qualification procedures. Limits were placed on size and density that are more restrictive than the ASME code. Licensees must determine if flaws at the clad-steel interface have penetrated through the clad. The NRC is considering whether to permit licensees to adjust the measured flaw sizes to account for errors in the nondestructive evaluation. The intent of the inspections is to demonstrate that the plant specific flaw distributions are consistent with those used in the analyses to determine the screening criteria for allowable embrittlement of the vessel. A plant-specific analysis can be submitted to the NRC if the limits on flaw size, density, and location necessary to show consistency with the generic analysis are not met.

Mr. Elliot stated that the reference temperatures for different materials (i.e., axial welds, circumferential welds, plates, and forgings) are calculated including the effect of surveillance data. No margin term is included in the calculation, since the margin was accounted for in the technical basis analysis. The shift of the transition temperature due to irradiation is calculated by a prescriptive methodology. If plant-specific data shows that the prescriptive method of calculating the shift of the embrittlement curve is not valid, then the licensee must propose a different method. The new supplemental rule is only applicable to currently-operating plants and those with similar designs. The risk limit is expected to be a TWCF of 10^{-6} per reactor year or less.

Ms. Veronica Rodriguez, NRR, stated that the comment period for the supplemental proposed rule is closed. The Commission is scheduled to review the final rule in April 2009, with publication of the rule in July 2009. NRR requests a final rule briefing during the March 2009 ACRS Full Committee meeting. At that time, all public comments are expected to be addressed.

Member Comments:

Discussion of Current PTS Rule (10 CFR 50.61)

Member Corradini asked about initiating events. Mr. Elliot responded that the events involve repressurization: e.g., steam line breaks, steam generator tube rupture, small break loss-of-coolant accidents (LOCAs), and extended high-pressure coolant injection. Member Bonaca stated that the new rule accounts for operator action, which is different from the current rule.

Member Corradini asked about the actions required if a plant is projected to violate the current rule. Mr. Elliot stated that the possible actions include vessel annealing and a plant specific risk analysis, but that these options are considered onerous to implement.

Some discussion centered on the extent to which industry participated in developing the new rule, since industry receives benefit from the relaxed requirements. Chairman Shack stated that the NRC's role is to determine the acceptance criteria. Mr. Kirk stated that several plants are projected to exceed the current acceptance criteria, which would lead to extensive use of resources to extend the life of the plant. He said that the development of the new rule is a more efficient method to address the problem.

Members Bley and Corradini asked about the screening limit in the current rule. Mr. Elliot stated that the limit line is set so that, if a plant exceeds the limit, the licensee may perform a refined risk analysis to determine the integrity of the vessel.

Member Apostolakis asked why some plants are expected to violate the current rule and others are not. Mr. Elliot stated that the main factor is copper content, which is now known to be a major factor in vessel embrittlement.

Member Abdel-Khalik asked about plants that have gone through a power uprate. Mr. Elliot stated that Indian Point has gone through a power uprate and is expected to exceed the current screening limit.

Chairman Shack asked about the plants that were granted license renewal and are expected to exceed the screening criteria during extended operation. Mr. Elliot stated that they have to inform the NRC of their corrective actions three years before they exceed the limit.

Technical Basis for the Rulemaking

Member Armijo asked about the scatter bands associated with embrittlement data. Mr. Kirk stated that the lower band is a true lower limit.

Member Corradini asked whether vessel annealing has ever been performed. Mr. Kirk stated that annealing has occurred in Russia. Member Corradini then asked about the likely location of the crack. Mr. Kirk stated that the area of concern is the beltline region.

Member Corradini asked whether a plant tried to implement Regulatory Guide 1.154 for the plant-specific analysis. Mr. Kirk stated that Yankee Row unsuccessfully tried that approach.

Member Corradini wondered how close the plants can approach the screening limit, considering uncertainties in the analysis.

Member Stetkar asked whether the pressurization associated with medium- and large-break LOCAs is enough to challenge the vessel. Mr. Kirk stated that it is. Member Stetkar then asked why BWRs are not affected by PTS events. Mr. Kirk stated that the vessel diameter in BWRs is large enough that irradiation embrittlement is not significant.

Members Brown and Corradini asked whether there is a paradigm shift in the manner in which uncertainties in the data are treated when forming the new rule. Mr. Kirk stated that the uncertainties are more auditable.

Member Apostolakis asked about the TWCF limit of 10^{-6} per reactor year. Mr. Kirk stated that this limit ensures that Regulatory Guide 1.174 is met.

Member Bley asked whether there is a probability of frequency that is associated with the TWCF curve determined for a plant. Mr. Kirk stated that the comparison metric is the 95th percentile. Member Apostolakis stated that the new rule compounds margins. Mr. Kirk stated that the TWCF is more likely to lead to core damage than large early release, so that a factor of safety of 10 is inherent in the new rule. Additional margin in the rule comes from using the 95th percentile on TWCF and conservative assumptions in areas where the state of knowledge was not advanced.

In response to a question from Members Khalik and Corradini, Mr. Kirk stated that the 10^{-6} limit was determined considering the sum of all transients.

Member Armijo asked where operator actions are accounted for in the model. Mr. Kirk stated that operator actions are included in the sequence analysis.

In response to a question from Members Brown and Apostolakis, Mr. Kirk stated that the output of the analysis is a cumulative TWCF for all possible events.

Member Apostolakis asked about the sequences that were considered when writing the new rule. Mr. Kirk stated that medium- to large-break LOCAs were ignored and main steam line breaks were included. Member Abdel-Khalik asked whether the knowledge gained from these studies has been integrated into the functional restoration guidelines of the plants. Member Bley stated that the guidelines concern plant conditions, rather than initiating events. Member Abdel-Khalik expressed concern that the guidelines were not developed with the assumption that repressurization and cooldown are required for a PTS event.

Member Bley asked about the knowledge gained from identifying all the uncertainties. Mr. Kirk stated that this process is beneficial for defending the work, documenting the basis for decisions, and reviewability.

Member Apostolakis asked about the physical models used in numerically treating uncertainties. Mr. Kirk stated that the parametric fits to the data were based upon models that are derived from physical insights. The uncertainties come from the data.

Member Stetkar asked about operator actions. Mr. Kirk stated that the sequences they modeled followed certain procedures that concern the balance of temperature and pressure in the reactor. Member Apostolakis asked what model was used to quantify this circumstance. Mr. Kirk stated that he did not know.

Member Maynard asked whether the plant-specific models considered differences in design. Mr. Kirk stated that the analysis accounted for the individual TH and PRA models.

Member Bonaca stated that allowing for operator action is an important point. He also confirmed that a steam line break does not contribute to the risk, which is very different from the 1980s analysis.

Chairman Shack asked whether the staff has a response to the Duke comment on the TH analysis of Oconee. Mr. Steve Dinsmore, NRR, stated that the initiating event frequency was very low and that no significant change was noted in the analysis when incorporating their comment.

Member Bley asked whether good mixing was an assumption in the TH analysis, and Mr. Kirk confirmed. Mr. Kirk said that a 10 – 20^{o}C plume only increases the axial stresses. The axial stresses in turn only affect circumferential flaws, which do not contribute to the TWCF because of a natural arrest mechanism. Member Abdel-Khalik asked whether stratification in the cold leg, which results in a circumferential gradient in the downcomer, is considered negligible. Mr. Kirk confirmed that it is. Member Corradini asked whether someone tried to determine if a circumferential plume could be formed. Mr. Kirk stated that it was considered and never observed. Member Abdel-Khalik expressed concern about circumferential temperature gradients that could open an axial crack. Mr. Kirk stated that the stress caused by the gradient is roughly proportional to the distance over which the gradient exists. The gradient is so localized in this case, that the increase in stress is not appreciable. Member Bley asked if the crack arrest mechanisms for the circumferential flaws were included in the earlier models. Mr. Kirk stated that they were and explained vessel experiments that occurred in the 1970s and 1980s.

Member Abdel-Khalik asked how the analysis accounted for the fact that certain events are more severe at the beginning of life than at the end of life. Mr. Kirk stated that events were considered to initiate at both hot zero power and hot full power, accounting for the fraction of time the plant will be in one condition or another. Member Abdel-Khalik stated that certain high-consequence events should be considered by themselves. Mr. Kirk stated that this approach is not adopted for this work, and that would be a policy decision. For this case, no events with a probability of occurring above 10^{-9} – 10^{-8} per year were excluded. He said high-consequence events do not happen frequently. Member Bley expressed concern that events with high conditional probabilities should be specifically noted for further study. He stated that it is wise to consider these events and the conditions under which they occur.

Member Abdel-Khalik asked how the different bins in the TH analysis were determined. Mr. Kirk stated that a bin that accounts for a large portion of the risk may have been subdivided. TH analysis was then applied to each of those bins.

Member Powers asked about the comparison of the phenomenological uncertainties in the TH analysis and the uncertainties of the sequence frequencies. Mr. Kirk stated that the comparison metric is the end result of the analysis. As the bins are iteratively subdivided, eventually the TWCF does not change. Mr. Kirk stated that the uncertainties in the frequencies can be several orders of magnitude. Mr. Steve Dinsmore, NRR, stated that the uncertainties are so large because so many TH sequences have been included in a single bin. The worst sequence of the bin was used and assigned to the whole frequency of the bin. Member Bley asked if the uncertainty was actually due to the binning, and Mr. Kirk agreed. Member Powers expressed concern that the parameter uncertainty may not be negligible compared to the frequency uncertainty. Mr. Kirk stated that the aim was to select the worst transient from the bin to represent that bin entirely, with the heat transfer coefficient and flow conditions being modeled from a best-estimate perspective. Member Stetkar asked how it is known that the uncertainties in the TH analysis are small compared to the uncertainties inherent in the bin.

Member Armijo asked whether any experiments had shown that subcritical cracks would grow under cyclic loading conditions. Chairman Shack stated that the cyclic loading on the pressure vessel is very low. Mr. Elliot stated that, over 40 years, very small incremental growth is observed. Member Bley asked about the flaw sizes used in the analysis.

Member Abdel-Khalik asked about the manner in which the stainless steel liner was incorporated into the analysis. Mr. Kirk stated that the liner contributes residual and thermal stresses in the steel. It also contributes a flaw population associated with lack of fusion.

Member Abdel-Khalik asked whether it was important to know surface density and volumetric density of base metal or underclad flaws. Mr. Kirk stated that there is no mechanism to cause surface flaws and that underclad is considered separately. In response to a question from Member Armijo, Mr. Kirk stated that truncation was related to the surface flaws in the clad.

Member Abdel Khalik asked about the basis for the original flaw distribution. Mr. Kirk stated that it was based upon a population of ex-service flaws in non-nuclear vessels

Member Bley asked about the validation of the FAVOR code. Mr. Kirk stated that FAVOR results show good agreement with experiment and that independent panels have reviewed the code. Member Abdel-Khalik asked how the code was verified with experimental data when considering probabilities of failure between 0 and 100%. Mr. Kirk stated that the experimental toughness data follow a Weibull distribution. Member Powers and Member Bley wondered whether the Weibull distribution was based upon physical or empirical considerations.

Member Bley asked about public comments that led to an update to NUREG-1806. Mr. Kirk stated that an individual asked about crack face pressure. They modeled that effect and found that it was not an important factor.

In response to a question from Member Armijo, Mr. Kirk stated that the fluence level can vary up to an order of magnitude from point to point in the vessel.

Member Armijo asked whether data on as-fabricated flaws were included in the plant-specific analyses. Mr. Kirk said that it was not included.

Member Powers asked about the random number generator. Mr. Kirk stated that he would respond at a later time.

Member Brown asked about how a flaw distribution, which was measured in a few vessels, can be reliably applied to many vessels, some of which use different materials and welding operations. Mr. Kirk said that that the only difference is in regards to flaw density, so the largest observed density is used in the analysis. He stated that licensees must analyze ISI data to determine whether the measured flaw distribution is adequately accounted for in the general flaw distribution. Mr. Kirk said that a certain plant's ISI data only had four flaws, so the distribution used in this analysis is bounding.

In response to a question from Members Abdel-Khalik and Bley, Mr. Kirk stated that, although certain cases showed that plate material was embrittled more that the axial welds, the axial weld flaws always initiated in the analysis.

Member Stetkar asked about how detailed the external event analysis was, since fire models have shown that stuck-open valves are a source of core damage. Mr. Kirk stated that the level of complexity of the external event analysis was less than that for the internal event analysis. He said that the external events were eventually disregarded, as internal events were more significant. The internal event analysis was performed between 1998 and 2003, while the external event analysis was performed afterwards.

Member Abdel-Khalik asked how insights from the external event analysis were communicated to those who write the operating procedures.

Member Bley asked about the level of confidence that good mixing exists during a feed-and-bleed scenario, since good mixing ensures that the temperature does not decrease significantly.

Member Abdel-Khalik asked whether the three plants considered in detail were classified as low pressure or high pressure plants. Mr. Robert Hardies, NRR, stated that Palisades is a low pressure plant and Oconee is a high pressure plant. Member Abdel-Khalik stated that the reason the three plants demonstrated similar TWCF due to stuck-open valves could be something besides the plants repressurizing to the safety valve setpoint.

Chairman Shack asked about the nature of the sensitivity studies to determine the general applicability of the work. Mr. Kirk stated that different embrittlement curves were used when calculating TWCF.

Chairman Shack and Member Armijo expressed concern about the treatment of densely-packed flaws. Mr. Kirk stated that, by treating them as individual flaws with no neighboring flaws to share the load, the treatment is conservative.

Member Armijo asked about the relevance of performing statistical tests (e.g., the slope test) on small data sets from surveillance capsules. Mr. Elliot and Mr. Kirk stated that the procedure provides a method by which the licensee must discuss the situation with NRR, if the surveillance data is not consistent with the master embrittlement curve.

Member Armijo expressed concern that small flaws are difficult to detect with ISI, when considering the entry condition to the new rule.

Member Stetkar expressed concern that initiating event frequencies were not addressed in this work. Mr. Dinsmore stated that the generalization studies showed that it was not important to consider those frequencies. Member Stetkar pointed out that frequencies of stuck-open valves and small LOCAs can be very plant-specific. Member Bley asked for documentation on the generalization studies.

Discussion of Alternate PTS Rule (10 CFR 50.61a):

Chairman Shack asked about the rationale for keeping the embrittlement correlation in the rule, as opposed to publishing it as an NRC-approved methodology. Mr. Elliot stated that there was concern that publishing it in a separate document would create confusion as to what is approvable. Mr. Geary Mizuno, Office of the General Council, stated that keeping the correlation in the rule provides regulatory stability and predictability to NRC staff and licensees, along with transparency to the public.

Member Brown expressed concern that NRR is placing too much emphasis on relieving regulatory burden as reasoning behind the rule making.

Chairman Shack asked whether NRR had demonstrated the feasibility of demonstrating the allowable number of flaws in the welds. Member Armijo agreed with the concern. Mr. Mitchell stated that the proposed requirements should not be beyond the licensees' limitations.

Member Abdel-Khalik emphasized that the committee needed to see more information on the how the TH uncertainties were accounted for. He also requested that lessons learned from this study be provided to licensees in case there are procedural implications. Chairman Shack emphasized that the committee needed to see the report on the generalization studies.

Member Bley asked to see the peer review of FAVOR. Member Maynard stated that it would be beneficial to include a requirement that licensees show that their event frequencies are similar to the assumptions made in the analysis. Member Powers expressed concern that the treatment of uncertainties was unclear. Member Armijo expressed concern that using five significant figures in some of the equations was not believable. Member Bley stated that TH uncertainties, confidence in FAVOR, and the generalization studies are three critical points that need further review.

Subcommittee Decisions and Actions:

The committee requested the staff to provide documentation on three issues for further review. The first issue was justification of the neglect of TH uncertainties. Next, the members wanted to review the validation of the FAVOR code because of the critical role it plays in the overall analysis. Finally, the committee wanted to review the generalization studies because of the plant-specific nature of initiating-event frequencies, which were not considered in the technical basis. No letter was written as a result of this meeting. Assuming these issues are resolved, the Full Committee is expected to review this issue in March 2009 without another Subcommittee meeting.

Background Materials Provided to the Subcommittee Prior to the Meeting:

1. Letter from Graham B. Wallis to Luis A. Reyes, dated March 11, 2005.
2. NUREG-1806, Published August 2007.
3. NUREG-1874, Published TBD.
4. Letter from Michael J. Case to Frank Gillespie, dated March 7, 2007.
5. Letter from Michael J. Case to Edwin M. Hackett, dated September 2, 2008.
6. Letter from Brian W. Sheron to James E. Dyer, dated June 9, 2006.
7. Letter from George E. Apostolakis to William D. Travers, dated February 14, 2002.
8. Letter from George E. Apostolakis to William D. Travers, dated July 18, 2002.

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Note: Additional details of this meeting can be obtained from a transcript of this meeting available for downloading or viewing on the Internet at http://www.nrc.gov/reading-rm/doc-collections/acrs/tr/subcommittee/2008/ or purchase from Neal R. Gross and Co., Inc., (Court Reporters and Transcribers) 1323 Rhode Island Avenue, NW, Washington, DC 20005 (202) 234-4433.