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Your ref: Project Number 740
Our ref: DCP/NRC1969

July 27, 2007

Subject: AP1000 COL Responses to Requests for Additional Information (TR #86)

In support of Combined License application pre-application activities, Westinghouse is submitting a response to NRC request for additional information (RAI) on AP1000 Standard Combined License Technical Report 86, APP-GW-GLN-018, Rev. 0, Alternate Steam and Power Conversion. This RAI response is submitted as part of the NuStart Bellefonte COL Project (NRC Project Number 740). The information included in the response is generic and is expected to apply to all COL applications referencing the AP1000 Design Certification.

The response is provided for request for additional information RAI-TR86-SBPB-01. This completes the responses to all RAIs received on TR86 to date.

Pursuant to 10 CFR 50.30(b), the response to request for additional information on Technical Report 86 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,

D. J. Hutchings for

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

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D079
D063
NRO

/Attachment

1. "Oath of Affirmation," dated July 27, 2007

/Enclosure

1. Response to Request for Additional Information on Technical Report No. 86

cc:	D. Jaffe	-	U.S. NRC	1E	1A
	E. McKenna	-	U.S. NRC	1E	1A
	S. Adams	-	Westinghouse	1E	1A
	G. Curtis	-	TVA	1E	1A
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	M. Moran	-	Florida Power & Light	1E	1A
	C. Pierce	-	Southern Company	1E	1A
	E. Schmiech	-	Westinghouse	1E	1A
	G. Zinke	-	NuStart/Entergy	1E	1A
	K. Schwab	-	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

W. E. Cummins
Vice President
Regulatory Affairs & Standardization

Subscribed and sworn to
before me this 27th day
of July 2007.

COMMONWEALTH OF PENNSYLVANIA
Notarial Seal
Patricia S. Aston, Notary Public
Murrysville Boro, Westmoreland County
My Commission Expires July 11, 2011
Member, Pennsylvania Association of Notaries

Patricia S. Aston
Notary Public

ENCLOSURE 1

Response to Request for Additional Information on Technical Report No. 86

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR86-SBPB-01
Revision: 0

Question:

The proposed alternate steam and power conversion design in TR-86 replaces the mechanical overspeed protection with electrical overspeed trip. This is not consistent with Paragraph III.2.c of Section 10.2 (Revision 2) of the SRP. The proposed design exhibits redundancy but not diversity. The mechanical trip provides a diverse trip mechanism, which eliminates common cause failures associated with electrical components, and thereby increases reliability of the turbine overspeed function. Therefore, the proposed deviation from the criterion specified in SRP 10.2, Rev. 2 must be justified if any structures, systems or components (SSCs) important to safety are vulnerable to turbine missiles, or if the turbine missile effects could otherwise pose a challenge to plant operators in achieving and maintaining safe shutdown conditions. For example, a situation that could pose a challenge to plant operators is a turbine missile strike on a hazardous chemical or flammable liquid storage tank. The justification should include the following information:

1. A complete listing of turbine missile vulnerabilities that exist of the nature described above, including a diagram showing locations relative to the turbine placement to facilitate NRC review.
2. Potential consequences of turbine missile strikes on the SSCs identified in item 1 above.
3. A comparison of the reliability of the proposed turbine overspeed trip protection capability to the reliability that is afforded by the diverse capability that exists for existing plants.
4. Provide a failure modes and effects analysis for the proposed turbine overspeed protection equipment. Specifically identify and address any common mode or common cause failure vulnerabilities that exist.
5. Compare the likelihood of generating turbine missiles with the turbines to be used in the new plants, with the likelihood of turbine missiles generation on current plants that have diverse turbine overspeed trip capability.
6. Provide a summary discussion of what the overall consequences are of eliminating the diverse turbine overspeed trip capability on plant safety, taking into consideration the above factors.

Westinghouse Response:

1. Please refer to DCD Figure 1.2-2 which is the standard site plan for the single unit AP1000. Site specific departure from this site plan will be covered in the site application or in the combined license application.

   Directions for north, south, east and west used in this plan are nominal site description directions and have no relationship to directions on an actual site.

As shown in this figure, the building structures are oriented such that the turbine building is located to the north of the nuclear island, with the other principal buildings adjacent to the nuclear island to meet their functional purpose. Within the turbine building (Item 2 in the figure), the turbine rotors are oriented north-south using the north, south, east and west convention shown in the figure. This orientation is a favorable orientation as defined in NUREG-0800 Standard Review Plan (SRP) 3.5.1.3, "Turbine Missiles", which minimizes potential interaction between turbine missiles and safety-related structures and components. Any turbine missiles generated will tend to have an east-west trajectory.

Structures, systems or components (SSCs) not important to safety and potentially vulnerable to turbine missiles because they lie in the east-west trajectory path are (listed by DCD Figure 1.2-2 legend item number):

3. Annex Building
5. Service Water System Cooling Towers[a]
9. Circulating Water Pump Intake Structure[b]
11. Circulating Water System Cooling Tower[b]
12. Circulating Water System Intake Canal[b]
18. Diesel Generator Fuel Oil Storage Tanks[a]
24. Waste Water Retention Basin[b]

a = Plant Investment Component b = Site Specific Component

2. Based on the above list, there are no potential turbine missile strikes on SSCs important to safety or SSCs that could pose a challenge to the operators.

3. The electronic overspeed trip system relies on three smart I/O modules that contain an on board microprocessor as a degree of diversity. Measured speed is compared at the I/O module level to a stored setpoint that actuates a relay when the setpoint is exceeded. Three speed detector I/O modules are utilized and connected to three separate speed sensors. The relay output contacts of the three speed detector modules are hardwired in a voting arrangement to provide a trip signal. Another degree of diversity is provided by the software based trip that takes the speed reading from the I/O modules and applies control builder logic to determine the trip function which is then output via separate relay outputs.

   A third overspeed limiting function, sometimes called Overspeed Protection Control (OPC) or pre-emergency governor, actuates at a pre-set setpoint (e.g., 103%) in a different controller using a different set of speed detectors and modules. The OPC function uses a speed measurement that is based on timing the passing of a fixed number of gear teeth which is different from the measurement used for tripping the turbine on overspeed (e.g., 110 or 111%) which counts the number of teeth passing in a fixed time. Both of these measurements are dynamic in nature and are continuously under surveillance providing a known relationship of turbine speed to grid frequency.

While the mechanical overspeed protection provided on old style turbines is diverse, it suffers from the deficiency that it places the turbine at risk during the testing period. Even at shutdown, testing the mechanical device requires defeating the OPC and actually putting the turbine into an overspeed condition, risking machine damage and increasing the risk of generating a missile. Conversely, the electronic trip system can be tested on line, one channel at a time by injecting a simulated probe signal into the front end of the speed detector module and varying this signal over its range, without defeating the other protection channels.

Other disadvantages of the mechanical overspeed trip device are:

A. The mechanical overspeed system has multiple moving parts (i.e., linkages, spring adjuster, etc.) which are subject to wear that reduce reliability and have resulted in spurious trips.

B. Each moving assembly in the mechanical system represents a single point vulnerability (SPV). The large number of potential SPVs reduces the reliability of the trip function and also increases the likelihood of a spurious trip. There is OE data compiled by INPO that confirms this statement.

C. A latent failure in the mechanical overspeed subcomponents can not be detected on line which reduces the reliability of the system. An electronic based system has the capability to detect latent failures.

D. Although testing of the mechanical overspeed system can be performed on line, this greatly increases the risk of a spurious trip and reduces the overall reliability of the system.

Reliability analyses have been performed on upgrades for existing operating units where the mechanical overspeed trip device was replaced with an emergency electrical overspeed trip system. These analyses show that because of the high degree of redundancy and diversity within the design of the electronic trip system, the electronics are not a significant contributor to the unavailability of the trip system on demand.

4. Detailed design of the emergency overspeed trip system is being completed for AP1000. Upon completion of the system design, a FMEA will be performed to identify and address potential common cause failures. Diversity will be provided to the extent possible through the design of the system.

5. Please refer to WCAP-16650-P for an analysis of the probability of generation of missiles for the AP1000 turbine. The likelihood of generating missiles with the turbines to be used in the new plants will be the same or less as current plants that have a mechanical overspeed trip device.

6. Westinghouse's position is the electronic overspeed trip is at least as reliable as its predecessor that includes a mechanical trip device. This is basically due to the fact that the electronic system is designed for performing on-line surveillance testing of its functional capabilities, without defeating other protections, as compared to a mechanical trip device.

   While the mechanical overspeed protection provided on old style turbines is unquestionably diverse, it suffers from the deficiency that it is a difficult, tedious and time consuming task to verify proper operation by testing. Even more concerning is testing this device requires defeating the overspeed protection control function and putting the turbine into an overspeed condition, risking machine damage and increasing the risk for generating a missile. Testing of the mechanical overspeed trip device is typically performed as follows:

   Off-Line Testing

   To perform a test on the mechanical overspeed trip device, the turbine must be run up to the 110% speed trip point. If the trip does not occur at the designated speed, the turbine is tripped manually and must coast down to turning gear. This process takes over an hour to perform. Once back on turning gear, the front pedestal must be opened and a mechanical adjustment made to the spring tension of the trip device. This also takes about an hour. Once the adjustment is made and the front pedestal is closed, the turbine is then restarted and run up to the trip point speed. If the trip does not again occur at the designated speed this procedure must be repeated.

   On-Line Testing

   The procedure requires at least two technicians. One person must physically hold the trip handle at the front pedestal in the reset position while the other technician rotates a handle in the front pedestal and watches a gauge to verify the oil pressure drops when the trip bolt deploys. The downside of this process is that it puts the turbine at extreme risk during the ten or so minutes while the trip handle is being held in the reset position. If the initial adjustment of this mechanism is not done correctly, the turbine will trip on line during this test. Most utilities find testing the mechanical overspeed trip device challenging.

   Replacing the mechanical overspeed trip device with an emergency electrical overspeed eliminates these concerns.

Reference:

1. WCAP-16650, Revision 0, “Analysis of the Probability of the Generation of Missiles from Fully Integral Nuclear Low Pressure Turbines”
2. APP-GW-GLN-018, Revision 0, “Alternate Steam and Power Conversion Design,” (Technical Report Number 86)

Design Control Document (DCD) Revision:
None

PRA Revision:
None

Technical Report (TR) Revision:
None