



Westinghouse Electric Company
Nuclear Power Plants
P.O. Box 355
Pittsburgh, Pennsylvania 15230-0355
USA

U.S. Nuclear Regulatory Commission
ATTENTION: Document Control Desk
Washington, D.C. 20555

Direct tel: 412-374-6306
Direct fax: 412-374-5005
e-mail: sterdia@westinghouse.com

Your ref: Project Number 740
Our ref: DCP/NRC1927

52-006

June 8, 2007

Subject: AP1000 COL Response to Requests for Additional Information (TR #59)

In support of Combined License application pre-application activities, Westinghouse is submitting another set of responses to NRC requests for additional information (RAI) on AP1000 Standard Combined License Technical Report 59, APP-GW-GLR-011, Rev. 0, Execution and Documentation of the Human Reliability Analysis/Human Factors Engineering Integration. 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 TR59-COLP-10 and TR59-COLP-12, transmitted by email dated April 26, 2007 from Steve Bloom to Don Lindgren.

Pursuant to 10 CFR 50.30(b), the responses to requests for additional information on Technical Report 59 are submitted as Enclosure 1 under the attached Oath of Affirmation. The detailed requests for additional information are included with the appropriate responses in Enclosure 1.

Questions or requests for additional information related to the content and preparation of this response 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 handwritten signature in black ink, appearing to read 'A. Sterdis'.

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

D063
D079
MRD

/Attachment

1. "Oath of Affirmation," dated June 8, 2007

/Enclosure

1. Response to Requests for Additional Information on Technical Report No.59

cc:	D. Jaffe	- U.S. NRC	1E	1A
	E. McKenna	- U.S. NRC	1E	1A
	G. Curtis	- TVA	1E	1A
	P. Grendys	- Westinghouse	1E	1A
	P. Hastings	- Duke Power	1E	1A
	C. Ionescu	- Progress Energy	1E	1A
	D. Lindgren	- Westinghouse	1E	1A
	A. Monroe	- SCANA	1E	1A
	M. Moran	- Florida Power & Light	1E	1A
	C. Pierce	- Southern Company	1E	1A
	E. Schmiech	- Westinghouse	1E	1A
	D. Hutchings	- Westinghouse	1E	1A
	G. Zinke	- NuStart/Entergy	1E	1A
	D. McLaughlin	- 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)

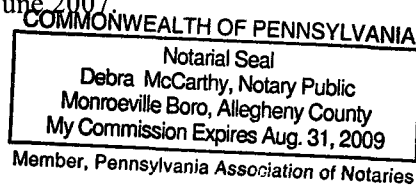
APPLICATION FOR REVIEW OF
"AP1000 GENERAL COMBINED LICENSE INFORMATION"
FOR COL APPLICATION PRE-APPLICATION REVIEW

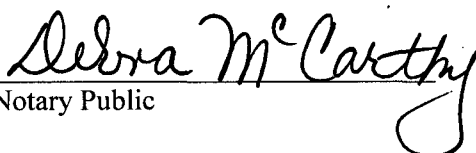
W. E. Cummins, being duly sworn, states that he is Vice President, Regulatory Affairs & Standardization, for Westinghouse Electric Company; that he is authorized on the part of said company to sign and file with the Nuclear Regulatory Commission this document; that all statements made and matters set 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 8th day
of June, 2007.




Notary Public

ENCLOSURE 1

Responses to Requests for Additional Information on Technical Report No. 59

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR59-COLP-10
Revision: 0

Question:

For flooding: the response addresses those human actions (HAs) that are part of the internal events probabilistic risk assessment (PRA) model, as used as part of the flooding PRA, but not the HAs that are specific to the flooding analysis. For example, there are HAs that contribute to the flood initiator in the Annex Building 135'-3", North Air Handling Equipment Area. For this case, there is multiple credit taken for auxiliary operators and security guards to mitigate the flooding. If both were to fail, this would have a high risk achievement worth (RAW) value and is unacceptable. Please address these types of flood-specific HAs for flooding PRA.

For focused PRA: the staff does not agree with the response which says that NRC guidance for focused PRA and regulatory treatment of non-safety systems (RTNSS) does not require treatment of shutdown LERF and external events. For focused PRA, NRC guidance (RG 1.206, C.IV.9 and SECY-94-084) is to include at-power and shutdown, core damage frequency (CDF) and LERF, and internal and external events. The AP1000 safety evaluation report, Chapter 22, RTNSS, discusses this issue specifically for the AP1000 and both requires and credits the shutdown LERF assessment by the focused PRA. It does note in Section 22.5.1.1 that separate RTNSS external events event studies were not required for AP1000 because the risk was addressed conservatively in the main PRA. Please address risk-important HAs for LERF based on the shutdown focused PRA.

Westinghouse Response:

For flooding:

The AP1000 Internal Flooding PRA-specific operator actions have been evaluated to determine their risk importance. Specifically, there are four Internal Flooding PRA operator actions, all of which contribute solely to the Annex Building 135'-3", North Air Handling Equipment Area initiating event frequency. The Internal Flooding PRA operator actions are defined below.

- SGDTM: Security guard fails to diagnose that water is leaking and fails to mitigate by opening the annex building front door.
- CRDET: Control room personnel fail to respond to the fire protection system alarms and notify auxiliary personnel to investigate.
- SGCCR: Security guard fails to call control room personnel.
- FLISM: Auxiliary personnel fail to isolate or mitigate the flood.

The analysis was performed by modifying the Initiating Event frequency by making each operator action probability 0.0 (for Risk Reduction Worth calculation) or 1.0 (for Risk Achievement Worth calculation). Subsequently, a new total plant CDF was determined. Table 1 and Table 2 document the results of the Risk Achievement Worth and Risk Reduction

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

Worth analyses, respectively. The results indicate that none of the Internal Flooding operator actions are important to total plant risk. This is indicative of the already low Internal Flooding risk demonstrated by the AP1000 design. The AP1000 total plant Core Damage Frequency is 5.09E-07 /year.

Table 1: Risk Achievement Worth

RANK	BASIC EVENT ID	BASIC EVENT DESCRIPTION	PSF	BEV PROB.	RAW
1	SGDTM	Security guard fails to diagnose that water is leaking and fails to mitigate by opening the annex building front door.	N/A	1.90E-02	1.004E+00
2	FLISM	Auxiliary personnel fail to isolate or mitigate the flood.	N/A	3.80E-02	1.001E+00
3	CRDET	Control room personnel fail to respond to the fire protection system alarms and notify auxiliary personnel to investigate.	N/A	4.31E-02	1.001E+00
4	SGCCR	Security guard fails to call control room personnel.	N/A	5.10E-01	1.000E+00

Table 2: Risk Reduction Worth

RANK	BASIC EVENT ID	BASIC EVENT DESCRIPTION	PSF	BEV PROB.	RRW
1	SGDTM	Security guard fails to diagnose that water is leaking and fails to mitigate by opening the annex building front door.	N/A	1.90E-02	1.000E+00
2	FLISM	Auxiliary personnel fail to isolate or mitigate the flood.	N/A	3.80E-02	1.000E+00
3	CRDET	Control room personnel fail to respond to the fire protection system alarms and notify auxiliary personnel to investigate.	N/A	4.31E-02	1.000E+00
4	SGCCR	Security guard fails to call control room personnel.	N/A	5.10E-01	1.000E+00

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

For focused PRA:

The AP1000 focused shutdown Large Release Frequency (LRF) was estimated using AP1000 calculations and estimates. The following equation was used and documented in Chapter 54 of APP-GW-GL-022 (Reference 1). CCFP is defined as Conditional Containment Failure Probability and CDF is defined as annual Core Damage Frequency.

$$\text{LRF}(\text{focused shutdown}) = \text{CCFP}(\text{focused shutdown}) * \text{CDF}(\text{focused shutdown})$$

It is concluded that no additional insights would be gained by performing a detailed quantification of the LRF from events that could occur at shutdown for the AP1000. Since no detailed AP1000 focused shutdown level 2 PRA model quantification was performed, no cutsets were generated and operator action importance measures were not quantified. The release frequency for events at focused shutdown is comparable to the release frequency for focused internal events at power. Since the focused shutdown large release risk profile is expected to be similar to that of the focused at-power large release risk profile, the focused at-power large release risk-important operator actions are considered representative of the focused shutdown large release risk-important operator actions.

Reference:

1. Westinghouse AP1000 Document APP-GW-GL-022, "AP1000 Probabilistic Risk Assessment", Revision 8, 2004

Design Control Document (DCD) Revision:

None

PRA Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

Technical Report (TR) Revision:

Revise Section 3.2 of TR-59:

3.2 Risk-Important Human Actions, Post Accident

Risk-important human actions used to mitigate accident are identified using both quantified PRA importance measures and an expert panel.

As discussed in section 2.2.1, the risk importance measures are expressed as RAW and RRW values. These values have been calculated for the following initial conditions and accidents; the results are shown in the tables indicated (reference 5.2):

		CDF	LRF
Base:	At-Power – internal	A-1, A-2	A-3, A-4
	- fire	A-5, A-6 (1)	-
	- flood	A-15, A-16 (2)	-
	Shutdown – internal	A-7, A-8	(3)
Focused:	At-Power – internal	A-9, A-10	A-11, A-12
	- fire	(4)	-
	- flood	(5)	-
	Shutdown – internal	A-13, A-14	(6)

The items with a "-" are not required as indicated in section 2.2.1. Note that some of the required RAW / RRW values could not be calculated from the AP1000 PRA because of simplifications that were made in calculating some of the PRA results. The acceptability of not calculating these items is justified in the following footnotes.

Footnotes:

- 1) The human action RAW / RRWs for baseline PRA, at-power, fire CDF were calculated from the AP1000 baseline PRA for human actions unique to the fire event, but not for other human actions. This is acceptable since the unique fire human actions are included in the evaluation and the other human actions were included in the baseline PRA, at-power, internal events. Note that the baseline PRA, at-power fire events has a lower CDF as shown in Table 3.2-1 which will make the other human actions less important than in the baseline PRA, at-power, internal events.
- 2) The human action RAW / RRWs for baseline PRA, at-power, flood CDF could not be calculated from the AP1000 baseline PRA. This is acceptable since the CDF for floods at power is very low, a factor of ~ 270 less than that for at-power internal events. **The internal flooding specific operator actions, which contribute to the Annex Building 135'-3" North Air Handling Equipment Area initiating event frequency, were analyzed to determine their risk importance to total AP1000 CDF. The results are documented in Table A-15.**
- 3) The human action RAW / RRWs for baseline PRA, shutdown, internal event LRF could not be calculated from the baseline AP1000 PRA. This is acceptable since there are few ways that the

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

containment can be bypassed other than failing to be isolated. Failure to close the containment (equipment hatch, personnel doors, etc) was added as a risk-important human action by the expert panel.

- 4) The human action RAW / RRWs for focused PRA, at-power, fire CDF could not be calculated from the focused AP1000 PRA. This is acceptable since the unique human actions related to the fire event have been reviewed in the at-power fire event. In addition the CDF for fires at shutdown is lower than that for shutdown internal events.
- 5) The human action RAW / RRWs for focused PRA, flood CDF could not be calculated from the focused AP1000 PRA. This is acceptable since the CDF for floods at-power are very low, a factor of ~ 270 less than that for at-power internal events.
- 6) The human action RAW / RRWs for focused PRA, shutdown, internal event LRF could not be calculated from the focused AP1000 PRA. This is acceptable for the same reasons discussed in foot note 3).

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

Add the following tables to TR-59 Attachment A:

Table A-15: Risk Achievement Worth					
RANK	BASIC EVENT ID	BASIC EVENT DESCRIPTION	PSF	BEV PROB.	RAW
1	SGDTM	Security guard fails to diagnose that water is leaking and fails to mitigate by opening the annex building front door.	N/A	1.90E-02	1.004E+00
2	FLISM	Auxiliary personnel fail to isolate or mitigate the flood.	N/A	3.80E-02	1.001E+00
3	CRDET	Control room personnel fail to respond to the fire protection system alarms and notify auxiliary personnel to investigate.	N/A	4.31E-02	1.001E+00
4	SGCCR	Security guard fails to call control room personnel.	N/A	5.10E-01	1.000E+00

Table A-16: Risk Reduction Worth					
RANK	BASIC EVENT ID	BASIC EVENT DESCRIPTION	PSF	BEV PROB.	RRW
1	SGDTM	Security guard fails to diagnose that water is leaking and fails to mitigate by opening the annex building front door.	N/A	1.90E-02	1.000E+00
2	FLISM	Auxiliary personnel fail to isolate or mitigate the flood.	N/A	3.80E-02	1.000E+00
3	CRDET	Control room personnel fail to respond to the fire protection system alarms and notify auxiliary personnel to investigate.	N/A	4.31E-02	1.000E+00
4	SGCCR	Security guard fails to call control room personnel.	N/A	5.10E-01	1.000E+00

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR59-COLP-012
Revision: 0

Question:

The concern relates to being able to appropriately perform the necessary scope of HFE (across the several HFE program elements) for HAs that are not well-defined. In the example of REC-MANDAS, "Failure to detect the need to perform an activity by using the cues provided by diverse actuation system [DAS], or the probability to perform an activity by using the controls that are DAS related," the response refers to Table 30-2 of the PRA, which does provide a bit more detail, system-by-system, of what is included in REC-MANDAS. Will each of these items and systems be addressed as risk-important HAs? Please provide further clarification to address the concern.

Westinghouse Response:

When an operator error is assessed for various accident scenarios in the AP1000 PRA, evaluations were performed for different conditions if major distinctions, such as accident sequence timing, were believed to exist. Otherwise, they were grouped under one identifier and used in the different system fault trees. Although the limiting case is used, the results are not expected to be sensitive to the human error probability value. As such, several operator actions may be described in a more generic fashion because they were evaluated to be applicable across a range of accident sequences. The limiting operator action is used in performing the HFE activities.

There are several items of consideration with respect to the specific REC-MANDAS action. First, the DAS is only necessary following failure of the Protection and Safety Monitoring System (PMS). The AP1000 standard control room has been designed such that recognizing the need for manual actions on the DAS panel will be fairly straightforward. The PMS is designed with comprehensive self diagnostics to provide indication of internal PMS health. One of the insights gained from the PRA indicate that that the most risk significant failures of the PMS will not be single PMS component failures, but will be common cause software failures. The common cause failures will fail the entire PMS, which will provide clear indication to the operators that an error has occurred. Thus, recognizing the need for DAS is independent of the accident sequence. A single representative operator action is sufficient for future HFE activities.

Secondly, detailed Emergency Operating Procedures are being written to aid the operators in recognizing issues with internal PMS health. Operators will be well trained in recognizing failures of the PMS and will have adequate training in understanding the consequences of PMS failures and recoveries via the DAS. The process used by the operators to recognized failures of the PMS and to subsequently move to the DAS panel is expected to be similar among all possible manual DAS actions. Again, this provides further evidence that recognizing the need for DAS is independent of the accident sequence. A single representative operator action is sufficient for future HFE activities.

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

Finally, additional detail could be added to the AP1000 PRA to model all of the manual DAS actions for the considered systems. The current modeling approach is to use a representative manual DAS action (REC-MANDAS) and apply that action to multiple sequences. This approach results in the single REC-MANDAS basic event contributing to many PRA cutsets. However, additional model detail would result in many manual DAS actions, each contributing to a few cutsets related to the system of interest. Using this less conservative approach, it is expected that any given manual DAS action would be of reduced importance to risk. It is likely that each manual DAS action would become risk insignificant and the manual DAS actions would no longer be considered for HFE activities. Therefore, the conservative modeling approach currently used in the AP1000 PRA results in the inclusion of a manual DAS action in HFE activities, whereas less conservative modeling approaches may result in the removal of the manual DAS actions from future consideration.

Thus, the use of a limiting operator action in the PRA is considered representative of the typical manual DAS action. The limiting operator action is used in performing the HFE activities.

Reference:

None

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None