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Your ref: Project Number 740
Our ref: DCP/NRC1960

July 13, 2007

Subject: AP1000 COL Responses to Requests for Additional Information (TR #45)

In support of Combined License application pre-application activities, Westinghouse is submitting responses to NRC requests for additional information (RAI) on AP1000 Standard Combined License Technical Report 45, APP-GW-GLR-027, Rev. 1, Operator Actions Minimizing Spurious Actuations. These RAI responses are submitted as part of the NuStart Bellefonte COL Project (NRC Project Number 740). The information included in the responses is generic and is expected to apply to all COL applications referencing the AP1000 Design Certification.

The responses are provided for requests for additional information RAI-TR45-001 through -023, transmitted in NRC letter dated March 30, 2007 and May 4, 2007 from Steven D. Bloom to Andrea Sterdis, Subject: Westinghouse AP1000 Combined License (COL) Pre-application Technical Report 45 – Request for Additional Information (TAC No. MD2495).

Pursuant to 10 CFR 50.30(b), the responses to requests for additional information on Technical Report 45 is submitted as Enclosure 1 under the attached Oath of Affirmation.

Questions or requests for additional information related to the content and preparation of these responses should be directed to Westinghouse. Please send copies of such questions or requests to the prospective applicants for combined licenses referencing the AP1000 Design Certification. A representative for each applicant is included on the cc: list of this letter.

Very truly yours,

A. Sterdis, Manager
Licensing and Customer Interface
Regulatory Affairs and Standardization

D079
D063

NRO

/Attachment

1. "Oath of Affirmation," dated July 13, 2007

/Enclosure

1. Responses to Requests for Additional Information on Technical Report No. 45

cc:	D. Jaffe	-	U.S. NRC	1E	1A
	E. McKenna	-	U.S. NRC	1E	1A
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	A. Monroe	-	SCANA	1E	1A
	M. Moran	-	Florida Power & Light	1E	1A
	C. Pierce	-	Southern Company	1E	1A
	E. Schmiech	-	Westinghouse	1E	1A
	G. Zinke	-	NuStart/Entergy	1E	1A
	C. Watson	-	Westinghouse	1E	1A

ATTACHMENT 1

"Oath of Affirmation"

ATTACHMENT 1

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

In the Matter of:	)
NuStart Bellefonte COL Project	)
NRC Project Number 740	)

APPLICATION FOR REVIEW OF
"AP1000 GENERAL COMBINED LICENSE INFORMATION"
FOR COL APPLICATION PRE-APPLICATION REVIEW

W. E. Cummins, being duly sworn, states that he is Vice President, Regulatory Affairs & Standardization, for Westinghouse Electric Company; that he is authorized on the part of said company to sign and file with the Nuclear Regulatory Commission this document; that all statements made and matters set forth therein are true and correct to the best of his knowledge, information and belief.

W. E. Cummins
Vice President
Regulatory Affairs & Standardization

Subscribed and sworn to
before me this 13th day
of July 2007.

COMMONWEALTH OF PENNSYLVANIA
Notarial Seal
Debra McCarthy, Notary Public
Monroeville Boro, Allegheny County
My Commission Expires Aug. 31, 2009
Member, Pennsylvania Association of Notaries

Debra McCarthy
Notary Public

ENCLOSURE 1

Responses to Requests for Additional Information on Technical Report No. 45

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR45-001
Revision: 0

Question:

The AP1000 DCD indicates that the potential for spurious actuation of the series motor-operated valves is minimized by the provision of physical separation between potential hot short locations. This technical report, however, did not specify the provided form of physical separation. Is physical separation achieved by electrical raceway fire barrier systems (ERFBS) or distance? If ERFBS, what is their rating? If distance, how far are the control cables separated from each other without intervening combustibles? Has or will the physical separation be justified via a fire model?

Westinghouse Response:

Automatic depressurization system stages 1, 2, and 3 consist of parallel paths, each path having two normally closed motor-operated valves in series. The two series valves are controlled and powered from the same PMS division. Dedicated ADS stage 1 switches are provided in the MCR on the dedicated safety panels. Two switches are provided, one on each panel. The switches on each panel are required to be actuated simultaneously in order to actuate ADS stage 1. ADS stages 2 and 3 actuated automatically on timers following actuation of ADS stage 1. Spurious actuation from the control room dedicated PMS switches that could lead to a breach of reactor coolant system pressure boundary is prevented by the use of dual two-pole, energize-to-actuate, ungrounded dc circuits, which require at least four simultaneous hot shorts of proper polarity for spurious actuation. In addition, the two switches are located on separate panels that are approximately 6 feet apart. It is reasonable to assume that a fire in the MCR would start in one location and spread. The MCR is continuously occupied; therefore, if the operators could not extinguish the fire, they would evacuate the MCR and disable the controls via the transfer switch before the fire could spread from one switch to the other, regardless of the initial location of the fire.

ADS stages 1, 2, and 3 can also be actuated by dedicated switches from the DAS panel in the MCR. Two switches are provided for each ADS stage. Both switches are required to be actuated in order to actuate the ADS stage. DAS does not provide automatic ADS actuation. To further prevent inadvertent actuations, the DAS manual controls are normally de-energized. Power to the DAS manual controls is provided via the normally-off DAS master enable switch located on the RO console. This arrangement prevents a single operator action or a fire from spuriously actuating DAS manual controls. There is also a DAS master disable switch, co-located outside of the MCR with the main transfer switch for the RSR, used to disable the master enable switch, therefore disabling all DAS manual actuation capability. The master disable switch is operated when evacuating the MCR and transferring control to the remote shutdown console.

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

A fire located in a PMS control cabinet could lead to spurious actuation of one ADS stage 1, 2, or 3 valves. Before that fire could spread to another PMS cabinet that could control the series ADS valve, the fire would be detected and the power to that division removed. TR-45 provides a detailed analysis of the actions that the operators would take to remove PMS power in case of such a fire.

Each Class 1E (safety) division cable raceway is separate from all non-safety and all other safety division cable raceways. There is no separation between isolation valve cables and actuation valve cables for ADS Stages 1, 2, and 3, powered by the same division. A spurious actuation of one path of the ADS would require at least four simultaneous hot shorts of proper polarity across two separate cables. Internal faults within these cables cannot initiate a spurious ADS actuation.

Reference:

1. APP-DAS-J7-001, Rev. A, Diverse Actuation System Specification Document.
2. APP-OCS-J7-001, Rev. C, AP1000 Operations and Control Centers System Specification Document.
3. APP-JC01-V1-001, Rev. A, AP1000 Main Control Area Layout Top View.

Design Control Document (DCD) Revision:
None

PRA Revision:
None

Technical Report (TR) Revision:
None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR45-002
Revision: 0

Question:

The AP1000 DCD assumes that "no postulated fire can spread to the hot short locations before the operator can remove power from the fire zone." The analysis provided in this technical report indicated that operator manual actions required for isolating all electrical power in the area of the target control circuits can be performed within 30 minutes after the detection of a fire. Does this imply that hot shorts which may cause spurious ADS actuation can occur as soon as 30 minutes after a fire is detected? If not, what is the available time margin, and how was the time margin assessed or calculated? Also, what is the postulated time period between fire initiation and fire detection? Furthermore, to effectively assess the risk, the technical report should discuss the consequences of not being able to perform the prescribed operator manual actions as part of defense in depth and safety margin evaluation.

Westinghouse Response:

With no operator action a spurious ADS actuation is unlikely; however, per the COL Information Item and the AP1000 FSER, Section 9.5.1.5c, the 30 minutes starts following detection of the fire. This time limit was agreed upon between Westinghouse and the NRC for COL item 9.5-5 (Reference 1, Table 1.8-2 Sheet 7 of 13) and FSER Section 9.5.1.5c.

In the event that power is not removed, ADS actuation is unlikely; however, its actuation can not be precluded. While not desirable, if ADS were to actuate as the result of a fire, the plant would still achieve and maintain safe shutdown through the use of passive system feed / bleed cooling.

There is no postulated time period between fire initiation and detection. The technical report begins the evaluation of operator actions at detection of the fire. No postulated fire that could cause hot shorts in the specified rooms would go undetected.

Fire detectors will meet the requirements of NFPA 72 National Fire Alarm Code. This includes the sensitivity and location of the detectors in regards to the size of the fire that is to be detected, fuel involved, sensitivity of the detector, field of view of the detector, distance between the fire and the detector, radiant energy absorption of the atmosphere, presence of extraneous sources of radiant emissions, purpose of the detection system, and an evaluation of the response time required.

Reference:

1. APP-GW-GL-700, Revision 16, Design Control Document.

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

Design Control Document (DCD) Revision:
None

PRA Revision:
None

Technical Report (TR) Revision:
None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR45-003
Revision: 0

Question:

The analysis concluded that no additional operator manual action is required for a fire initiated in the Main Control Room (MCR) due to the transfer of control to the remote shutdown workstation. However, it is not clear if the transfer switch scheme would electrically isolate the effects of the potential hot shorts just downstream of the MCR control switches. If the design does not adequately isolate these potential hot shorts, how would spurious ADS actuation, specifically, and other spurious equipment actuations, in general, be mitigated?

Westinghouse Response:

Transfer of control to the remote shutdown panel will not result in a spurious ADS actuation.

The transfer switch isolates the control circuits outside of the main control room. The transfer switch is located in stairwell S05, a different fire area from the MCR and Remote Shutdown room; separated by three hour fire barriers; preventing the spread of the fire from the main control room and the transfer switch.

The MCR system level actuation switches are cabled directly from the control room to the PMS protection system LCL controllers. This coincidence logic cabinet processes the actuation signals from the MCR for ADS signals generated by the PMS. The MCR/RSR transfer switches are wired directly to the PMS protection system LCL controllers, disabling signals generated in the MCR from generating actuation signals for this coincidence logic cabinet, regardless of the cause. It is not creditable for a fire to cause the de-powered switches from generating a control signal that would cause the PMS to take an action.

There is also a DAS master disable switch, co-located outside of the MCR with the main transfer switch for the RSR, is used to disable the master enable switch, therefore disabling all DAS manual actuation capability. The master disable switch is operated when evacuating the MCR and transferring control to the remote shutdown console.

Reference:

1. APP-GW-GL-700, Revision 16, Design Control Document.
2. APP-OCS-J7-001, Rev. C, AP1000 Operations and Control Centers System System Specification Document.

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

Design Control Document (DCD) Revision:
None

PRA Revision:
None

Technical Report (TR) Revision:
None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR45-004
Revision: 0

Question:

In an event of a fire that spreads to multiple rooms in the same fire area, how would an equipment operator perform the manual actions in a room which was or is on fire? For example, the Division A Instrumentation and Control Room (Room 12301) and the Division A DC Equipment Room (Room 12201) are in the same Fire Area 1202 AF 04. If a postulated fire spread from Room 12301 to Room 12201, the equipment operator may not be able to enter Room 12301 to isolated power to the Power Management System Cabinets as prescribed for a fire in Room 12201.

Westinghouse Response:

The evaluation is based on the valid assumption is that fires in these areas will start small and be detected before it has spread throughout a room, and long before it could have spread to another room. Fire zones in this evaluation are separated by a minimum 1-hour rated fire barrier, as well as the associated fire dampers to prevent the affects of smoke from permeating the zone barrier. This allows for completion of operator actions within 30 minutes of fire detection, before the fire will breach the rated barrier of the fire zone in question.

While not desirable, if ADS were to actuate as the result of the inability of an operator to complete the required actions, the plant would still achieve and maintain safe shutdown.

Reference:

1. APP-GW-GL-700, Rev. 16, Design Control Document.

Design Control Document (DCD) Revision:
None

PRA Revision:
None

Technical Report (TR) Revision:
None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR45-005
Revision: 0

Question:

What is the rational for performing manual actions both remotely and from the MCR for certain equipment when a fire starts in a particular room and not for others?

Westinghouse Response:

Remote operation from the Main Control Room is preferred due to ability to secure power quickly. However, local operation may be necessary if remote operation from the MCR is not available. If remote control could be affected by the fire, it was not relied upon.

Reference:
None

Design Control Document (DCD) Revision:
None

PRA Revision:
None

Technical Report (TR) Revision:
None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR45-006
Revision: 0

Question:

Are the assumptions related to potential spurious actuations for this technical report consistent with Regulatory Issue Summary (RIS) 2005-30, "Clarification of Post-Fire Safe-Shutdown Circuit Regulatory Requirements," and RIS 2006-10, "Regulatory Expectations with Appendix R Paragraph III.G.2 Operator Manual Actions."

Westinghouse Response:

Upon review of RIS 2005-030 and RIS 2006-010, it was determined that these Regulatory Issue Summaries both detail requirements regarding the ability to safe-shutdown the plant. Technical Report 45 evaluates the operator actions necessary to minimize the probability of a spurious ADS actuation occurring due to a fire; therefore, these documents are not applicable to the report. The AP1000 safe-shutdown evaluation is documented in the Fire Protection Analysis (FPA), Section 9A of the Design Control Document (DCD). The AP1000 DCD provides an evaluation of the ability to achieve safe shutdown from the Main Control Room and from the Remote Shutdown Room without passive system operation (including ADS operation). Disabling ADS has no impact on the ability to achieve safe shutdown as described in the DCD evaluation.

While not desirable, if ADS were to actuate as the result of a fire, the plant would still achieve and maintain safe shutdown.

Reference:

1. APP-GW-GLR-027, Operator Actions Minimizing Spurious ADS Actuation.
2. APP-GW-GL-700, Revision 16, Design Control Document.

Design Control Document (DCD) Revision:
None

PRA Revision:
None

Technical Report (TR) Revision:
None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR45-007
Revision: 0

Question:

The report states that, "NRC should consider the combined license (COL) Information Item closure to be acceptable and generically applicable to COL applications referencing the AP1000 design certification." The report presents analyses to show operators can remove power in areas of the plant where a prolonged fire may result in multiple hot shorts requiring the operator action within 30 minutes. The analysis considers the specific locations for these rooms and specific distances from the main control room (MCR). However, the location of the rooms in relation to the MCR may be plant-specific and could significantly affect the time required to carry out the actions. Please justify why the analysis presented can be generically applicable to all AP1000 COL applications.

Westinghouse Response:

The rooms identified in the Tables 1 through 17 of the technical report are within the vital boundary area, not site-specific locations. AP1000 is a standard design with a standard Design Certification. This analysis is generally applicable to all AP1000 plants.

Reference:

1. APP-GW-GLN-027, Rev. 1, Operator Actions Minimizing Spurious ADS Actuation.

Design Control Document (DCD) Revision:
None

PRA Revision:
None

Technical Report (TR) Revision:
None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR45-008
Revision: 0

Question:

The report presents analyses for selected rooms, e.g., Division A I&C Room, Division A Battery Room, Division C Reactor Coolant Pump Switchgear Room. The analysis considers that the fire starts in specific plant rooms or in the same fire area as one of these rooms and eventually spreads to the entire fire area. Please provide further details that identify all rooms where there is a potential for hot short, and all rooms in each fire area where a fire may start or may eventually spread. The details presented should identify the rooms, the associated fire area, other rooms in the fire area, and the reason for not considering any of the rooms.

Westinghouse Response:

The specific plant rooms where there is a potential for multiple hot shorts causing spurious ADS actuation are identified in the Technical Report: the Main Control Room (MCR), Division A I&C room, Division B I&C room, Division C I&C room, Division D I&C room, Division A penetration room, and Division C penetration room.

Rooms within the same fire area as those listed above are no susceptible to causing a spurious ADS actuation.

Rooms that are in the same Fire Area as those identified in the Technical Report are listed in the table below:

Room	Fire Area	Room #	Other Rooms in Area	FPA Reference
Main Control Room	1242 AF 01	12401	none	9A.3.1.2.5.1
Div. A I&C Room	1202 AF 04	12301	12101, 12201	9A.3.1.2.1.1
Div. B I&C Room	1201 AF 02	12304	12104, 12204, 12207	9A.3.1.2.2.1
Div. C I&C Room	1202 AF 03	12302	12102, 12202, 12203, 12312, 12313	9A.3.1.2.3.1
Div. D I&C Room	1201 AF 03	12305	12105, 12205	9A.3.1.2.4.1
Div. A Penetration Room	1242 AF 02	12412	none	9A.3.1.2.1.2
Div. C Penetration Room	1202 AF 03	12313	12102, 12202, 12203, 12302, 12312	9A.3.1.2.3.1

Reference:

1. APP-GW-GLR-027, Operator Actions Minimizing Spurious ADS Actuation.
2. APP-GW-GL-700, Revision 16, Design Control Document.

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

Design Control Document (DCD) Revision:
None

PRA Revision:
None

Technical Report (TR) Revision:
None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR45-009
Revision: 0

Question:

Standard Review Plan (SRP) 9.5.1, Rev. 4, Section 7.1.2, states that the plant layout should allow for safe access and egress to areas for personnel performing safe shutdown operations. Considerations should include fire and post-fire habitability in safe shutdown areas, protection or separation from fire, conditions of access and egress, pathways to safe shutdown structures, systems, and components, and potential restrictions or delays to safe shutdown area access potentially caused by (security) locking systems.

A. The analysis assumes that there are no vital access doors that need to be bypassed by security due to the fire. The operability and accessibility of vital access doors that the operator may need during a fire should be demonstrated. Please expand on the assumption and explain how a fire may require bypassing access doors by security and discuss additional time that may be required, if there is a need for bypassing a door by security.

B. Justify why this assumption can be assured for all future plants generically, since future plant security modifications could significantly impact the future validity of this assumption.

Westinghouse Response:

A. Technical Report 45 discusses the minimization of spurious ADS actuation, not the performance of operator actions regarding a safe shutdown. However, the actual location of the Vital Area boundary is designated Safeguards Information (SGI). Recognition of the existence of the boundary is unclassified. For AP1000, achieving safe shutdown requires no operator actions even if an entire fire area is destroyed by a fire. No vital access doors need to be bypassed by security for an operator to perform any safe shutdown operations regardless of the location of the fire. Vital area doors will allow alarmed egress from the vital area in the event evacuation is required as the result of a fire. The main control room (MCR) is isolated and proper habitability parameters are maintained in the MCR if a fire is detected outside the MCR that could jeopardize the operators.

B. AP1000 is a standard design with a standard Design Certification.

Reference:

1. APP-GW-GLR-027, Operator Actions Minimizing Spurious ADS Actuation.

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

Design Control Document (DCD) Revision:
None

PRA Revision:
None

Technical Report (TR) Revision:
None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR45-010
Revision: 0

Question:

The operator's ability to access areas where manual actions are performed should be demonstrated by a comprehensive analysis, to include the environmental conditions that could negatively effect the ability to perform the manual actions, including radiation, lighting, temperature, humidity (caused, for instance, by water from sprinkler operation), smoke, toxic gases, and noise.

A. The analysis assumes that operators will have unimpeded access to these areas without smoke or heat. In some of these rooms, it appears that the fire has started in one room and has propagated to another. It seems possible that the operator may have to pass through areas affected by fire and smoke. Please justify the basis for the assumption.

B. Personnel protection equipment (PPE) may need to be worn to permit access to and egress from locations where the operator manual actions must be performed, since the routes could be negatively affected by fire effects (such as smoke) that propagate beyond the immediate fire area. Hence, PPE is an extension of the equipment needed to achieve and maintain hot shutdown. NUREG-0800, Section 18.0, references NUREG-0700, "Human-System Interface Design Review Guidelines," Rev. 2, May 2002. NUREG-0700 supports the need to consider personnel protection equipment as follows: "[t]he operation of controls should be compatible with the use of protective clothing, if it may be required... The likelihood of operators requiring protection... is greater outside the control room." Please provide the results of your evaluation of these concerns.

Westinghouse Response:

A. All access and egress routes (stairwells and corridors) are designated as separate fire areas. Fire barriers and fire dampers/ventilation fans mitigate the spread of smoke and fire to another fire area or fire zone within the time the EO will be required to perform actions that necessitate access to rooms in the same fire area.

B. Per section 9.5.1.8.1 of the Design Control Document (DCD), "The Combined License applicant will address qualification requirements for individuals responsible for development of the fire protection program, training of firefighting personnel, administrative procedures and controls governing the fire protection program during plant operation, and fire protection system maintenance."

Part of the fire protection program and training of personnel will be the procurement and use of personnel protection equipment (PPE). The responsibility of an evaluation on the necessity and use of PPE is assumed by the COL holder.

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

Taken from the AP1000 Design Control Document (DCD) section 9A.2.7.1:

> "Although the typical shutdown sequence does not require manual actions by the operator, fire damage may not be sufficient in many cases to trip the plant. The operator may take appropriate actions to expedite an orderly shutdown. These actions are performed in the main control room. If the fire occurs in the main control room, these actions are performed at the remote shutdown workstation."

The EO is not required to perform any actions in the plant to achieve safe shutdown (hot shutdown).

In regards to actions to minimize spurious ADS actuations during a fire, as discussed in the Technical Report, it is not necessary that the EO wear PPE to complete the required actions. The time required to complete actions, taken into account with the ability of the fire barriers and fire dampers to mitigate the spread of fire and smoke, permits the EO to take required actions without entering or performing said actions in an area affected by fire or smoke.

Reference:

1. APP-GW-GL-700, Rev. 16, Design Control Document.

Design Control Document (DCD) Revision:
None

PRA Revision:
None

Technical Report (TR) Revision:
None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR45-011
Revision: 0

Question:

In analyzing the overall time needed for the operator to complete needed actions to minimize spurious actuation of automatic depressurization system (ADS) valves, the time needed to complete each of the steps is determined. For example, 3 minutes is assessed for verifying the alarm by the equipment operator (EO) for a fire in Division A direct current equipment room. However, variability exists in completing the action, e.g., difficulty in distinguishing the alarms between two adjacent rooms because of fire and smoke, and impediments in accessing the area. It may be useful to present a time range rather than a single value. The average values of the ranges can then be used to estimate the total average time for the task. Please, justify why using the single value is appropriate for analysis or, re-analyze using a time range methodology.

Westinghouse Response:

The time limits shown in the Technical Report are maximum values based on distance traveled at 200 fpm, time to perform the required task, plus excess time for unforeseen complications. This approach is more conservative than applying an average value for each task. The analysis results showed that the actions can be performed within the 30 minutes using these conservative times.

In the remote chance that failure of the operator to perform the actions within the stated time results in a spurious ADS actuation, safe shutdown of the plant can still be achieved with passive safety features using passive feed/bleed cooling.

Reference:
None

Design Control Document (DCD) Revision:
None

PRA Revision:
None

Technical Report (TR) Revision:
None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR45-012
Revision: 0

Question:

In the analysis, to estimate the total time (in minutes) for a task, time (in minutes) for each of the steps is delineated (Tables 1 to 17). Please discuss the approach used to define the time for a step. In comparing one Table to another, it is difficult to decipher an approach for selecting a time for a step. For a defined approach, with the information given, an analysis or review should be able to directly obtain the time presented.

Westinghouse Response:

The calculation of time to complete each task required to prevent spurious operation of the ADS is based on the distance the operator traveled at 200 fpm, the excess time added to each step for conservatism, and the best judgment of the engineer who performed the analysis.

In the remote chance that failure of the operator to perform the actions within the stated time allows a spurious ADS actuation, safe shutdown of the plant will not be impeded.

Reference:
None

Design Control Document (DCD) Revision:
None

PRA Revision:
None

Technical Report (TR) Revision:
None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR45-013
Revision: 0

Question:

The analysis presents the time required to carry out the task of removing power for fires in different areas. This analysis is presented to demonstrate that the operators can accomplish the task within 30 minutes. The staff believes that further analysis using an human reliability analysis methodology is necessary to support deterministic conclusions for this highly risk-important event. A low human error probability (HEP) will be an indicator that the task can be accomplished within 30 minutes. Please present an analysis of HEP for three of the fire areas, i.e., by selecting the analysis presented in 3 of the 17 Tables (Tables 1 to 17).

Westinghouse Response:

The potential for a spurious actuation of ADS caused by a fire is a low probability event based on the AP1000 design features, including the separation of circuitry/cabling. The conservative evaluation for operator's actions lowers the possibility of a spurious ADS actuation even more, decreasing the risk level further. In addition, even if the operators fail to perform the actions and a spurious ADS actuation occurs, safe shutdown of the plant is still available using passive safety feed / bleed. A Human Error Probability (HEP) evaluation is unnecessary for this low risk/low probability event and is not within the scope of this technical report.

Reference:
None

Design Control Document (DCD) Revision:
None

PRA Revision:
None

Technical Report (TR) Revision:
None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR45-014
Revision: 0

Question:

Typically, in considering the time needed to carry out a task by an operator, two aspects are considered: time for diagnosis and time needed to carry out the needed activities once a diagnosis has been made to determine the need. Diagnosis is not specifically addressed in the Tables. Please discuss how the diagnosis time was included in these operator actions.

Westinghouse Response:

There is no complex diagnosis occurring within this evaluation. The EO will be required to verify the presence of a fire, and then take the appropriate action determined and relayed by the RO. Diagnosis time is included in the evaluation for the RO to identify which power supply should be secured (refer to the RAI-TR45-15 response). It was determined that the time required for specific diagnosis by the EO is negligible in respect to the time required to travel to the scene and take the required actions (securing power).

Reference:
None

Design Control Document (DCD) Revision:
None

PRA Revision:
None

Technical Report (TR) Revision:
None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR45-015
Revision: 0

Question:

In step 4 of each table in the report, the reactor operator (RO) identifies the power that needs to be secured. Please discuss the process for the RO to identify the power that needs to be secured. If a procedure is available clearly delineating the power that needs to be secured for fires in different locations, then the time required for the step will be short. An alternate process requiring an analysis to identify the applicable cabinets will require a longer time. Please discuss the available information for the RO to carry out this step and calculation of "2 minutes" for the step considering the available information.

Westinghouse Response:

The fire postulated in this evaluation is beyond design basis, and operator actions should not be confused with any design basis requirements. The actions of the RO to identify power supplies to in the event of a fire in the plant will be identified in the applicable Abnormal Operating Procedures or Alarm Response Procedures when they have been completed. These references will be readily available in the MCR.

Two (2) minutes is an engineering assumption determined to be an adequate time limit for a qualified RO to identify required power supplies.

Reference:
None

Design Control Document (DCD) Revision:
None

PRA Revision:
None

Technical Report (TR) Revision:
None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR45-016
Revision: 0

Question:

In general, the analysis does not appear to be consistent with staff guidance related to the acceptability of manual actions as a means of achieving and maintaining hot shutdown conditions during and after fire events. NUREG-1852, "Demonstrating the Feasibility and Reliability of Operator Manual Actions in Response to Fire," (Draft Report for Comment, September, 2006), provides criteria and associated technical bases for use in evaluating the feasibility and reliability of post-fire operator manual actions implemented in nuclear power plants. As indicated by the observations and questions in the following RAIs, the analysis does not appear to be consistent with that guidance. Please provide a comparison of this analysis against the criteria of NUREG-1852, and, if necessary, provide a suitable justification/technical basis where the analysis does not meet those criteria. Though the NUREG is in draft form, the staff anticipates implementing the basic criteria contained therein.

Westinghouse Response:

As documented in the AP1000 DCD, it is understood that no fire shall result in the breeching of the reactor coolant system pressure boundary; therefore, in the event of a fire, safe shutdown, which for AP1000 is hot shutdown, is achieved by means other than ADS actuation. The focus of Technical Report (TR) 45 is to remove power from the ADS valves so as to eliminate the possibility of actuating those valves in the event of certain prolonged fires. In the event that power is not removed, ADS actuation is unlikely; however, it is not possible to assure that ADS will not actuate. While not desirable, if ADS were to actuate as the result of a fire, the plant would still achieve and maintain safe (hot) shutdown.

The AP1000 DCD provides an evaluation of the ability to achieve hot shutdown (safe shutdown) from the Main Control Room and from the Remote Shutdown Room without passive system operation (including ADS operation). Disabling ADS has no impact on the ability to achieve safe shutdown as described in the DCD evaluation.

Draft NUREG-1852 evaluates the acceptability of manual actions as a means of achieving and maintaining hot shutdown conditions during and after fire events. As discussed in the previous paragraph, the manual actions described in TR 45 are not related to achieving and maintaining hot shutdown conditions during and after fire events and Westinghouse therefore considers the guidance in draft NUREG-1852 to be not applicable to the procedure described in TR 45.

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

Reference:

1. APP-GW-GLR-027, Operator Actions Minimizing Spurious ADS Actuation.
2. APP-GW-GL-700, Revision 16, Design Control Document.

Design Control Document (DCD) Revision:
None

PRA Revision:
None

Technical Report (TR) Revision:
None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR45-017
Revision: 0

Question:

A. The 30-minute time frame assumed to be available to perform operator actions outside the MCR, appears to be based on the physical separation of control circuits. That is, appropriately-separated circuitry could survive an ongoing fire for 30 min., allowing time for operators to de-energize those circuits. However, the analysis does not provide any information that describes the physical separation of these circuits in each of the affected fire areas or how this separation will be assured for future plants. Please provide.

B. In addition, for each of the affected fire areas / rooms, the estimate of the time available should account for unique fire-related uncertainties that could affect that estimate, such as:
- nature of the fire (e.g., whether the fire is a fast energetic fire, failing equipment quickly, or a slow developing fire with little or no equipment failures for some time)
- variations in fire detector response times and sensitivities
- variations in air flows that could affect the fire and its growth
- specific fire initiation location relative to important targets
- presence (or lack thereof) of temporary transient combustibles

Westinghouse Response:

A. Spurious actuation from control room dedicated switches which could lead to a breach of reactor coolant system pressure boundary, is prevented by the use of dual two-pole, energize-to-actuate, ungrounded dc circuits, which require at least four simultaneous hot shorts of proper polarity for spurious actuation. These circuits run in separate cable trays. Internal faults within these cables cannot initiate a spurious ADS actuation.

AP1000 is a standard design with a standard Design Certification. Any modifications to the vital area boundary, fire hazards analysis, addition of the first safe shutdown operator action or other modification affecting the assumption on operator response to a fire will receive an appropriate review as required by 10CFR52.

B. As the start time for the analysis is upon fire detection, the type, severity, and location of the fire and fire detector response variations is irrelevant to the evaluation. The combustible loading (in-situ and transient combustibles) of each fire zone/fire area can be found in the Fire Protection Analysis (FPA) located in DCD section 9A, Table 9A-3, which evaluates for the nature, severity, and duration of a postulated fire in the respective zone/area. This table and the associated fire protection analysis text (such as 9A.3.1.2.4.1) indicates that these rooms are "a light fire hazard area and the rate of fire growth is expected to be slow". Fire dampers in ventilation ductwork and rated fire barriers mitigate the spread of smoke and fire.

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

Reference:

1. APP-GW-GL-700, Revision 16, Design Control Document.

Design Control Document (DCD) Revision:
None

PRA Revision:
None

Technical Report (TR) Revision:
None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR45-018
Revision: 0

Question:

The third paragraph of the Technical Background section of the report states that the analysis is provided to demonstrate that operators can remove power in areas of the plant where fire could result in spurious actuation of ADS within 30 minutes of fire initiation (emphasis added). However, the accompanying time lines appear to be based on a time frame of 30 minutes after fire detection. Depending on the type/method of detection, the time from fire initiation to detection could be on the order of several minutes. Please clarify/justify.

Westinghouse Response:

The COL information item from the AP1000 Design Control Document (DCD) is as follows:

> The Combined License applicant will provide an analysis that demonstrates that operator actions which minimize the probability of the potential for spurious ADS actuation as a result of a fire can be accomplished within 30 minutes following **detection** of the fire and the procedure for the manual actuation of the valve to allow fire water to reach the automatic fire system in the containment maintenance floor.

This Technical Report was written with the detection of the fire being the start time (0 seconds) for evaluation of operator actions, in accordance with the COL Information item above from the AP1000 DCD. The use of "initiation" is an error and will be corrected in a revision to the Technical Report.

Reference:

1. APP-GW-GLR-027, Operator Actions Minimizing Spurious ADS Actuations.
2. APP-GW-GL-700, Revision 16, Design Control Document.

Design Control Document (DCD) Revision:
None

PRA Revision:
None

Technical Report (TR) Revision:

TECHNICAL BACKGROUND

This analysis is provided to demonstrate that the operators can remove power in areas of the plant where prolonged fires could result in the multiple hot shorts required for spurious automatic depressurization system (ADS) actuation within 30 minutes of the fire ~~initiation~~detection. The specific plant rooms where there is a potential for multiple hot shorts causing spurious ADS actuation are: the Main Control Room (MCR), Division A I&C room, Division B I&C room, Division C I&C room, Division D I&C room, Division A penetration room, and Division C penetration room.

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR45-019
Revision: 0

Question:

The analysis assumes the EO begins the task at the MCR. The basis for this assumption is not clear since the EO could be (and typically is) located in areas of the plant more remote than the MCR.

Westinghouse Response:

The AP1000 plant allowances for personnel include two auxiliary equipment operators. Assuming at least one of the operators is within the confines of the power block at all times, even at the furthest reaches of the Turbine Building, it will take no more than 4.5 minutes to reach the Main Control Room. This is based on the assumption concurrent with the Technical Report that the operator is traveling at a sustained 200 fpm, and allows for 1 minute to gain access thorough any door.

Evaluating Tables 1-17 of the Technical Report, Table 4 indicates the greatest time to complete all operator actions at 25 minutes. Given the time above at 4.5 minutes of maximum travel time, the equipment operator can still achieve his goal within the required time.

The physical location of the operator within the plant will not impede the ability of said operator to complete all required actions within 30 minutes to prevent a spurious ADS actuation.

In the remote chance that failure of the operator to perform the actions within the stated time allows a spurious ADS actuation, safe shutdown of the plant will not be impeded.

Reference:

1. WCAP-14694, OCS-GEH-024, Rev. 0, Designer's Input to Determination of the AP600 Main Control Room Staffing Level.
2. APP-GW-GLR-027, Rev. 1, Operator Actions Minimizing Spurious ADS Actuation.

Design Control Document (DCD) Revision:
None

PRA Revision:
None

Technical Report (TR) Revision:
None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR45-020
Revision: 0

Question:

The analysis credits portable lighting carried by the operator. As stated in SRP 9.5.1, §7.1.7, "Emergency Lighting," emergency lighting should be provided throughout the plant as necessary to support fire suppression actions and safe shutdown operations, including access and egress pathways to safe shutdown areas during a fire event. Detailed guidance on the acceptable design, testing and maintenance of emergency lighting is addressed in Regulatory Guide I.189, "Fire Protection for Nuclear Power Plants." Please clarify/justify the apparent lack of fixed emergency lighting units.

Westinghouse Response:

Section 9.5.3 of the Rev. 16 DCD addresses the plant lighting system. The plant lighting system includes normal, emergency, panel, and security lighting. Emergency lighting provides illumination in areas where emergency operations are performed upon loss of normal lighting. As noted in Section 9.5.3.2.2, the emergency lighting units are provided in areas where manual actions are required for operation of equipment needed during a fire.

The following information is per section 9.5.3.2.2 of the DCD, Rev. 16.

> The main control room and remote shutdown room each has emergency lighting consisting of 120 V ac fluorescent lighting fixtures which are continuously energized. The fixtures are powered from the Class 1E 125 V dc switchboards through the Class 1E 208Y/120 V ac inverters and are isolated through two series fuses.
>
> Emergency lighting in areas outside the main control room and remote shutdown room is accomplished by 8-hour, self-contained, battery pack lighting units.

Reference:
1. APP-GW-GL-700, Rev. 16, Design Control Document.

Design Control Document (DCD) Revision:
None

PRA Revision:
None

Technical Report (TR) Revision:
None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR45-021
Revision: 0

Question:

Adequate communications capability should be demonstrated for operator manual actions that need to be coordinated with other plant operations and personnel. Any necessary communications capability should be routinely and readily available for all personnel involved in the actions and should be protected from the effects of a postulated fire. This should include initial notification of the EO. The unpredictability of fires can force plant staff to deviate from planned activities (hence, the need for effective, and in some cases, constant communications). In addition, communications permit the performance of sequential operator manual actions (where one action must be completed before another can be started) and provide verification that procedural steps have been accomplished, especially those that must be conducted at remote locations.

Based on the above, it does not appear that the impact of the loss of communications has been fully considered in the analysis or accompanying time-lines. Please clarify.

Westinghouse Response:

Loss of communication is accounted for on each of the Tables for operator action. Step 3 in each of the 17 tables states that "EO verifies the alarm, and reports back to the MCR by using plant communication system (telephone or sound power phone), or travels back to the MCR to report the situation when the plant communication system is not available."

Also, the assumptions in the report state "For the analysis it is assumed the communication is not working and the RO must return to the MCR to verify the fire (see typical Step 3 in Tables 1 – 17)." This assumption actually refers to the EO and will be revised in the Technical Report to indicate the correct personnel.

Section 9.5.2 of the Rev. 16 DCD addresses the plant communication system (EFS). The communication system consists of the following subsystems:

- Wireless telephone system
- Telephone/page system
- Private automatic branch exchange (PABX) system
- Sound powered system
- Emergency offsite communications
- security communication system

This system is designed to provide "effective intraplant communications and effective plant-to-offsite communications during normal, maintenance, transient, fire, and accident conditions..." As noted in Section 9.5.2.1, the communication subsystems are independent of one another; therefore, a failure in one subsystem does not degrade performance of the other subsystems.

Reference:

1. APP-GW-GLR-027, Operator Actions Minimizing Spurious ADS Actuation
2. APP-GW-GL-700, Rev. 16, Design Control Document.

DCD Revision:
None

PRA Revision:
None

TR Revision:

ASSUMPTIONS:

For the analysis it is assumed the communication is not working and the ~~RO~~ EO must return to the MCR to verify the fire (see typical Step 3 in Tables 1 – 17).

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR45-022
Revision: 0

Question:

Operator actions outside the MCR should be shown such that they can be dependably and repeatably performed within the available time, by different crews, under somewhat varying conditions with a high success rate (see definition of reliable actions action in NUREG-1852).

The "Conclusion" section of the report states: "no specific analysis is provided for a fire in the MCR. The process of moving to the remote shutdown workstation and the switching action at the transfer switches minimizes the potential for spurious ADS with no additional action required." Please provide the results of the evaluation which demonstrates that spurious actuation of ADS will not occur prior to actuation of isolation / transfer switches at the remote shutdown panel (RSP). This evaluation should consider such aspects as the physical and electrical separation of circuits of concern and the time for operators to abandon the main control room and implement the alternative shutdown capability. In addition, the evaluation should demonstrate that operators will be capable of mitigating the event at the RSP should it occur.

Westinghouse Response:

RAI-TR45-001 discusses the ADS control switches located in the MCR, physical separation of these circuits, and the actions that would be taken following a fire in the MCR. Separation of switches and cabling in the MCR is adequate to allow completion of operator actions within the 30 minute time limit. Transfer of control from the MCR to the Remote Shutdown Room can occur in far less than this 30 minute time limit. The manipulation of the transfer switches to transfer control to the RSW prevent spurious ADS actuation from the PMS circuitry in the MCR. There is also a DAS master disable switch, co-located outside of the MCR with the main transfer switch for the RSR, used to disable the master enable switch, therefore disabling all DAS manual actuation capability. The master disable switch is operated when evacuating the MCR and transferring control to the remote shutdown console.

3(three)-hour fire barriers around the MCR prevent fire and smoke from spreading to the stairwell S05 where the transfer switch is located, or the Remote Shutdown Room.

In addition, the Remote Shutdown Panel (RSP) can also be used to bring the plant to a safe shutdown.

Reference:
None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

Design Control Document (DCD) Revision:
None

PRA Revision:
None

Technical Report (TR) Revision:
None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR45-023
Revision: 0

Question:

For fires in the various fire areas and rooms, the analysis assumes that many actions can be reliably taken from the MCR to mitigate the effects of these fires. As an example, Table 1, Step 5 states that the RO takes action from the MCR to open motor control center circuit breakers.

Please provide the results of the evaluation which demonstrates that the circuits necessary for these operator actions in the MCR will remain free of fire damage prior to the operator actions being completed.

Westinghouse Response:

As stated in RAI-TR45-05, remote operation is a preferred course of action. However, should remote circuits be damaged and inoperable the EO will manipulate the circuits locally.

Circuits identified in this evaluation that deenergize a fire zone are not located in the affected fire zone. Electrical cabinets that are to be remotely deenergized by the RO are located adjacent to the affected fire zone. Fire barriers for the affected zone are rated at a minimum of 1-hour, and will prevent the spread of fire to the adjacent room for at least one hour. This allows time for the RO to take remote action and deenergize the required circuits prior to fire spreading to the room and damaging the remote circuits.

Reference:
None

Design Control Document (DCD) Revision:
None

PRA Revision:
None

Technical Report (TR) Revision:
None