OG-01-058
September 28, 2001

WCAP-15376-P, Rev. 0
Project Number 694

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Attention: Chief, Information Management Branch,
Division of Inspection and Support Programs

Subject: Westinghouse Owners Group
Transmittal of Response to Request for Additional Information (RAI) Regarding WCAP-15376-P, Rev. 0, "Risk-Informed Assessment of the RTS and ESFAS Surveillance Test Intervals and Reactor Trip Breaker Test and Completion Times" (MUHP-3046)

Reference: 1) NRC Letter, dated August 1, 2001, from M. L. Scott, NRC, to A. Drake, Westinghouse, Westinghouse Topical Report WCAP-15376, "Risk-Informed Assessment of the RTS and ESFAS Surveillance Test Intervals and Reactor Trip Breaker Test and Completion Times" (MUHP-3045) (TAC No. MB0983)

Attachment 1 to this letter transmits the responses to the Request for Additional Information (RAI) contained in Reference 1, except for RAI numbers 4 and 11. The responses to RAI numbers 4 and 11 requires additional analysis and will be transmitted to the NRC by November 19, 2001.

If you require further information, feel free to contact Mr. Ken Vavrek in the Westinghouse Owners Group Project Office at 412-374-4302.

Very truly yours,

Robert H. Bryan, Chairman
Westinghouse Owners Group

attachment

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OG-01-058
September 28, 2001

cc: WOG Steering Committee (1L, 1A)
WOG Primary Representatives (1L, 1A)
WOG Licensing Subcommittee Representatives (1L, 1A)
WOG MERITS Working Group Representatives (1L, 1A)
B. Barron, Duke Energy (1L)
C. Bakken, AEP (1L)
M.L. Scott, USNRC OWFN 07 E1 (1L)
C.K. Doutt, USNRC OWFN 8 H3 (1L)
R. Etling, W- ECE 5-43 (1L)
H. A. Sepp, W- ECE 4-15 (1L)
A. P. Drake, W- ECE 5-16 (1L, 1A)

Responses to NRC Request for Additional Information (RAI) on WCAP-15376-P "Risk-Informed Assessment of the RTS and ESFAS Surveillance Test Intervals and Reactor Trip Breaker Test and Completion Times"

NRC RAI 1, Part 1:
The Westinghouse Owners Group (WOG) is requesting extension of completion time (CT) for reactor trip breakers (RTBs) from 1 hour to 24 hours. The WOG is also requesting extension of the bypass time for RTBs from 2 hours to 4 hours. Please address the following questions:

- From an operational point of view, please explain how bypass time is related to the CT. Can a RTB be in an inoperable state and at the same time not be in a bypassed state? If so, for how long?

Response to NRC RAI 1, Part 1:
The bypass time is the amount of time that an RTB can be bypassed for surveillance testing (currently up to 2 hours, 4 hours is being requested), prior to starting the Completion Time clock (currently 1 hour, 24 hours is being requested). An RTB can be bypassed (inoperable), for a maximum time of 3 hours currently (2 hours for testing, plus a 1 hour Completion Time), and for a maximum time of 28 hours (4 hours for testing, plus a 24 hour Completion Time) being proposed by WCAP-15376. During the time that an RTB is bypassed for testing or corrective maintenance, the RTB is inoperable.

NRC RAI 1, Part 2:
- The fourth sentence in the third paragraph of Section 3 reads, "This can result in the shorter RTB CT and bypass time limiting logic cabinet activities if tested concurrently." What would be a representative alignment when a logic cabinet and a RTB are tested concurrently?

Response to NRC RAI 1, Part 2:
The amount of time that an RTB can be bypassed for testing is currently limited to 2 hours, and the current Completion Time is 1 hour. This bypass time of 2 hours limits the amount of time than an RTB can be bypassed for testing. The amount of time that a logic cabinet can be bypassed for testing is limited to 4 hours, and the Completion Time is 24 hours (WCAP-14333). If during the testing of an RTB, it is determined that the RTB is inoperable, the current RTB Completion Time of 1 hour does not provide sufficient time to allow the logic cabinet to be tested (1 hour Completion Time for an RTB, versus 24 hours for a logic cabinet), nor does it allow an RTB to be bypassed for greater than 2 hours, if tested concurrently. The requested changes to the RTB bypass time of 4 hours, and the Completion Time of 24 hours will make them consistent with the currently approved bypass time of 4 hours and Completion Time of 24 hours for the logic cabinet. Bypassing an RTB or logic train for testing or corrective maintenance will result in inoperability of that train.

The following is a discussion of a typical alignment that would be used for concurrent, sequential testing of the A (or B) Train of RTS and ESFAS logic, and RTB and Reactor Trip Bypass Breakers (RTBB). The Train A (or B) RTBB is racked into the Test Position and a shunt trip test is performed on the RTBB locally to verify that the RTBB will open upon receipt of a reactor trip signal. The Train A (or B) RTBB would be then racked in to the connect position and closed. The actuation logic would then be tested, followed by the SSPS Master Relays and output relays. The Train A (or B) RTB would then be tested to verify Operability of the undervoltage trip attachment and then the automatic shut trip mechanism. The Train A (or B) RTB would then be reset and theTrain A (or B) RTBB would be tripped and racked out.

NRC RAI 1, Part 3:
- The same paragraph addresses the inconsistency in the current technical specification (TS) related to CT and bypass time of RTBs and logic cabinets. It appears that this inconsistency was introduced as the result of changes requested under WCAP-10271 and WCAP-14333. Please confirm this and confirm that all such inconsistencies will have been removed after the proposed TS changes go into effect.

Response to NRC RAI 1, Part 3:
As discussed above in the response to NRC RAI 1, Part 2, the requested changes to the RTB bypass time of 4 hours and the Completion Time of 24 hours will make them consistent with the currently approved bypass time of 4 hours, and Completion Time of 24 hours for the logic cabinet. Bypassing an RTB or logic train for testing or corrective maintenance will result in inoperability of that train. The time that a logic cabinet can be bypassed was extended from 1.5 hours to 4 hours in WCAP-10271, and the Completion Time was extended from 6 hours to 24 hours in WCAP-14333. The RTB bypass time and Completion Time were not changed in either WCAP-10271 or WCAP-14333. To acknowledge this inconsistency in the bypass test times of 2 hours for the RTB and 4 hours for the logic cabinet, a Note was added to Condition R of Tech Spec 3.3.1 of NUREG-1431, Rev. 1 (Condition O of NUREG-1431, Rev. 2) to state that the RTB train may be bypassed for up to 4 hours for concurrent testing of the RTB and logic cabinet, since bypassing an RTB for testing would be limited to 2 hours by the Note in Condition R of NUREG-1431, Rev. 1 (Condition O of NUREG-1431, Rev. 2) if an RTB and logic cabinet were tested concurrently. Following approval of the change to extend the RTB bypass time to 4 hours, this Note will no longer be needed. The inconsistencies between the RTB and logic bypass times and Completion Times will be eliminated following approval of these changes. No other similar inconsistencies exist in Tech Spec 3.3.1 of NUREG-1431.

NRC RAI 2:
Please explain why WCAP-15376 proposes deletion of note 2 under "required action" for Condition R of TS 3.3.1. Also, WCAP-14333 requested approval to insert an additional note to TS 3.3.1, Condition R. Specifically, the note read, "One RTB train may be bypassed for up to [4] hours for concurrent surveillance testing of the RTB and automatic trip logic, provided the other train is OPERABLE." This note has been approved by NRC. However, it is not reflected in WCAP-15376. Please explain why.

Response to NRC RAI 2:
Note 2 in Condition R of Tech Spec 3.3.1, NUREG-1431, Rev. 1 (Condition O of NUREG-1431, Rev. 2) allows an RTB to be bypassed for up to 2 hours for performing maintenance on the undervoltage or shunt trip mechanisms. This Note was needed since the Completion Time for Condition R.1 in NUREG-1431, Rev. 1 (Condition O.1 of NUREG-1431, Rev. 2) is 1 hour. Following approval of the extension of the RTB Completion Time from 1 hour to 24 hours, this Note will no longer be needed, since an RTB will be able to be bypassed for up to 24 hours for corrective maintenance. See the response to NRC RAI 1, Part 3, above, with regard to the Note added by WCAP-14333 for concurrent surveillance testing of the RTB and automatic trip logic.

NRC RAI 3, Part 1:
Clarifications are needed regarding the relationship between the proposed changes, the baselines against which the proposed changes are to be measured, and previous changes to the baselines. Please address the following:

- Describe how the cumulative risks have been defined, tracked, and documented. Reference 3.32 of Regulatory Guide 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis." Are additional relaxations (surveillance test interval [STI] and allowed outage time [AOT/CT] proposed for the reactor trip system and engineered safety features actuation system (RTS/ESFAS) that may increase risk cumulatively with the proposed relaxations (e.g., slave relays, sensors, response time testing)?

Response to NRC RAI 3, Part 1:
Regulatory Guide 1.174, Section 3.3.2 gives the following as relevant information related to cumulative risks.

I. The calculated change in risk for each application (CDF and LERF) and the plant elements (e.g., SSCs, procedures) affected by each change.

WCAP-10271 and Supplements 1 and 2 provides the justification for the initial change to the Channel Operational Test (COT) STI and AOTs for the RTS and ESFAS. WCAP-14333 provides the

justification for additional extensions to the AOTs for the RTS and ESFAS. WCAP-15376 now provides the justification for extensions to the STIs for the RTS and ESFAS, and for the reactor trip breaker (RTB) AOT. The specific changes considered in each of these WCAPs are provided on Tables 1.1, 1.2, 4.1, and 4.2 of WCAP-15376. These three studies have used a risk approach to justify the changes. The cumulative impact on risk of these changes is provided in WCAP-15376 on Table 8.33.

The following additional changes have also been justified for the RTS/ESFAS.

- WCAP-13877 ("Reliability Assessment of Westinghouse Type AR Relays Used as SSPS Slave Relays") used a failure modes and effects analysis, an aging assessment, and data analysis to demonstrate that the slave relay failure probability is not impacted by its STI. Since the relay failure probability is independent of its STI, there is no impact on risk.

- WCAP-13878 ("Reliability Assessment of Potter & Brumfield MDR Series Relays") used a failure modes and effects analysis, an aging assessment, and data analysis to demonstrate that the slave relay failure probability is not impacted by its STI. Since the relay failure probability is independent of its STI, there is no impact on risk.

- WCAP-13632 ("Elimination of Pressure Sensor Response Time Testing Requirements") used a failure modes and effects analysis to show that component failures that can cause response time degradation will be detected by sensor calibration tests. Therefore, this change does not impact the reliability of the components, or the time between detecting unacceptable response time testing, so there is no impact on risk.

- WCAP-14036 ("Elimination of Periodic Protection Channel Response Time Tests") used a failure modes and effects analysis, and the results of tests on the electronic signal processing with degraded components of the reactor protection circuitry to justify relaxation of periodic response time testing. Bounding circuit response times were used in an assessment to show acceptable results. In addition, response time degradation will be detected by other tests, such as, calibration tests and other Tech Spec surveillance testing requirements. WCAP-15376 only proposes to increase the interval between the COTs, and not to change the test itself. Therefore, the COT will still be able to detect failures that impact the response time. An unacceptable component degradation that is identified by the COT is considered a failure in the WCAP-15376 analysis, and would also be considered a failure with regard to response time. Acceptable tests with respect to the COT are also acceptable from the perspective of response time. Failures of the COT, which result in an unacceptable response time, are included in the RTS and ESFAS unavailability analyses as component failures. Therefore, the impact of changing the COT intervals on response time and the proper functioning of the channel is reflected in the analysis.

No other WOG programs are currently in progress that will impact the reliability or availability of the RTS/ESF actuation signals for the W solid state protection system or the relay protection system.

The Westinghouse Standard Technical Specifications affected by these changes have been previously provided to the NRC with the WCAP submittals.

II. Qualitative arguments that were used to justify the change (if any) and the plant elements affected by these arguments.

Not applicable to WCAP-10271 and Supplements 1 and 2, WCAP-14333, or WCAP-15376 since the justification used for these changes are quantitative. The justifications used in the other WCAPs (WCAP-13877, WCAP-13878, WCAP-13632, and WCAP-14036) are discussed above.

III. Compensatory measures or other commitments used to help justify the change (if any) and the plant elements affected.

WCAP-10271 and Supplements 1 and 2: No compensatory measures are required.
WCAP-14333: No compensatory measures are required.
WCAP-13877: No compensatory measures are required.
WCAP-13878: No compensatory measures are required.
WCAP-13632: No compensatory measures are required.
WCAP-14036: No compensatory measures are required.

IV. Summarized results from the monitoring programs (where applicable) and a discussion of how these results have been factored into the PRA or into the current application.

WCAP-10271 and Supplements 1 and 2: There are no specific monitoring programs required.
WCAP-14333: There are no specific monitoring programs required.
WCAP-13877: Establish a program to evaluate the adequacy of the proposed test interval if two or more AR relays fail in a 12 month period.
WCAP-13878: Establish a program to evaluate the adequacy of the proposed test interval if two or more MDR relays fail in a 12 month period.
WCAP-13632: There are no specific monitoring programs required.
WCAP-14036: There are no specific monitoring programs required.

10CFR50.65, the Maintenance Rule, will be used where applicable to monitor the component performance via the performance criteria requirement. Plants that include these components in their PRA model and collect plant specific reliability data on these components will enable utilities to establish a degree of performance monitoring. That is, during PRA model updates, component failure probabilities that change significantly can be identified.

NRC RAI 3, Part 2:

- Item 6 of WCAP-15376, Section 5.0 states: "The analysis results should be referenced back to pre-TOP (TS Optimization Program) and TOP (WCAP-10271) AOT and STI conditions." The second paragraph of Section 8.3.1 defines the base case as the model developed for WCAP-14333. As stated in the first paragraph of Section 8.3.3 of WCAP-15376, the base case model chosen for comparative risk studies was not the original WCAP-14333 model but a variation of the WCAP-14333 model in which Westinghouse modeled the components in logic cabinets at the card level instead of at the component level. Please clarify and justify the choice of the base model and comment on the appropriateness of the conclusions drawn from comparative risk studies in view of the use of a modified base case.

Response to NRC RAI 3, Part 2:

Fault Tree Models

The fault tree models used to evaluate the signal unavailabilities are based on the models used in the WCAP-14333 evaluation. This means that the same fault trees that formed the basis for the signal unavailability analysis in the WCAP-15376 study, as those used in WCAP-14333. The assumptions in Sections 8.3.2 which define the fault tree structure are identical in the two studies. The only changes to these trees are discussed in Section 8.3.3 of WCAP-15376. These are:

- Multiple master relay failure modes modeled as separate basic events have been combined into one basic event.
- Logic cabinet components were moved from component level modeling, to card level modeling. That is, instead of modeling the logic cabinets at the component level, this study models at the card level.
- In the previous studies, the fault trees were split into several parts and quantified separately. In the WCAP-15376 study, one single fault tree is used for each signal that is evaluated.

The first two changes were made since industry specific data was available for this study at the master

relay level and card level. Using industry specific data provides a more realistic assessment of the signal unavailability. These two changes represent improvements to the fault tree models. The third change was made to simplify the quantification process. In addition to these changes to the fault trees, the component failure probability data and several common cause failure parameters were updated using the most recently available data. The component failure probabilities are provided in Section 8.2, and the common cause factors are provided in Section 8.3.1 of WCAP-15376. Therefore, the base fault tree models used in this study are the fault trees modified as noted above, and the data that was updated to include the most recent data available.

The signal unavailabilities for the currently approved STIs and AOTs (listed in Tables 1.1 and 1.2 of WCAP-15376 under the WCAP-14333 heading) were re-evaluated using the modified fault trees. This is referred to as the Base Case. The results for all the other cases presented on Tables 8.9 through 8.23 of WCAP-15376 are based on these same fault trees and data.

It was acknowledged in WCAP-15376 that these fault tree and data changes will impact the signal unavailability values calculated for the same STI and AOT parameters between the WCAP-14333 and WCAP-15376 analyses, but these changes also provide more representative values. That is, the signal unavailability values calculated for the same set of STIs and AOTs using the WCAP-14333 and WCAP-15376 fault tree models will not be the same. This is discussed in Section 8.3.5 of WCAP-15376. Table 8.25 provides a comparison of signal unavailabilities from three different studies; the current study (WCAP-15376), WCAP-14333, and NUREG/CR-5500. This comparison demonstrates that the signal unavailabilities improve (values reduce) as the modeling and data (industry specific data) improve. Note that the unavailability values for the RT signals improve significantly from WCAP-14333 to WCAP-15376. This is primarily due to replacing conservative generic data, with industry specific data for reactor trip breaker random failures and common cause failures. Although these unavailability values are significantly lower than the WCAP-14333 values, they are similar to those provided in NUREG/CR-5500. The current study is considered a better assessment of the signal unavailability.

Therefore, the base fault tree models used in the WCAP-15376 study represent an improved assessment of signal unavailability over previous studies.

PRA (Risk) Model

The Vogtle PRA model used in the WCAP-14333 study was also used in the WCAP-15376 study. No changes were made to the model for the current analysis.

Appropriateness of Approach

Due to the fault tree model changes made between WCAP-14333 and WCAP-15376, it could be argued that to have a valid assessment of the risk change from the pre-TOP or TOP STI and AOT parameters to the parameters proposed in WCAP-15376, the signal unavailabilities for the pre-TOP and TOP parameters should be re-calculated using the modified fault trees and updated data. But, this is not necessary in this case, due to the changes being considered in each WCAP.

From pre-TOP to TOP (WCAP-10271 and Supplements 1 and 2) AOT changes, bypass time changes, and STI changes (analog channels only) were considered. From TOP to WCAP-14333 only AOT and bypass time changes were considered.

When considering only AOT or bypass time changes, the exact modeling of the components is not critical since their reliability is not impacted by the AOT or bypass time change. The component reliability remains the same in the "before" and "after" cases. What is important, is the impact of the AOT and bypass time changes on component unavailability (not component reliability or failure probability) due to testing and maintenance activities. Therefore, it is acceptable to use the two different fault tree models used in these studies, and to sum their impacts on risk to determine the cumulative impact.

In the case where an STI change was considered, this approach may not be necessarily accurate, due to the

modeling and component reliability data differences, and their impact on the signal unavailabilities. For the situation of concern here, only STI changes for the analog channels in the TOP (WCAP-10271 and Supplements 1 and 2) analysis are involved. But these studies have shown that analog channels generally do not contribute significantly to signal unavailability, when considering diversity and backup operator actions, so the impact of this approach is small.

NRC RAI 3, Part 3:

- The cumulative core damage frequency (CDF) changes relative to two regimes are compared in Section 8.4.4. Is the comparison realistic in light of the fact the both the logic models and data have been changed since the approval of WCAP-10271?

Response to NRC RAI 3, Part 3:
As discussed above, this is a valid approach, considering the STI and AOT changes being considered and the modeling differences between the two regimes.

NRC RAI 3, Part 4:

- The comparison provided in Table 8.33 does not match the information in the WCAP-14333 safety evaluation report (SER). Please explain the reason for this difference.

Response to NRC RAI 3, Part 4:
The core damage frequency (CDF) values reported in the SER are from Table 8.4 of WCAP-14333. The NRC provides the CDF values for 2/4 and 2/3 logic for the case that does not credit a 0.5 trips/year reduction in transient initiating event frequency. These cases are labeled "TOP" and "Proposed" on Table 8.4. The sensitivity cases shown on Table 8.4 of WCAP-14333 credit this reduction in transient initiating event frequency. The values provided in Table 8.33 of WCAP-15376 for "CDF Impact: Pre-TOP to WCAP-14333" are also from Table 8.4 of WCAP-14333. The values provided are changes in CDF for 2/4 and 2/3 logic for the sensitivity cases (crediting a 0.5 trips/year reduction in transient initiating event frequency). These are calculated as follows:

2/4 logic: -2.3E-07/yr = 5.683E-05/yr – 5.706E-05/yr
2/3 logic: 2.4E-07/yr = 5.741E-05/yr – 5.717E-05/yr

The values for "CDF: WCAP-14333 to Current Request" are for Case 7 from Table 8.29 of WCAP-15376. The values for "CDF Impact: Pre-TOP to Current Request" is the summation of the values "CDF Impact: Pre-TOP to WCAP-14333" and "CDF Impact: WCAP-14333 to Current Request".

NRC RAI 4:
The AOT risk analysis for RTBs does not follow guidelines of NUREG/CR-6141 relative to common cause failure analysis. According to the guidelines, if the limiting condition for operation (LCO) is entered for corrective maintenance (CM), the redundant hardware should be assigned a β-factor, which is the conditional failure probability given one item has already failed. The AOT risk of CM, if provided, can provide the upper bound for the AOT risk associated with the LCO configuration. Please explain why the common cause failure analysis guidelines of NUREG/CR-6141 were not used for the AOT risk analysis for RTBs in WCAP-15376. Also, please describe what steps would be taken to provide assurance against common cause hardware failures.

Response to NRC RAI 4:
The response to this NRC RAI will be provided by November 19, 2001.

NRC RAI 5:
Please clarify how and when operator actions are credited in the signal unavailability analyses. Some operator actions appear to be credited in the fault trees and others in the accident sequences. Please explain how assurance is provided that operator credit is not "double-counted" in the analysis. Also, please address the following:

- It appears that some of the human error probabilities (HEPs) provided in Table 8.28 of the analysis (WCAP-15376, page 8-52) do not correlate with the HEPs listed in Table 3.3.3.2 of the Vogtle probabilistic risk analysis (PRA). Please explain how the events OSI1, OSI2, OMG, and OCR of the Vogtle PRA model correspond to events listed in Table 8.28 of WCAP-15376.

- Please explain how the split fractions for top events engineered safety features (ESF) and reactor trip (RT) of the Vogtle PRA (Table 3.3.5-1, pages 3-141 and 3-153) are impacted as a result of the requested changes. In your response please correlate these split fractions to split fractions reported under the "base case" regime in Table 8.9 through 8.13 of WCAP-15376.

Response to NRC RAI 5:
Table 8.28 lists the operator actions that are important to this analysis. These are:

- Reactor trip from the main control board trip switches (ORT)
- Reactor trip by interrupting power from the motor-generator sets (OMG)
- Manually insert the control rods into the core (OCR)
- Safety injection from the main control board switches (OSI1)
- Safety injection by manual actuation of individual components (ESFAS-HE1)
- Auxiliary feedwater (AFW) pump start

Note that OSI2 (Initiate manual SI; SI switch fails – manual alignment required) is not used.

Reactor trip is modeled in the event trees (accident sequences) for each event. ORT is included in the fault trees used to model the unavailability of reactor trip signals as noted on Table 8.26 in WCAP-15376. If reactor trip fails, then the sequence is treated as an ATWS event, and OMG is modeled in the ATWS event tree. OMG always follows failure of reactor trip. OCR is also modeled in the ATWS event tree following failure of reactor trip and OMG.

The SI signals are included in the support state model. The values (split fractions) used are dependent on the event under consideration. For large LOCA events, no credit is taken for operator actions. For medium LOCA events, credit to actuate safety injection from the control board (OSI1) is included. This is modeled directly in the fault trees used to model the unavailability of SI. For other events, in which there is sufficient time to credit additional operator actions if the SI signal fails, manual actuation of individual components is modeled by "ANDing" the failure of the automatic actuation signals with the failure of the operator actions to actuate the individual components. Operator actions credited related to ESFAS are summarized on Table 8.27 in WCAP-15376.

The signals to start the AFW pump, in response to events not generating a SI signal, are modeled in the fault tree for the AFW system. This includes the AFW pump start signal, the operator action, and the AMSAC signal. Signals are also modeled for starting containment sprays and performing steam generator isolation. These signals are modeled in the fault trees for those functions.

To ensure that the correct signals and operator actions are modeled, the structure of each event tree is developed consistent with the emergency operating procedures. In addition, the event trees are developed consistent with the support state model and the signals (automatic and operator actions) included in it.

The events OSI1, ESFAS-HE1, OMG, and OCR, defined above, are the same in the Vogtle PRA and in this study. Table RAI 5-1 summarizes the HEPs for these actions, and the reasons the for numerical value differences.

Table RAI 5-2 provides a comparison of the ESF and RT Vogtle PRA split fractions (unavailabilities) to those used in this study. Please note the following on the use of the Vogtle and the WCAP-15376 split fractions in the risk analysis:

- The split fractions for top events ESF and RT from the Vogtle PRA (Table 3.3.5-1) are not used in this study. The values in WCAP-15376, Tables 8.9 through 8.13, are used in this analysis for ESF and RT in the risk analysis.

- The Vogtle values, as with any plant specific values, are based on Vogtle specific testing and maintenance requirements, and Vogtle specific mean time to test and repair values. The WCAP-15376 values are based on more generic assumptions that result in a more conservative analysis applicable to all Westinghouse NSSS plants. The WCAP-15376 analysis assumes the total test time, bypass time, and AOT is used. In actual practice, the total is not used, which would be reflected in the Vogtle or any plant specific PRA.

- The overall approach used in the study is discussed in Section 8.1.3 of the WCAP. Step 3 of the process calculates the impact of the STI, AOT, and bypass time changes on a number of signal unavailabilities. In Step 4, these unavailabilities are used as input to the Vogtle PRA model, replacing the Vogtle specific values, to determine the impact on risk.

Table RAI 5-1 Comparison of Vogtle Specific and WCAP-15376 Human Error Probabilities			
Operator Action	**HEP (Vogtle)[1]**	**HEP (WCAP-15376)[2]**	**Comments**
OSI1	7.04E-03	1E-02	The value used in this study is a conservative value based on a review of a number of plant PRAs for Westinghouse NSSS plants and not taken directly from the Vogtle PRA.
ESFAS-HE1	2.14E-03	2E-03	The value used in this study is essentially the same as that used in the Vogtle PRA.
OMG	4.40E-03 or 0.5[3]	0.5	The value used in the WCAP-15376 study was 0.5. This assumes the failure of a previous OA on which OMG is dependent.
OCR	1.43E-02 or 0.5[4]	0.5	The value use in the WCAP-15376 study was 0.5. This assumes the failure of a previous OA on which OCR is dependent.

Notes:

1. Vogtle IPE Report, Table 3.3.3-2.
2. WCAP-15376, Table 8.28.
3. The second value is based on the failure of a preceding operator action (ORT).
4. The second value is based on the failure of preceding operator actions (ORT and OMG).

Table RAI 5-2 Comparison of Vogtle Specific and WCAP-15376 ESF and RT Split Fractions		
Signal	**Vogtle Split Fraction**	**WCAP-15376 Split Fraction[1]**
ESF trains A&B fail (large LOCA)	7.07E-04[2]	8.96E-04[3]
ESF train A fails (large LOCA)	8.51E-03[2]	2.74E-02[3]
ESF train B fails (large LOCA)	8.51E-03[2]	2.74E-02[3]
ESF trains A&B fail (medium LOCA)	7.07E-04[2]	6.05E-04[4]
ESF train A fails (medium LOCA)	8.51E-03[2]	2.49E-02[4]
ESF train B fails (medium LOCA)	8.51E-03[2]	2.49E-02[4]
ESF trains A&B fail (other events)	1.51E-06[5]	1.29E-06[6]
ESF train A fails (other events)	4.26E-04[5]	1.25E-03[6]
ESF train B fails (other events)	4.26E-04[5]	1.25E-03[6]
ESF (manual actuation of components) fails	2.14E-03[7]	2.0E-03[8]
RT fail (non diverse signal with OA) – all support	1.23E-06[7]	2.74E-06[9]
RT fail (non diverse signal with OA) – no support	4.61E-06[7]	1.63E-05[10]
RT fail (diverse signal with OA) – all support	7.03E-07[7]	2.22E-06[9]
RT fail (diverse signal with OA) – no support	4.08E-06[7]	1.58E-05[10]

Notes:

1. Split fractions provided for 2/4 logic.
2. Includes credit for operators initiating SI via the SI switch in the control room. From Table 3.3.5-1 of the Vogtle IPE report.
3. Does not include credit for operators initiating SI via the SI switch in the control room. From Table 8.9 of WCAP-15376.
4. Includes credit for operators initiating SI via the SI switch in the control room. From Table 8.9 of WCAP-15376.
5. Includes credit for operators manually actuating components required for SI. From Table 3.3.5-1 of the Vogtle IPE report.
6. Includes credit for operators manually actuating components required for SI. Not provided in WCAP-15376, obtained from a Westinghouse calculation.
7. From Table 3.3.5-1 of the Vogtle IPE report.
8. From Table 8.28 of WCAP-15376.
9. From Table 8.12 of WCAP-15376.
10. Not provided in WCAP-15376, obtained from a Westinghouse calculation.

NRC RAI 6:

Westinghouse developed failure probabilities for several components based on a WOG survey (Table 8.6). The failure probabilities were used in the analysis of the fault trees to determine the impact of the proposed changes. WCAP-15376 does not identify the observation period for the actual demand and failure data provided by the plants. Please provide the data observation periods.

Response to NRC RAI 6:
Tables RAI 6-1 and RAI 6-2 provide the observation periods for each plant that supplied data.

Table RAI 6-1
Data Observation Periods: Solid State Protection System Plants

Plant	Start Date	End Date
Braidwood Unit 1	7/29/88	11/13/96
Braidwood Unit 2	10/17/88	11/13/96
Byron Unit 1	9/16/85	12/03/98
Byron Unit 2	8/21/87	12/03/98
Callaway	12/19/84	11/30/98
Comanche Peak Unit 1	8/13/90	12/07/98
Comanche Peak Unit 2	8/03/93	12/07/98
Diablo Canyon Unit 1	5/07/85	7/19/96
Diablo Canyon Unit 2	3/13/86	7/19/96
Maanshan Unit 1	7/07/84	7/29/96
Maanshan Unit 2	5/05/85	7/29/96
McGuire Unit 1	12/01/81	8/07/97
McGuire Unit 2	3/01/84	8/07/97
North Anna Unit 1	6/06/78	12/07/98
North Anna Unit 2	12/14/80	12/07/98
Sequoyah Unit 1	7/01/81	7/01/96
Sequoyah Unit 2	6/01/82	7/01/96
South Texas Unit 1	8/25/88	11/30/98
South Texas Unit 2	6/19/89	11/30/98
Vogtle Unit 1	6/01/87	7/01/96
Vogtle Unit 2	5/20/89	7/01/96
Wolf Creek	9/03/85	7/18/96

Table RAI 6-2
Data Observation Periods: Relay Protection System Plants

Plant	Start Date	End Date
Indian Point Unit 2	8/01/74	7/23/96
Point Beach Unit 1	1/01/86	11/19/96
Point Beach Unit 2	1/01/86	11/19/96
Prairie Island Unit 1	12/16/73	7/19/96
Prairie Island Unit 2	12/21/74	7/19/96
Turkey Point Unit 3	12/14/72	7/25/96
Turkey Point Unit 4	9/07/73	7/25/96

NRC RAI 7:
Please explain why conclusion 4 on page 8-28 does not hold for total signal unavailability (e.g., ESFAS system).

Response to NRC RAI 7:
Conclusion 4 states "The ESFAS single train unavailabilities with common cause failure contributions for the Proposed Case are lower than the signal unavailabilities for the Base Case. This is directly related to the trade-off between the increased component failure probability and the decreased component unavailability due to the increased test interval." To fully understand this conclusion, it is necessary to examine the cutsets for both cases. Consider the safety injection signal with 2 of 4 logic for the SSPS. Table RAI 7-1 provides the dominant cutsets for this signal (dual train) with all support available for the Base Case and the Proposed Case. The cutsets contributing greater than 1.0E-06 for the Base Case are provided along with their comparable values for the Proposed Case. It can be concluded from this discussion that the common cause failure contributions dominate the signal unavailability, and therefore, they dominate the signal unavailability increase. Since the common cause failure contributions are directly proportional to the STI, the increase in the signal unavailability is driven by the STI increase. Table RAI 7-2 provides the dominant cutsets for this signal (single train) with all support available for the Base Case and the Proposed Case. The cutsets with contributors greater than 1.0E-04 for the Base Case are provided along with their comparable values for the Proposed Case. It can be concluded from this discussion, that testing (MTESTSI) is a large contributor to signal unavailability, and as the test interval is extended, this contribution is reduced. The increase in signal unavailability due to the higher component failure probabilities related to the STI increase does not completely match the reduction, therefore, the overall signal unavailability is decreased. In addition, the common cause failures that dominate the dual train unavailabilities are not valid cutsets for single train unavailabilities.

The following defines the cutset nomenclature:

MRxMSI – Master relay X in maintenance
MTESTSI – Train in test, master relay and logic cabinet
SGDxF – Safeguards driver card X fails
SRxxFS – Slave relay XX fails shorted electrically
SRxxMB – Slave relay XX fails due to mechanical binding
SRxxT – Slave relay XX in test
TxTSI – Train X in test
ULxxxxF – Universal logic card XXXX fails

Table RAI 7-1 Contributors to Signal Unavailability: Safety Injection, SSPS, 2/4 Logic, Dual Train			
Cutset	**Cutset**	**Base Case**	**Proposed Case**
1	CCF Slave Relays	5.15E-04	5.15E-04
2	CCF Universal Logic Cards	8.45E-05	2.53E-04
3	CCF Analog Channels	3.35E-05	6.23E-05
4	CCF Safeguards Driver Card	2.95E-05	8.85E-05
5	CCF Power Supply, 118V	5.40E-06	5.40E-06
6	TBTSI, SGDCF	4.81E-06	4.84E-06
7	TATSI, SGDEF	4.81E-06	4.84E-06
8	CCF Power Supply, 48V	3.60E-06	3.60E-06
9	CCF Power Supply, 15V	3.60E-06	3.60E-06
10	SRC1MB, TBTSI	3.52E-06	1.18E-06
11	SRC2MB, TBTSI	3.52E-06	1.18E-06
12	SRC3MB, TBTSI	3.52E-06	1.18E-06
13	SRD1MB, TBTSI	3.52E-06	1.18E-06
14	SRD2MB, TBTSI	3.52E-06	1.18E-06
15	SRD3MB, TBTSI	3.52E-06	1.18E-06
16	SRE1MB, TATSI	3.52E-06	1.18E-06
17	SRE2MB, TATSI	3.52E-06	1.18E-06
18	SRE3MB, TATSI	3.52E-06	1.18E-06
19	SRF1MB, TATSI	3.52E-06	1.18E-06
20	SRF2MB, TATSI	3.52E-06	1.18E-06
21	SRF3MB, TATSI	3.52E-06	1.18E-06
22	TBTSI, UL313CF	3.12E-06	3.14E-06
23	TBTSI, UL416CF	3.12E-06	3.14E-06
24	TBTSI, UL308CF	3.12E-06	3.14E-06
25	TBTSI, UL315CF	3.12E-06	3.14E-06
26	TBTSI, UL404CF	3.12E-06	3.14E-06
27	TATSI, UL313EF	3.12E-06	3.14E-06
28	TATSI, UL416EF	3.12E-06	3.14E-06
29	TATSI, UL308EF	3.12E-06	3.14E-06
30	TATSI, UL315EF	3.12E-06	3.14E-06
31	TATSI, UL404EF	3.12E-06	3.14E-06
32	SRC1T, SGDEF	1.08E-06	3.23E-06
33	SRC2T, SGDEF	1.08E-06	3.23E-06
34	SRC3T, SGDEF	1.08E-06	3.23E-06
35	SRD1T, SGDEF	1.08E-06	3.23E-06
36	SRD2T, SGDEF	1.08E-06	3.23E-06
37	SRD3T, SGDEF	1.08E-06	3.23E-06
38	SRE1T, SGDCF	1.08E-06	3.23E-06
39	SRE2T, SGDCF	1.08E-06	3.23E-06
40	SRE3T, SGDCF	1.08E-06	3.23E-06
41	SRF1T, SGDCF	1.08E-06	3.23E-06
42	SRF2T, SGDCF	1.08E-06	3.23E-06
43	SRF3T, SGDCF	1.08E-06	3.23E-06

Table RAI 7-2 Contributors to Signal Unavailability: Safety Injection, SSPS, 2/4 Logic, Single Train			
Cutset	**Cutset**	**Base Case**	**Proposed Case**
1	MTESTSI	8.22E-03	2.74E-03
2	SRC1T	1.83E-03	1.83E-03
3	SRC2T	1.83E-03	1.83E-03
4	SRC3T	1.83E-03	1.83E-03
5	SRD1T	1.83E-03	1.83E-03
6	SRD2T	1.83E-03	1.83E-03
7	SRD3T	1.83E-03	1.83E-03
8	MRCMSI	1.16E-03	1.16E-03
9	MRDMSI	1.16E-03	1.16E-03
10	SGDCF	5.90E-04	1.77E-03
11	SRC1MB	4.32E-04	4.32E-04
12	SRC2MB	4.32E-04	4.32E-04
13	SRC3MB	4.32E-04	4.32E-04
14	SRD1MB	4.32E-04	4.32E-04
15	SRD2MB	4.32E-04	4.32E-04
16	SRD3MB	4.32E-04	4.32E-04
17	UL313CF	3.83E-04	1.15E-03
18	UL416CF	3.83E-04	1.15E-03
19	UL308CF	3.83E-04	1.15E-03
20	UL315CF	3.83E-04	1.15E-03
21	UL404CF	3.83E-04	1.15E-03
22	SRC1FS	1.08E-04	1.08E-04
23	SRC2FS	1.08E-04	1.08E-04
24	SRC3FS	1.08E-04	1.08E-04
25	SRD1FS	1.08E-04	1.08E-04
26	SRD2FS	1.08E-04	1.08E-04
27	SRD3FS	1.08E-04	1.08E-04

NRC RAI 8:
Section 8.1.1 of WCAP-15376 identifies the representative reactor protection system (RPS) signals that are used for evaluation. Please provide additional explanation of the basis for selection of these representative signals and how assurance is provided that analysis of these signals bounds the risk posed by the proposed changes.

Response to NRC RAI 8:
To determine the impact of the Tech Spec changes on signal unavailability, it is necessary to identify the signals to evaluate. The original analysis (WCAP-10271 and Supplements 1 and 2) evaluated the impact of Tech Spec AOT, STI, and bypass time changes on a large number of signals, that is, those contained in the Westinghouse Standard Tech Specs which are common to most plants. It was concluded from the WCAP-10271 work, with regard to the signal unavailability impact, that the actuation signals can be grouped according to several important design features. These are the number of master and slave relays, logic cabinet type (SSPS or relay), and actuation logic. This is discussed in detail in Sections 6.0, 6.1, and 6.2 of WCAP-14333. As discussed in those sections, the decision is based on the signal unavailability values and the changes in unavailability values. Therefore, it is not necessary to evaluate the impact of the proposed Tech Spec changes in WCAP-15376 on all RT and ESF actuation signals as was done in WCAP-10271 and Supplements 1 and 2, but only to group the signals according to the important design features, and then complete the signal unavailability analysis on this reduced number of signals. This smaller set of signals are referred to as the representative signals, since the impact of the changes on them is the same as the impact on the signal(s) they represent. This is the same approach that was used in WCAP-14333. Please see WCAP-14333, Sections 6.0, 6.1, and 6.2, for additional discussion on this item.

It should noted that the actual logic (2/3 vs. 2/4 vs. a coincident logic) is not important to the impact on signal unavailability when backup operator actions or the availability of diverse signals are considered, and in most cases, either a backup operator action is possible, or signals from additional sources are available for the RT or the ESF function of interest. When considering the actual plant response to events, the analog channel logic is not a large influence on signal unavailability due to the backup (or diverse) signals available, and operator response.

The Table RAI 8-1 lists the signals evaluated, and the signals they represent with regard to signal unavailability impact. For example, if a signal unavailability value (or split fraction) is needed for steamline isolation on steamline pressure low with 2 of 3 logic for the SSPS, the value to be used is obtained from the signal unavailability evaluation for auxiliary feedwater pump start on steam generator level low-low with 2 of 3 logic in one loop.

Table RAI 8-1 Summary of Representative ESF Actuation Signals and RT Signals	
Signal	**Used to Represent**
Solid State Protection System	
Safety injection on pressurizer pressure low with 2 of 3 logic	Safety injection on 2/3 logic Containment spray on 2/3 logic Containment phase B isolation on 2/3 logic
Safety injection on pressurizer pressure low with 2 of 4 logic	Safety injection on 2/4 logic Containment spray on 2/4 logic Containment phase B isolation on 2/4 logic
Auxiliary feedwater pump start on steam generator level low-low with 2 of 3 logic in one loop	Auxiliary feedwater pump start on 2/3 logic Steamline isolation on 2/3 logic Main feedwater isolation on 2/3 logic
Auxiliary feedwater pump start on steam generator level low-low with 2 of 4 logic in one loop	Auxiliary feedwater pump start on 2/4 logic Steamline isolation on 2/4 logic Main feedwater isolation on 2/4 logic
Reactor trip on pressurizer pressure high with 2 of 3 logic	All reactor trip signals generated by 2/3 logic
Reactor trip on pressurizer pressure high with 2 of 4 logic	All reactor trip signal generated by 2/4 logic
Reactor trip on pressurizer pressure high with 2 of 3 logic or overtemperature delta T with 2 of 4 logic	All reactor trip signals developed from multiple sources
Relay Protection System	
Safety injection on pressurizer pressure low with 2 of 3 logic	Safety injection on 2/3 logic Steamline isolation on 2/3 logic Containment spray on 2/3 logic Containment phase B isolation on 2/3 logic
Safety injection on pressurizer pressure low with 2 of 4 logic	Safety injection on 2/4 logic Steamline isolation on 2/4 logic Containment spray on 2/4 logic Containment phase B isolation on 2/4 logic
Auxiliary feedwater pump start on steam generator level low-low with 2 of 3 logic in one loop	Auxiliary feedwater pump start on 2/3 logic Main feedwater isolation on 2/3 logic
Auxiliary feedwater pump start on steam generator level low-low with 2 of 4 logic in one loop	Auxiliary feedwater pump start on 2/4 logic Main feedwater isolation on 2/4 logic
Reactor trip on pressurizer pressure high with 2 of 3 logic	All reactor trip signals generated by 2/3 logic
Reactor trip on pressurizer pressure high with 2 of 4 logic	All reactor trip signal generated by 2/4 logic
Reactor trip on pressurizer pressure high with 2 of 3 logic or overtemperature delta T with 2 of 4 logic	All reactor trip signals developed from multiple sources

NRC RAI 9:
The single AOT risk for the reactor trip breakers is reported in Section 8.4.3.2. Please provide the following additional information:

- The percent contribution of anticipated transient without scram (ATWS) events to total CDF for Vogtle and other Westinghouse plants; and
- Whether the AOT risk results credit AMSAC.

Response to NRC RAI 9:
Table RAI 9-1 provides a summary of the ATWS contribution to CDF for Westinghouse NSSS plants. This information was provided by utilities to respond to this RAI, therefore, it is the most current information available. Not all utilities provided the ATWS information; those that did are listed. Care must be taken when comparing ATWS contributions between plants. The details of the modeling of the ATWS event varies between plants, so a direct comparison of percent contribution is not always meaningful. The Vogtle model used in the WCAP-15376 analysis reflects an accurate ATWS model and appropriate modeling of reactor trip signals for this evaluation. The ATWS contribution of this model is also provided in Table RAI 9-1, in addition to the current ATWS contribution to CDF for Vogtle. Note that the difference in these values is due to the following:

- WCAP-15376 is a generic analysis covering all WOG plants, therefore, it was assumed that the full bypass times, test times, and AOTs are used during test and maintenance activities, while the Vogtle model used values based on plant specific experience.

- WCAP-15376 used generic component failure rates and common cause failure factors, while the Vogtle PRA uses plant specific values where available.

The AOT risk results credit AMSAC to start the auxiliary feedwater pump and trip the turbine during an ATWS event. AMSAC is also credited as another method for starting auxiliary feedwater during a transient event, if the auxiliary feedwater start signal and the backup operator action fails.

Table RAI 9-1 Summary of Percent ATWS Contribution to Core Damage Frequency	
Plant	**Percent ATWS Contribution**
Plant A	4.4% (Unit 1) 13.9% (Unit 2)
Plant B	1.1%
Plant C	0.6%
Plant D	3.8%
Plant E	<0.1%
Plant F	<0.1%
Plant G	1.7%
Plant H	10.5%
Plant I	0.5%
Plant J	4.2%
Plant K	0.4%
Plant L	2.0%
Plant M	2.1%
Plant N	7.4%
Plant O	5.8%
Plant P	1.7%
Plant Q	~20%
Vogtle	0.4%
Vogtle (WCAP-15376 study)	2.1%
Plant R	7.7%
Plant S	2.2%

NRC RAI 10:
Regarding Sections 8.4.3.3 and 8.4.3.4 and the discussion of large early release frequency (LERF) and incremental conditional large early release probability (ICLERP): please provide the quantitative metrics used for "early" and for "large" in the Vogtle LERF model. For example, are all "early" failures considered "large," or do you discriminate between large and small releases at some radiological release threshold? Is a "Level-3" PRA performed to determine the effect of evacuation on early fatalities? Please provide the contributors (accident sequences) that contribute to the Vogtle LERF. Is this basically the same set of contributors across all the relevant Westinghouse plants?

Response to NRC RAI 10:
For the purpose of this analysis, LERF and ICLERP are based on the following sources:

- Core damage with containment bypass
  - Interfacing systems LOCA (ISLOCA)
  - Steam generator tube rupture (SGTR)
  - Secondary side breaks (SSB) inside containment with failure to isolate the break

- Core damage with failure of containment isolation

- Core damage with containment failure (there are several potential modes for containment failure, such as, hydrogen combustion, direct containment heating, and containment overpressurization)

The Vogtle IPE assessed possible containment failure modes and concluded that those most likely are containment bypass, containment isolation failure, and containment overpressurization. All other failure modes are considered unlikely. As discussed in the Vogtle IPE submittal (Section 4.4.3), "containment overpressurization caused by steaming and/or generation of noncondensible gases can be a potential late containment failure mode for VEGP." Therefore, this containment failure mode was eliminated for consideration, since it results in a late containment failure.

The impact of the Tech Spec changes under consideration on the remaining failure modes, containment bypass and failure of containment isolation, can be assessed directly from the Vogtle PRA model. It was assumed in this assessment that either of these failure modes will lead to a large, early release. With regard to the containment isolation failure mode, all containment penetrations were initially screened to determine if a large release is possible. The screening eliminated penetrations connected to the containment atmosphere with line sizes less than two inches in diameter.

The definition of a large release is a containment pathway of sufficient size to release the contents of containment (i.e., one volume change) within one hour. This is from the EPRI TR-105396, "PSA Applications Guide".

No "level-3" PRA was performed to determine the effect of evacuation on early fatalities.

Table RAI 10-1 provides a list of accident sequences for the Vogtle PRA model as quantified for this analysis. For simplification, it was assumed that the two events, SGTR and SSB inside containment with failure to isolate the break, with failure of reactor trip are bypass events. This is a conservative approach, since all the sequences associated with these two events are not necessarily bypass sequences. Similar type of sequences are expected for other Westinghouse plants.

Table RAI 10-1 Large Early Release Sequences		
Sequence Number	**Sequence**	**Base Case LERF with 2/4 Logic**
1	• Initiating Event: SGTR • Sequence: Auxiliary feedwater (AFW) failure, success of high pressure injection (HPI), failure to establish feed & bleed (F&B) cooling • Containment bypass	7.93E-07/yr
2	• Initiating Event: SGTR • Sequence: AFW failure, success of F&B, failure to establish high pressure recirculation • Containment bypass	7.72E-07/yr
3	• Initiating Event: SGTR • Sequence: AFW failure, HPI fails so F&B cannot be established • Containment bypass	2.66E-07/yr
4	• Initiating Event: Station Blackout • Sequence: Success or failure of offsite power recovery, reactor coolant pump (RCP) seal LOCA, failure to mitigate seal LOCA, failure of containment isolation • Containment not isolated	1.71E-07/yr
5	• Initiating Event: SGTR • Sequence: AFW success, HPI failure, failure to isolate ruptured steam generator • Containment bypass	1.71E-07/yr
6	• Initiating Event: SGTR • Sequence: Reactor trip (assumed that all SGTR ATWS events go to containment bypass) • Containment bypass	6.85E-08/yr
7	• Initiating Event: Interfacing Systems LOCA • Sequence: Failure of operator to reduce emergency core cooling flow to minimum required to remove decay heat and eventual loss of core cooling capability • Containment bypass	5.39E-08/yr
8	• Initiating Event: Station Blackout • Sequence: Recovery of offsite power, failure of decay heat removal including F&B, success of HPI, and failure to isolate containment • Containment not isolated	2.81E-08/yr
9	• Initiating Event: SSB Inside Containment • Sequence: Reactor trip (assumed that all SSB inside containment ATWS events go to containment bypass) • Containment bypass	7.12E-09/yr

Table RAI 10-1 (Cont'd) Large Early Release Sequences		
Sequence Number	**Sequence**	**Base Case LERF**
10	• Initiating Event: Station Blackout • Sequence: Recovery of offsite power, success or failure of decay heat removal, success of HPI, failure of high pressure recirculation (HPR), and failure to isolate containment • Containment not isolated	6.32E-09/yr
11	• Initiating Event: Transient • Sequence: Failure of AFW, condensate feedwater, and main feedwater for decay heat removal, success of F&B, but subsequent failure of HPR, and failure to isolate containment • Containment not isolated	6.10E-09/yr
12	• Initiating Event: Transient • Sequence: Failure of AFW, condensate feedwater, and main feedwater for decay heat removal, failure of HPI for F&B, and failure to isolate containment • Containment not isolated	6.09E-09

NRC RAI 11:
Regarding Section 8.4.3.4 and the discussion of ICLERP, WCAP-15376 states:
"Because the success of [sic] failure of the containment systems is independent of the reactor trip breakers, the LERF will increase only *in direct proportion* (emphasis added) to the increased frequency of core damage sequences involving reactor trip breaker failures." Is the document implying that if (for example) the core damage frequency increases by 10 percent, the LERF will always increase by the same amount, 10 percent (in consideration here of the reactor trip breaker failures)?

Response to NRC RAI 11:
The response to this NRC RAI will be provided by November 19, 2001.

NRC RAI 12:
WCAP-15376 does not clearly indicate how the common cause failure (CCF) grouping is performed. Please define the CCF group for each signal type.

Response to NRC RAI 12:
The following provides the requested CCF group information for each signal type. For the reactor trip breakers, slave relays, master relays, and components in the logic cabinets, the CCF groups are the components that perform the same function in the redundant trains. For the analog channels, if the logic is 2 of 4, then the CCF groups consist of three channels, and if the logic is 2 of 3, then the CCF groups consist of two channels. The specific CCF groups for each signal are as follows.

<u>Reactor Trip, Solid State Protection System (SSPS), Pressurizer Pressure High, 2/4 Logic</u>
Reactor trip breakers (1 combination of 2 components)
Undervoltage driver card (1 combination of 2 components)
Universal logic card 416 (1 combination of 2 components)
15V DC power supply (1 combination of 2 components)
Analog channels (includes output relay, pressure sensor, loop power supply, comparator, lead lag amplifier) (4 combinations of 3 components)

<u>Reactor Trip, SSPS, Pressurizer Pressure High, 2/3 Logic</u>
Reactor trip breakers (1 combination of 2 components)
Undervoltage driver card (1 combination of 2 components)
Universal logic card 416 (1 combination of 2 components)
15V DC power supply (1 combination of 2 components)
Analog channels (includes output relay, pressure sensor, loop power supply, comparator, lead lag amplifier) (3 combinations of 2 components)

<u>Reactor Trip, SSPS, Pressurizer Pressure High, 2/3 Logic or Overtemperature delta T, 2/4 Logic</u>
Reactor trip breakers (1 combination of 2 components)
Undervoltage driver card (1 combination of 2 components)
Universal logic cards 313 and 416 (1 combination of 4 components)
15V DC power supply (1 combination of 2 components)
Pressure analog channels (includes output relay, pressure sensor, loop power supply, comparator, lead lag amplifier) (3 combinations of 2 components)
Overtemperature delta T (includes output relay, RTD, amplifiers, summation amplifiers, lead lag amplifiers, comparator, power supply, transmitter, ion chamber detector, high voltage power supply) (4 combinations of 3 components)

<u>Auxiliary Feedwater Pump Start, SSPS, Steam Generator Level Low-Low in One Loop, 2/4 Logic</u>
Slave relays – between redundant relays (2 combinations of 2 components: C1/D1, C2/D2)
Master relays (1 combination of 2 components)
Safeguards driver card (1 combination of 2 components)
Universal logic card A313 (1 combination of 2 components)
Universal logic card A316 (1 combination of 2 components)

15V DC power supply (1 combination of 2 components)
48V DC power supply (1 combination of 2 components)
118V AC power supply (1 combination of 2 components)
Analog channels (includes output relay, level sensor, loop power supply, comparator) (4 combinations of 3 components)

Auxiliary Feedwater Pump Start, SSPS, Steam Generator Level Low-Low in One Loop, 2/3 Logic
Slave relays – between redundant relays (2 combinations of 2 components: C1/D1, C2/D2)
Master relays (1 combination of 2 components)
Safeguards driver card (1 combination of 2 components)
Universal logic card A313 (1 combination of 2 components)
Universal logic card A316 (1 combination of 2 components)
15V DC power supply (1 combination of 2 components)
48V DC power supply (1 combination of 2 components)
118V AC power supply (1 combination of 2 components)
Analog channels (includes output relay, level sensor, loop power supply, comparator) (3 combinations of 2 components)

Safety Injection, SSPS, Pressurizer Pressure Low Interlocked with P-11, 2/4 Logic
Slave relays – between redundant relays (6 combinations of 2 components: C1/E1, C2/E2, C3/E3, D1/F1, D2/F2, D3/F3)
Master relays (2 combinations of 2 components: C/E, D/F)
Safeguards driver card (1 combination of 2 components)
Universal logic cards A308 (1 combination of 2 components)
Universal logic cards A313 (1 combination of 2 components)
Universal logic cards A315 (1 combination of 2 components)
Universal logic cards A404 (1 combination of 2 components)
Universal logic cards A416 (1 combination of 2 components)
15V DC power supply (1 combination of 2 components)
48V DC power supply (1 combination of 2 components)
118V AC power supply (1 combination of 2 components)
Analog channels (includes output relay, pressure sensor, loop power supply, comparator, lead lag amplifier) (4 combinations of 3 components)

Safety Injection, SSPS, Pressurizer Pressure Low Interlocked with P-11, 2/3 Logic
Slave relays – between redundant relays (6 combinations of 2 components: C1/E1, C2/E2, C3/E3, D1/F1, D2/F2, D3/F3)
Master relays (2 combinations of 2 components: C/E, D/F)
Safeguards driver card (1 combination of 2 components)
Universal logic cards A308 (1 combination of 2 components)
Universal logic cards A313 (1 combination of 2 components)
Universal logic cards A315 (1 combination of 2 components)
Universal logic cards A404 (1 combination of 2 components)
Universal logic cards A416 (1 combination of 2 components)
15V DC power supply (1 combination of 2 components)
48V DC power supply (1 combination of 2 components)
118V AC power supply (1 combination of 2 components)
Analog channels (includes output relay, pressure sensor, loop power supply, comparator, lead lag amplifier) (3 combinations of 2 components)

Reactor Trip, Relay Protection System, Pressurizer Pressure High, 2/4 Logic
Reactor trip breakers (1 combination of 2 components)
Reactor trip contacts RT9 (1 combination of 2 components)
Reactor trip contacts RT10 (1 combination of 2 components)
PC contacts (4 combinations of 3 components)

Analog channels (includes output relay, pressure sensor, loop power supply, comparator, lead lag amplifier) (4 combinations of 3 components)

Reactor Trip, Relay Protection System, Pressurizer Pressure High, 2/3 Logic
Reactor trip breakers (1 combination of 2 components)
Reactor trip contacts RT9 (1 combination of 2 components)
Reactor trip contacts RT10 (1 combination of 2 components)
PC contacts (3 combinations of 2 components)
Analog channels (includes output relay, pressure sensor, loop power supply, comparator, lead lag amplifier) (3 combinations of 2 components)

Reactor Trip, Relay Protection System, Pressurizer Pressure High, 2/3 Logic or Overtemperature delta T, 2/4 Logic
Reactor trip breakers (1 combination of 2 components)
Reactor trip contacts RT3 (1 combination of 2 components)
Reactor trip contacts RT4 (1 combination of 2 components)
PC contacts (3 combinations of 2 components)
TC contacts (4 combinations of 3 components)
Pressure analog channels (includes output relay, pressure sensor, loop power supply, comparator, lead lag amplifier) (3 combinations of 2 components)
Overtemperature delta T (includes output relay, RTD, amplifiers, summation amplifiers, lead lag amplifiers, comparator, power supply, transmitter, ion chamber detector, high voltage power supply) (4 combinations of 3 components)

Auxiliary Feedwater Pump Start, Relay Protection System, Steam Generator Level Low-Low in One Loop, 2/4 Logic
Intermediate relays (1 combination of 2 components)
Input logic relay (4 combinations of 3 components)
Test contacts (1 combination of 2 components)
Analog channels (includes output relay, level sensor, loop power supply, comparator) (4 combinations of 3 components)

Auxiliary Feedwater Pump Start, Relay Protection System, Steam Generator Level Low-Low in One Loop, 2/3 Logic
Intermediate relays (1 combination of 2 components)
Input logic relay (3 combinations of 2 components)
Test contacts (1 combination of 2 components)
Analog channels (includes output relay, level sensor, loop power supply, comparator) (3 combinations of 2 components)

Safety Injection, Relay Protection System, Pressurizer Pressure Low Interlocked with P-11, 2/4 Logic
Slave relays – between redundant relays (6 combinations of 2 components: A1/C1, A2/C2, A3/C3, B1/D1, B2/D2, B3/D3)
Master relays (1 combination of 2 components)
125V DC power supply (1 combination of 2 components)
Input logic relay (4 combinations of 3 components)
Test contacts (1 combination of 2 components)
Blocking contacts (1 combination of 2 components)
Analog channels (includes output relay, pressure sensor, loop power supply, comparator, lead lag amplifier) (4 combinations of 3 components)

Safety Injection, Relay Protection System, Pressurizer Pressure Low Interlocked with P-11, 2/3 Logic
Slave relays – between redundant relays (6 combinations of 2 components: A1/C1, A2/C2, A3/C3, B1/D1, B2/D2, B3/D3)
Master relays (1 combination of 2 components)

125V DC power supply (1 combination of 2 components)
Input logic relay (3 combinations of 2 components)
Test contacts (1 combination of 2 components)
Blocking contacts (1 combination of 2 components)
Analog channels (includes output relay, pressure sensor, loop power supply, comparator, lead lag amplifier) (3 combinations of 2 components)

NRC RAI 13:
WCAP-15376 provides representative fault trees but does not provide basic event probabilities used in the fault trees. Please provide basic event probabilities used in the fault trees.

Response to NRC RAI 13:
The requested information was provided to the NRC in letter OG-01-040, "Transmittal of Response to Request for Additional Information (RAI) Regarding WCAP-15376-P, Rev. 0, "Risk-Informed Assessment of the RTS and ESFAS Surveillance Test Intervals and Reactor Trip Breaker Test and Completion Times" (MUHP-3046)", dated June 25, 2001.

NRC RAI 14:
Pages B-3 and B-4 of WCAP-15376 are missing. (The corresponding pages in WCAP-15377 are present.) Please provide the missing pages.

Response to NRC RAI 14:
The missing pages were provided to the NRC in letter OG-01-037, "NRC Review of WCAP-15376/15377, "Risk-Informed Assessment of the RTS and ESFAS Surveillance Test Intervals and Reactor Trip Breaker Test and Completion Times" and TSTF-411, Rev. 0, "Surveillance Test Interval Extensions for Components of the Reactor Protection System," MUHP-3046, dated June 8, 2001.

NRC RAI 15:
Page B-10 of WCAP-15376 identifies a proposed insert 2 to TS 3.3.2, page 3.3-29, that reads, "(a) Reviewer's Note: The Frequency remains at 31 days on a STAGGERED TEST BASIS for plants with a Relay Protection System." However, Table 1.2 of WCAP 15376 indicates that the master relay STI for the relay protection systems is one month. Please explain the apparent inconsistency and address the impacts of inconsistencies or incorrect periodicities (if any) used in the topical report analyses on the validity of the results of the analyses.

Response to NRC RAI 15:
A change to the master relay STI (Frequency) for relay protection systems was not evaluated in WCAP-15376. Therefore, there is no impact on the analyses, or the validity of the results of the analyses contained in WCAP-15376. The Reviewer's Note will be revised to reflect that a change to the master relay STI (Frequency) for relay protection systems was not evaluated in WCAP-15376.

NRC RAI 16:
The results of WCAP-15376 are for the most part based on plant operating data of existing components. With plant life extension and equipment modernization, how can assurance be provided that the results of WCAP-15376 will remain bounding with either component replacement or system retrofits (RPS replacements for example)? Will changes in system architecture/configuration or additional failure modes (software) be accommodated in the WCAP-15376 model?

Response to NRC RAI 16:
The WCAP-15376 analyses are based on the RTS and ESFAS equipment that is currently installed in Westinghouse Nuclear Steam System Supply plants. The applicability of the WCAP-15376 analyses to RTS and ESFAS equipment different that that evaluated in WCAP-15376 will have to be reviewed for impact on the analyses and conclusions of WCAP-15376.

NRC RAI 17:
Please describe how equipment performance will be monitored to provide feedback that equipment for which the proposed extended STIs and CTs would be implemented is performing per the assumptions of WCAP-15376?

Response to NRC RAI 17:
10CFR50.65, the Maintenance Rule, will be used, where applicable, to monitor component performance via the performance criteria requirement, and to monitor the target values for component unavailability.

NRC RAI 18:
Page 6-3 of WCAP-15376 states that the limiting safety system settings and response times are not impacted by the proposed changes. The channel operational test includes rack components (signal conditioning, bistables, etc.). There does not appear to be a provision in WCAP-15376 to review uncertainty assumptions for the included instrumentation to accommodate an extended surveillance interval. Additionally, how have time-related effects on these components (drift and aging) and the projection of these effects to an extended surveillance interval been addressed?

Response to NRC RAI 18:
Plant specific RTS and ESFAS setpoint uncertainty calculations and assumptions, including instrument drift, will be reviewed to determine the impact of extending the Surveillance Frequency of the Channel Operational Test (COT) from 92 days to 184 days.