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To: <SDB2@nrc.gov> Sonia Burgess, RIII
Date: 12/3/02 2:28PM
Subject: Risk Estimates for PBNP AFW issues

Hi Sonia,

I am sending this email to follow up on our phone conversation from last week. The following contains risk estimates for various Aux Feed Water Issues that have been identified at the plant.

AFW Orifice Plugging: As I have mentioned, at this time, I do not have additional information to provide. The risk will depend upon the deterministic information received about the mechanism that may be available (or not available) to plug the orifices. We expect to receive some information within the next 2 weeks and I'll have some preliminary risk information soon after that. I will keep you updated as the information becomes available.

AFW Discharge Flow Instrument Power Supplies not Safety Related: A loss of the flow instrumentation power supply could cause failure of the recirculation valves. In general, there are four potential affects on PRA risk due to the classification. Below I will summarize these affects and their impact on risk for this issue. In total, I expect the change in risk would be less than 1E-6.

Separation: This would only be an issue for a fire scenario. Appendix R credits the use of the local mechanical flow indication that is not affected. Therefore, there is negligible PRA risk due to a potential lack of separation.

EDG Power Backed: The power supplies for all of these instruments are off of a bus that is powered by the Emergency Diesels and is credited in the diesel loading. Therefore, there is no change in risk associated with this factor.

Seismic: At this time, I do not know what the seismic classification would be. However, I can show a quick bounding evaluation that would show that the change in risk would not be significant.

Change in Seismic Risk = (SFFail - SFSSE) * HEPManual

SFFail = Frequency of Earthquake required to fail the instrument. To perform a bounding estimate, I will assume that this is the same as Operating Basis Earthquake. This is the earthquake where the plant is expected to continue to operate (and AFW would not be required). Note this is bounding because the power supplies will probably work for earthquakes larger than the OBE. 2.7E-4/yr

HEPManual = Three of the four recirc valves will fail closed with a loss of the non-safety power supply. For this analysis, I am assuming that all 4 fail closed. The operator will still be able to control flow through the use of procedures that require stopping of the pump without minimum flow. Since this will occur only when the operator takes action to reduce flow, an HEP is estimated -this is the HEP that is in our current PRA model. 5E-3

SFSSE = If the power supply were safety related, it would be designed to handle at least a Safe Shutdown Earthquake, but could fail for earthquakes beyond this design. Therefore, the frequency of a SSE is being used as the risk associated with a conforming condition. 1.2E-4/yr

Upper bound for change = (2.7E-4 - 1.2E-4)/yr * 5E-3 = 7.5E-7/yr

Single Failure: A single failure could result in a loss of both AFW pumps credited with a Steam Generator Tube Rupture and a failure of the instrument supply bus. This would require a fault on the 'B' Steam Generator since a fault on the 'A' Steam generator would still have a motor driven AFW

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pump unaffected by the single failure. The failure of the bus is expected to be no more than 3E-6/day. The frequency for a faulted generator is approximately 7E-3/year. These two events alone are less than 1E-6. This also does not account for the operator to correctly control the pump with the loss of the valve by starting and stopping as necessary.

D01 Causes a Loss of 3 AFW Recirculation Valves: There are two ways that a loss of D01 could impact risk - first, loss of D01 as the initiating event, and second as a random failure of D01 following a different initiating event.

Loss of D01: A loss of D01 would result in a plant trip for both units and a loss of 3 out of 4 recirculation valves for AFW. One of the motor driven pumps would remain unaffected (the 'B' pump). In addition, Unit 1 would lose MFW and one train of safety systems (due to loss of control power). A calculation to bound the core damage frequency would be:

CDF = FD01 * HEPAFW * FFeedU2 * FFeedBleed

FD01 = Frequency for loss of D01. 1E-3/yr

HEPAFW = Probability that an operator fails to adequately control AFW flow with loss of the recirculation valve. In this case, the valve position would also be lost. The operators had procedures that describe how to operate the pump with a failed closed valve. In addition they have received training on the failure position of the valve (fail closed). The value of the HEP is approximately 5E-3. The operators have not been trained specifically on this condition (ie, no indication). Therefore, I am conservatively assuming the risk is one order of magnitude higher (the actual value should be somewhere around a factor of 3 higher). 5E-2

FFeedU2 = Main feed water is still available for unit 2. Therefore, Unit 1 would still have access to the remaining AFW pump unless main feed water failed on Unit 2. The probability of this is approximately 5E-2.

FFeedBleed = Even if all AFW was lost, one train of feed and bleed would still be available. The failure probability for this train is estimated to be approximately 5E-2

CDF = 1E-3 * 5E-2 * 5E-2 * 5E-2 = 1.25E-7/yr

Loss of D01 following another initiator: Following is a summary of the probability for occurrence of another initiator and a subsequent loss of D01. For those that are greater than 1E-7, I have also noted other recovery methods and approximate probabilities. The first value is the frequency of the initiator. The probability of losing D01 within the next 24 hours is approximately 3E-6. These are rough (but bounding) estimates to show how small the impact is.

Steam Generator Tube Rupture: 7E-3/yr * 3E-6 < 1E-7/yr
Transient without Main Feed: 2E-1 * 3E-6 * 5E-2(Feed/Bleed) < 1E-7
Dual Unit LOOP: 7E-3 * 3E-6 * 5E-2(Feed/Bleed) << 1E-7
Steam/Feed Break Inside Cont.: 5E-3 * 3E-6 < 1E-7
Loss of Service Water: 6E-5 * 3E-6 << 1E-7
Loss of Component Cooling Wtr: 3E-3 * 3E-6 << 1E-7
Steam Break Outside Cont.: 1E-2 * 3E-6 < 1E-7
SBO: 1E-6 * 3E-6 << 1E-7
Transient with Main Feed: 7E-1 * 3E-6 * 5E-2(Feed/Bleed) * 5E-2(Main Feed) << 1E-7
Loss of IA: 7E-5 * 3E-6 << 1E-7
Loss of D02: No change, loss of D01 and D02 would result in Core Damage

ATWS:	No change, loss of D01 would result in CD
LOCA:	Not highly dependant upon AFW - very little impact

Loss of Power to 3 of 4 Service Water Supply Valves to the AFW Pumps with a Loss of B Train AC Power: For this to be an issue, a number of things would have to occur besides the original initiator. A loss of offsite power would have to occur subsequent to the initiator. In addition, a single B train emergency diesel would have to be aligned to both units and that diesel would have to fail. In addition, the operator would have to fail to take manual local action to operate the valve. The operators are trained to perform this action.

CDF = INIT * LOSP * DieselB * HEPManual

INIT = Frequency of Initiator

LOSP = Probability of losing off-site power within 24 hours - approx 2E-5

DieselB = Probability of failing a single B train diesel and the fraction of time that the plant is aligned with a single B train diesel for both units. For this bounding analysis, the fraction is assumed to be 1.0. The probability of failing an EDG in 24 hours is approximately 5E-2

HEPManual = Probability that the operator fails to manually open the SW valve. Note that at least 45 minutes would be available. Estimated to be around 1E-3.

Steam Generator Tube Rupture:	7E-3/yr * 2E-5 * 5E-2 * 1E-3 < 1E-10/yr
Transient without Main Feed:	2E-1 * 2E-5 * 5E-2 * 1E-3 < 1E-10
Dual Unit LOOP:	7E-3 * 1.0 * 5E-2 * 1E-3 * 5E-2(F/B) < 1E-7
Steam/Feed Break Inside Cont.:	5E-3 * 2E-5 * 5E-2 * 1E-3 < 1E-10
Loss of Service Water:	6E-5 * 2E-5 * 5E-2 * 1E-3 < 1E-10
Loss of Component Cooling Wtr:	3E-3 * 2E-5 * 5E-2 * 1E-3 < 1E-10
Steam Break Outside Cont.:	1E-2 * 2E-5 * 5E-2 * 1E-3 < 1E-10
SBO:	No Change - AC power not available
Transient with Main Feed:	7E-1 * 2E-5 * 5E-2 * 1E-3 < 1E-10
Loss of IA:	1E-4 * 2E-5 * 5E-2 * 1E-3 < 1E-10
Loss of D02:	No Change - B Train AC not available
ATWS:	Minimal impact with a loss of offsite power
LOCA:	AFW has minimal impact on LOCA risk
Loss of D01:	1E-3 * 2E-5 * 5E-2 * 1E-3 < 1E-10

In summary, all of the electrical issues would result in risk values being less than 1E-6. The review above is primarily performed with conservative or bounding values with some of the values (particularly the HEPs) to be estimates. There is a lot of margin between the risk estimates and the 1E-6 threshold. This would more than make-up for any error that may occur within the estimates. I believe that the actual risk would be significantly less if a detailed evaluation were to be performed. If you believe any of these issues to be more significant than shown above, please let me know and if necessary, I can look into performing a detailed calculation to provide a more accurate picture of the risk.

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