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

March 3, 2009

MEMORANDUM TO: ACRS MEMBERS

FROM: Davide Bessette **/RA/**
Advisory Committee on Reactor Safeguards

SUBJECT: CERTIFICATION OF THE MINUTES OF THE SUBCOMMITTEE ON POWERUPRATES, MILLSONE-3 EXTENDED POWER UPRATE, HELD IN ROCKVILLE, MARYLAND, ON JULY 8, 2008

The minutes of the subject meeting have been certified as the official record of the proceedings for that meeting. A copy of the certified meeting is attached.

Attachment: As stated

cc via e-mail: ACRS Staff Engineers
S. Duraiswamy
J. Flack
V. Murphy

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MEMORANDUM TO: David Bessette, Senior Staff Engineer
ACRS

FROM: John Sieber, Chairman
Subcommittee on Power Uprates

SUBJECT: CERTIFICATION OF THE MINUTES OF THE SUBCOMMITTEE ON POWER UPRATES, MILLSONE-3 EXTENDED POWER UPRATE, HELD IN ROCKVILLE, MARYLAND, ON JULY 8, 2008

I hereby certify, to the best of my knowledge and belief, that the minutes of the subject meeting on July 7, 2008, are an accurate record of the proceedings for that meeting.

/RA/

John Sieber, Chairman
Extended Power Uprates

3/03/09
Date

Certified by: John Sieber Issued: 03/03/09
Certified: 3/3/2009

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
SUBCOMMITTEE ON POWER UPRATES
MILLSTONE POWER STATION UNIT 3 STRETCH POWER UPRATE
JULY 8, 2008
ROCKVILLE, MARYLAND

INTRODUCTION

The ACRS Subcommittee on Power Uprates met with representatives of the NRC Office on Nuclear Regulatory Regulation, Dominion, and the public to review the application for a 7% Stretch Power Uprate for Millstone-3 and the staff's safety evaluation. During the meeting, the Subcommittee heard presentations by and held discussions with Dominion Nuclear, Westinghouse, NRC staff, and the Connecticut Coalition Against Millstone. David Bessette was the Designated Federal Official. The meeting was convened by the Chairman at 8:30 a.m. and adjourned at 5:30 p.m.

ATTENDEES

ACRS
John Sieber, Chairman
J. Sam Armijo, Member
Sanjoy Banerjee, Member
Mario Bonaca, Member
Charles Brown, Member
Said Abdel-Khalik, Member
Otto Maynard, Member
Dana Powers, Member
William Shack, Member
John Stetkar, Member
Graham Wallis, Consultant
Tom Kress, Consultant
David Bessette, Designated Federal Official

Staff
Joseph Giitter, Director, Division of Operating Reactor Licensing, NRR
John Lamb, NRR
Samual Miranda, NRR
Benjamin Parks, NRR
Ahsan Sallman, NRR
Sheila Ray, NRR
Mathew Yoder, NRR
Ambrose Wallace, NRR
Richard Lobel, NRR

Dominion Nuclear
Alan Price, Site Vice President for Millstone
David Bouchee, Manager for Safety Engineering
Ron Thomas, Project Manager for Stretch Power Uprate Project
Mike Kai, Principal Engineer
Albert Gharakhanian
John Geirsey
Michael O'Connor, Manager, Systems and Component Engineering
Robert Burnham, I&C Design Engineer
Larry Salyards
Robert Burnham
Paul Russell

William Aiken
Mike Collier
Albert Caricone
Westinghouse
Sandy Andre
Josh Hartz
David Huegel
Mr. Wong
Stephanie Antoine

Connecticut Coalition Against Millstone
Nancy Burton
Arnold Gundersen

AGENDA

1.	Introductory Remarks by the Chairman	Jack Sieber
2.	Staff Introduction	Joseph Giitter, John Lamb, NRR
3.	Stretch Power Uprate Overview	Alan Price, Ron Thomas, DNC
4.	Fuel and Core	Mike Kai, DNC
5.	Safety Analysis	Mike Kai, DNC
6.	Safety Analysis	Benjamin Parks, NRR
7.	Containment Analyses	Mike Collier
8.	Containment Analyses	
9.	Public Comments	
10.	Subcommittee Discussion	

1. CHAIRMAN'S INTRODUCTORY REMARKS - Chairman Sieber

The Chairman opened the meeting, stating that its purpose was to consider the license amendment application to increase the licensed power of Millstone 3 by 7% including the safety analysis performed by Dominion Power and its contractor and the Safety Evaluation performed by NRR staff. Mr. Sieber noted that the staff's review was in accordance with Review Standard for Power Uprates 001.

2. STAFF INTRODUCTION - Joseph Giitter, John Lamb

Mr. Giitter introduced the subject of the meeting, namely, the application for a license amendment by Dominion Nuclear Connecticut Inc. (DNC) for a 7% stretch power uprate (SPU) for Millstone-3. This would increase licensed power from 3411 MWt to 3650 MWt. The staff performed a thorough safety evaluation and there are no open issues. In its review, the staff has significant interaction with DNC.

John Lamb, Senior Project Manager for Millstone-3, continued the introduction. Millstone-3 is a Westinghouse 4-loop plant. It received its operating license on January 31, 1986. The plant has already gone through license renewal in 2005. The staff has issued 61 SPUs to date. The staff has no specific guidance for SPU. It used Review Standard 001 for extended power uprates, which contains a review template. DNC submitted its application for a license

amendment on July 13, 2007 and plans to implement the SPU in the fall of 2008. The staff's review concentrated on fuel and safety analysis and environmental qualification.

3. Stretch Power Uprate Overview - Alan Price, Ron Thomas

Mr. Price introduced the DNC presentations. At the beginning, DNC established an executive oversight committee to guide the activities.

Mr. Thomas stated that DNC began work on SPU in December 2005. DNC decided against contracting out the entire process, but rather, to actively partake in the project. The principal contractors were Shaw, Stone and Webster and Westinghouse. The DNC project team included a senior reactor operator and a full time engineer (Larry Salyards) dedicated to margin management. In response to a question by the Chairman, Mr. Thomas indicated that Millstone-3 has a permanent margin management program. Mr. Sieber indicated that all plants ought to have someone responsible for margin management. Mr. Maynard added that DNC should indicate how much of the margin management associated with the SPU was due to refined analysis versus changes to plant hardware or operations.

The Chairman noted that Millstone-3 will operate with a T_h of 619F. Mr. Maynard added that this is fairly typical of the large PWRs now. Mr. Thomas replied that the effect of the temperature on the Alloy 600 steam generator tubes will be addressed during the meeting.

Mr. Thomas noted that several years ago DNC began a review of what would be involved in an SPU. They found that there was a significant margin available in all systems and components, with the exception of the generator. The next limiting component was the high pressure turbine. The main feed pump turbine was marginal, so the decision was made that it would be replaced. The new turbine runs at 5100 rpm, compared to 4700 rpm for the old turbine.

Millstone-2 is a Combustion Engineering plant. Dominion has no plans for an SPU of Millstone-2.

In terms of changes to safety systems, a new permissive (P19) will be implemented to help avoid pressurizer overfill on a spurious safety injection actuation.

4. FUEL AND CORE - Mike Kai

Mr. Kai discussed the fuel and core analysis associated with the SPU. The fuel design is RFA-2 and will remain unchanged. The increase power will be accommodated by increasing the number of fuel assemblies that are replaced during each refueling. The number will increase from the present 72-76 to 80-84. The radial power distribution will be flatter, and the radial peaking factor actually decreases from 1.7 to 1.65. The most positive moderator temperature coefficient is unchanged.

There followed a discussion of how the fluence to the vessel would change with the 7% increase in power and the flatter power profile. Mr. Kai indicated that the most recent surveillance capsule that was examined showed that fluence was being overpredicted, so while actual fluence will increase, the calculated fluence will decrease. Mr. Kai did not have actual data to present. Mr. Sieber noted this information was not in the license amendment application

either and stated that DNC should provide more information on this issue. Mr. Wallace (NRR), who is responsible for reactor fluence reviews, indicated that the three important factors in fluence calculations are the power levels of the peripheral assemblies, the axial and radial power profiles, and the azimuthal power profile. Mr. Sieber noted that Millstone-3 originally has six surveillance capsules. Typically one is removed every 10 years. Three have been removed thus far.

Prof Abdel-Khalik asked what the fuel duty index will be at the higher power level. Mr. Geirsey replied that the Westinghouse duty index will increase from 160-165 to 200-205. This places the plant in the high range. The peak linear heat generation rate will increase from 14.2 to 15.1 at SPU conditions.

Prof. Abdel-Khalik also inquired about the peak pressure for a loss of feedwater ATWS. Ms. Andre replied that the maximum pressure was 2979 psi, while for a loss of load ATWS the maximum pressure was 3105 psi.

At increased power, T_{av} will remain unchanged. The core outlet temperature, T_h, will increase by 2F, while the core ΔT will increase by 4F. Mr. Kai proceeded to slide eight, which was a table that attempted to show changes to cold leg and hot leg temperatures from current conditions to SPU conditions. The Subcommittee found the table to be confusing and did not show one-to-one comparisons. One conclusion is that the minimum technical specification flow rate for DNB increases from 372,000 gpm to 379,200 gpm at SPU power level. This compares to the actual flow rate of ~400,000 gpm.

The pressurizer level control changes slightly for SPU. The zero power level remains the same at 27%, while the 100% power level increases from 61.5% to 64%, reflecting the increase in T_h. The top of the pressurizer heaters is about 17%.

5. SAFETY ANALYSIS - Mike Kai

Mr. Kai turned to the subject of safety analyses. The chapter 15 accidents were reanalyzed. The previous inputs were validated. It was not necessary to use new methodology to show acceptable results, nevertheless, the analyses were updated using the current Westinghouse methods. These include using COBRA/TRAC for LOCA instead of BART/BASH. COBRA/TRAC was used for best-estimate analysis. The Westinghouse Advanced Statistical Treatment of Uncertainties Methodology (ASTRUM) was used to obtain the best-estimate plus uncertainly number for peak cladding temperature. To establish the 95% uncertainty, 124 COBRA/TRAC calculations were run.

Concerning DNB, Mr. Kai began by discussing what is called an “upper plenum anomaly.” This is related incomplete mixing of the core exit flow before it enters the hot leg. It is common place in pressurized water reactors. As a result, individual hot legs experience random fluctuations in temperature of 1-4F. These temperature waves are measured and are fed into the DNB calculator. On infrequent occasions, this causes OTΔT or OPΔT alarms in the control room. The concern is that a spurious trip could occur. Therefore, an effort has been made to increase the setpoint margins for these two DNB trips. Two changes in particular were to: 1) switch from the old WRB-2 (Columbia test data) to the WRB-2M DNB correlation; and 2) reduce the radial peaking factor from 1.70 to 1.65. The other modifications were to: eliminate automatic rod withdrawal; install an electronic filter (4 s time constant) on the hot leg temperatures; and

decrease the high neutron flux setpoint from 118% to 116.5%. The temperature spikes have a frequence of the order of 30 s, a duration of the order of 1s, and a magnitude of the order of a few degrees. Hot leg temperatures are measured by RTDs located in thermal wells, with three RTDs per hot leg, 120 degrees apart. Mr. Huegel (Westinghouse) indicated that the methodology for calculating DNB setpoints is described in WCAP-8745.

Mr. Kai indicated that the limiting transient for DNB for Millstone is a steam line break with coincident rod withdrawal. The removal of the automatic rod withdrawal mitigates this accident. It was originally intended for use during load follow, but in fact it was never used in practice.

Mr. Kai reviewed important changes in values associated with DNB (these numbers are proprietary). At SPU conditions, the margin between the DNB design limit and the DNB value for which the safety analysis was performed was increased to allow for increased flexibility in core design and operations. In response to a question from Prof. Abdel-Khalik, Mr. Kai replied that the W3 correlation is used for conditions for which WRB-2M is not applicable, such as low pressures. The SPU accident analyses indicated that the limiting DNB transient was rod withdrawal from subcritical conditions with two reactor coolant pumps (RCPs) operating. However, in practice, all four RCPs are running during startup, and the technical specifications require at least three RCPs to be running.

Prof. Abdel-Khalik asked why DNB margin increased considerably for SPU conditions for an inadvertent opening of the PORV. Mr. Kai replied that the calculation of this scenario was done using RETRAN, which models DNB rather than using a correlation such as WRB2-M. DNB modeling is more general with greater uncertainty than using a correlation. Mr. Huegel added that there are additional complications in the analyses such that the two numbers are not comparable one-to-one. Because of many differences in the former analyses and the analyses for SPU conditions, the two sets of numbers cannot be compared with each on the same basis. Following considerable discussion of slides 13-15, it was concluded that the focus should be on comparing calculated values to the regulatory limit.

Mr. Kai discussed pressurizer overfill transients. The Millstone-3 PORVs are qualified for water relief. Mr. Kai indicated that the loss of feedwater transient was analyzed using a number of conservative assumptions. To reduce the probability of going water solid, a new permissive (P19) was added to only allow the charging (high pressure injection) pumps to inject if the reactor coolant system pressure is low. The permissive greatly extends the time for the reactor coolant system to go water solid for an inadvertent safety injections actuation scenario.

Mr. Kai discussed results from safety analyses performed for steam line and feedwater line breaks, reactor coolant pump locked rotor, rod ejection, steam generator tube rupture, small break LOCA and large break LOCA. Dr. Powers asked about the rod ejection results with respect to the fraction of fuel calculated to fail and the fraction of fission gas calculated to be released from the failed fuel. Other points of discussion included modeling of fuel rod heat transfer, CCFL, loop seal clearing, reflux condensation, and liquid holdup in the steam generator tubes.

The next topic in the safety analysis was radiological consequences. Mr. Sieber noted that Millstone-3 had switched to using the alternate source term approximately four years ago. Most of the doses are far below regulatory limits with the exception of a small line break outside containment. For this event, it is said that the thyroid dose and the whole body are not

applicable. Dr. Powers added that the critical attribute to the source term for this event is the gap inventory. Mr. Kai responded by saying that the small line break outside containment was one of the only accident scenarios not covered by the alternate source term methodology from the submittal that was approved four years ago. With the current SPU submittal, this scenario was brought into the alternate source term. The methodology results in an equivalent dose by combining thyroid and whole body together. This accident scenario is terminated by the operator isolating the broken line. The scenario was analyzed in such a way as to determine the maximum allowable time for the action to occur and still stay within the regulatory limit for release.

The discussion of safety analyses concluded with a summary of changes to the PRA predictions of core damage frequency and large early release frequency. Members of the Subcommittee made a number of comments regarding how meaningful the information provided in the SPU submittal really was. Mr. Aiken noted that the analyses of time available for operations done for SPU were done using RELAP5, whereas the prior PRA timings were obtained using MAAP. It was clear that actual times should be reduced by 7% in accordance with the increase in decay heat, however, one-to-one before and after comparisons could not be made because several changes were made by Dominion to the Millstone-3 PRA.

6. SAFETY ANALYSIS - Benjamin Parks, Sam Miranda, Paul Clifford

Mr. Parks discussed the NRR safety evaluation of the Dominion license amendment submittal. The Extended Power Uprate Review Standard 001 (RS-001) was used for guidance. From the fuel perspective, the linear heat generation rate increases slightly, while the radial peaking factor decreases slightly. The review was done for a reference core design, although in practice reload analyses are specific to actual cycle-specific core designs.

The staff review included transients from matrix eight of RS-001. The staff decided to pay particular attention to overpressure protection, inadvertent SI actuation (P19 permissive), and uncontrolled rod withdrawn at power and from subcritical.

The limiting overpressure event is a loss of load. The acceptance criterion is that pressure should not exceed 110% of design pressure, or 2750 psi

Mr. Miranda discussed the implementation of the P19 permissive. This was done to reduce the probability of filling the pressurizer water solid in the event of an inadvertent actuation of ECCS. Millstone-3 has an added advantage of being one of six plants having PORVs that are qualified for discharge of water. The P19 permissive logic is unique to Millstone-3; other PWRs have not made this modification.

Mr. Clifford discussed reactivity accidents. The governing regulatory guide is 1.77, which specifies an enthalpy limit of 280 cal/g. An error was made when this number was first incorporated into the regulatory guide. When this error is taken into account, the enthalpy limit is 230 cal/g. Westinghouse is using a lower value of 200 cal/g as an acceptable limit. In calculating the number of fuel rod failures, Westinghouse uses DNB as the criterion. Point kinetics modeling of neutronics is known to be highly conservative. When 3D methods are used, Westinghouse calculates peak enthalpies of 60-70 cal/g. Calculations indicate the DNB is expected to occur around 170 cal/g.

Mr. Parks discussed rod withdrawal at power. The staff questioned whether the high pressurizer pressure trip would terminate the event in time to prevent overpressure if the event were to occur starting from low power. The analysis performed by Westinghouse predicted peak pressures less than 2750 psi. A scram signal is generated by the positive flux rate trip signal.

Mr. Parks next turned to the subject of LOCA. The peak clad temperature for a small break (4-inch) was calculated to be 1193F. The large break peak cladding temperature was 1781F, including uncertainties. There is, therefore, significant margin to the 2200F acceptance criterion.

Prof Wallis asked why the change was made from THINK and LOFTRAN to VIPRE and RETRAN. Mr. Huegel replied that Westinghouse decided to use more modern methods. The predictions of the newer codes are similar to the older codes.

The Chairman indicated that in the interest of time, that the agenda items dealing with electrical systems and flow accelerated corrosion could be abbreviated, since the review was straightforward and there were no issues. Mr. Stetkar asked whether the atmospheric release valves were safety related or not. Mr. Russell replied that they were not.

7. CONTAINMENT ANALYSIS - Mike Collier

Mr. Collier discussed the containment analysis performed for the SPU. A change was made from the FROTH code to GOTHIC for containment. A benchmark comparison was made between the two codes and the results were close. Prof. Wallis noted that the temperature range that was analyzed for initial conditions was an average and asked whether jet impingement was analyzed. Mr. Caricone replied that the reactor coolant system piping was all shielded from the containment so there was no path for jet impingement. For a steam line break, there could be jet impingement. Prof. Wallis said that buckling should be considered. Mr. Kai noted that while Millstone-3 was designed as a subatmospheric containment, similar to Beaver Valley, a license amendment about 10 years ago removed this criterion, so the plant now operates as nearly atmospheric.

Mr. Kai indicated that twelve LOCA scenarios were analyzed to confirm that containment pressure remained below the licensing basis for equipment qualification. The design pressure of containment is 45 psig. Similar comparisons were shown for containment temperature. When operated as a subatmospheric containment, the containment recirculation spray pumps started 11 minutes after the safety injection signal. At that time the sump temperature is calculated to be 260F. That is now changed so that the recirculation spray pumps start on low-low water level in the RWST. This reduces the sump temperature at the time of spray initiation to 225F. Concerning GSI-191, the new strainers are installed but the analyses are continuing.

Mr. Kai stated that containment spray actuates on high containment pressure (five psig). The fan cooling system is not safety related so the fans would not be running during an accident. Leak-before-break was credited to remove large break LOCAs from subcompartment analyses.

Mr. Bouchee presented analyses of time available for operator action. RELAP5 was used to redo calculations performed previously with MAAP-4. The objective was to determine whether

the success times and criteria were still met, with the results being that they were. Dominion did not look into decrease in margins for operator actions.

8. CONTAINMENT ANALYSIS - Ahsan Sallman

Mr. Sallman, the reviewer for Millstone-3 SPU containment, presented the staff's review of containment matters. The review was conducted for the relevant GDCs and in accordance with RS-001. A number of requests for additional information were generated and were answered by Dominion satisfactorily. Dominion used the GOTHIC code for containment analysis. The containment pressures and temperatures calculated by Dominion for SPU condition were within design values. Prof. Abdel-Khalik asked whether the staff did any independent analysis. The reply was, no, because there was no evident need.

Mr. Sallman noted that the design temperature of 280F for the containment liner is common to many plants. Prof. Wallis asked whether this temperature was indeed correct given the possibility of jet impingement. Mr. Sallman replied that jet impingement would not occur. The Chairman added that the crane wall shields the liner.

9. CONNECTICUT COALITION AGAINST MILLSTONE - Nancy Burton, Arnold Gundersen

Ms. Burton presented comments related to health effects. Ms. Burton indicated that she represents a number of environmental organizations in Connecticut. She linked the Millstone units to deaths in the surrounding area from various forms of cancer and heart failure. Speaking about Millstone-2, Ms Burton noted that the unit had three unplanned shutdowns within a month recently. Ms. Burton added that more time should be provided before SPU is approved.

Mr. Gundersen next spoke. He indicated that he was a former licensing engineer at Millstone-3 in the 1970s. He stated that the Millstone-3 containment, at 2.3 million ft^3 is the fifth smallest of the 25 plants he examined. In 1991, the operating pressure for containment was changed from 10 psia to 14 psia. Based on the ratio of core power to containment volume, Millstone-3 is the smallest for plants greater than 2700 MWt. Mr. Gundersen added that the staff should have performed independent containment analyses. He agreed with Ms. Burton that more time should be provided before SPU is approved. Also, if Millstone-3 returns in a few years with a request for a further 2% increase in power, would this then make it an extended power uprate (EPU) rather than a SPU.

Dr. Powers asked whether a review of the containment analysis methods that was done by the staff was equivalent to independent analysis. Mr. Gundersen replied that his opinion was that it was not. He noted that it was necessary to use leak before break for subcompartment analysis.

10. SUBCOMMITTEE DISCUSSION

The Subcommittee discussed the presentations to be made to the full Committee. The Chairman indicated that the focus should be on fuel and safety analysis. Mr. Maynard added that the absence of one-to-one comparisons of pre and post-SPU analysis had caused considerable difficulty. He inquired about the strictly legal status of whether the application was an SPU or an EPU. Mr. Lamb answered that this was considered and the ASLB had issued a ruling that it was an SPU.

Mr. Stetkar noted that this was not a risk informed application and there was no mention of PRA in it. He noted that there are no PRA scenarios that take credit for the new P19 permissive.

The meeting adjourned at 5:30 p.m.