Westinghouse

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: 412-374-6206
Direct fax: 412-374-5005
e-mail: sisk1rb@westinghouse.com

Your ref: Docket No. 52-006
Our ref: DCP_NRC_002530

June 12, 2009

Subject: AP1000 Response to Request for Additional Information (SRP 10)

Westinghouse is submitting a response to the NRC request for additional information (RAI) on SRP Section 10. This RAI response is submitted in support of the AP1000 Design Certification Amendment Application (Docket No. 52-006). The information included in this response is generic and is expected to apply to all COL applications referencing the AP1000 Design Certification and the AP1000 Design Certification Amendment Application.

Enclosure 1 provides the response for the following RAI(s):

RAI-SRP10.2-SBPA-02 R1

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,

D. G. Lindgren /FOR

Robert Sisk, Manager
Licensing and Customer Interface
Regulatory Affairs and Standardization

/Enclosure

1. Response to Request for Additional Information on SRP Section 10

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cc:	D. Jaffe	-	U.S. NRC	1E
	E. McKenna	-	U.S. NRC	1E
	P. Buckberg	-	U.S. NRC	1E
	T. Spink	-	TVA	1E
	P. Hastings	-	Duke Power	1E
	R. Kitchen	-	Progress Energy	1E
	A. Monroe	-	SCANA	1E
	P. Jacobs	-	Florida Power & Light	1E
	C. Pierce	-	Southern Company	1E
	E. Schmiech	-	Westinghouse	1E
	G. Zinke	-	NuStart/Entergy	1E
	R. Grumbir	-	NuStart	1E
	P. Loza	-	Westinghouse	1E

ENCLOSURE 1

Response to Request for Additional Information on SRP Section 10

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP10.2-SBPA-02
Revision: 1

Question:

With respect to the diversity of AP1000 DCD turbine overspeed control system, in its earlier request for additional information (RAI-TR86-SBPB-01, Item 3), the NRC staff requested the applicant to provide further information for a comparison of the reliability of the proposed turbine overspeed protection capability to the reliability that is afforded by the diverse capability that exists for existing plants. In its response, in a letter dated July 27, 2007, Westinghouse stated, "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 modules." Westinghouse response was not specific enough whether this applies to the primary overspeed trip of 110 percent and/or the emergency backup overspeed trip of 111 percent. Further, nothing else was stated in the DCD markup (TR-86) or in the rest of the above RAI response that would provide further details of the software configuration for the overspeed trip system. The NRC staff's concern is that if both the 110 percent and 111 percent overspeed trips use the same software, then a common cause failure (CCF) could render both systems inoperable. Therefore, with respect to defense against CCF for design diversity, and also to meet the guidance provided in SRP 10.2, Part III, "REVIEW PROCEDURES," Subsection 2.A where it states, "The design of the in-depth defense provided by the turbine generator protection system to preclude excessive overspeeds should include diverse protection means," the staff requests additional information and justification relating to the diversity of the turbine overspeed control system for AP1000 DCD, since it replaces the current mechanical overspeed system.

Westinghouse Response: <u>(Revision 0)</u>

In this and previous RAI-TR86-SBPB-01, Item 3, the NRC staff requested that Westinghouse to provide additional information on the diversity of the electronic replacement of the mechanical 110% overspeed trip with emergency 111% trip.

Westinghouse believes that the original design approach using the Ovation speed detector module firmware for both trips in parallel with Ovation controller software based logic provides a level of redundancy and diversity at least equivalent to the recommendations for turbine overspeed protection found in Part III of the Standard Review Plan (NUREG-0800) Section 10.2. However, Westinghouse has decided to commit to implementing the two overspeed trips using diverse (hardware and software/firmware) electronic means (i.e. one of the trips will not be implemented using the Ovation speed detector module), such that the 110% and 111% trips are not susceptible to a common cause software failure that would render them both inoperable.

Additional Westinghouse Response based on NRC comments at 3/18/09 meeting: (Revision 1)

Westinghouse will provide a Diverse Electronic Overspeed Protection System, which will prevent any single-failure and common cause failure from occurring. Diversity will be achieved by using a second electronic Overspeed Protection System (diverse hardware and software/firmware) in place of the mechanical trip mechanism, and the Ovation System for back-up overspeed protection. The circuitry of these systems and their control signals will be isolated and independent of each other. The Diverse Overspeed Protection System will be located in the Emergency Trip System cabinet drop (for tripping the turbine at 110% of rated speed), while the Ovation (back-up) System will be located in the Operator Automatic (OA) cabinet drop and will trip the turbine at 111% of rated speed.

Both systems will use a set of magnetic pickups for sensing speed and each set will be mounted on a separate bracket. Active magnetic probes will be used on the Ovation System and the Diverse Overspeed Protection System will use passive magnetic probes.

The overspeed trips are discussed in DCD Section 10.2.2.5.3, "Overspeed Trip Functions and Mechanisms." (The AP1000 uses trip setpoints of 110 and 111 percent, rather than the 111 and 112 percent indicated in the SRP.) Words are added in the DCD markup below containing text similar to that in the SRP, to clarify in the DCD that diversity exists. Also, an ITAAC is added to confirm the design acceptance criteria (DAC) of diverse hardware/firmware/software between the two overspeed trips.

The overspeed protection system will function for all abnormal conditions, including a single failure of any component or subsystem.

SRP 10.2, part III-2-D indicates that an independent and redundant backup electrical overspeed trip circuit senses the turbine speed by magnetic pickup and closes all valves associated with speed control at approximately 112 percent of rated speed. The circuitry is reviewed to confirm that the control signals from the two systems are isolated from, and independent of, each other.

Design Control Document (DCD) Revision: (Revision 1)
~~None~~

Modify DCD Tier 1, Section 2.4.2 as shown:

2.4.2 Main Turbine System

Design Description

The main turbine system (MTS) is designed for electric power production consistent with the capability of the reactor and the reactor coolant system.

The component locations of the MTS are as shown in Table 2.4.2-2.

1. The functional arrangement of the MTS is as described in the Design Description of this Section 2.4.2.

2. a) Controls exist in the MCR to trip the main turbine-generator.

   b) The main turbine-generator trips after receiving a signal from the PMS.

   c) The main turbine-generator trips after receiving a signal from the DAS.

3. The overspeed trips for the AP1000 turbine are set for 110% and 111%. Each trip is initiated electrically in separate, diverse systems. The control signals from the two turbine-generator overspeed trip systems are isolated from, and independent of, each other.

Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.4.2-1 specifies the inspections, tests, analyses, and associated acceptance criteria for the MTS.

Table 2.4.2-1
Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Test, Analyses	Acceptance Criteria
1. The functional arrangement of the MTS is as described in the Design Description of this Section 2.4.2.	Inspection of the as-built system will be performed.	The as-built MTS conforms with the functional arrangement as described in the Design Description of this

		Section 2.4.2.
2.a) Controls exist in the MCR to trip the main turbine-generator.	Testing will be performed on the main turbine-generator using controls in the MCR.	Controls in the MCR operate to trip the main turbine-generator.
2.b) The main turbine-generator trips after receiving a signal from the PMS.	Testing will be performed using real or simulated signals into the PMS.	The main turbine-generator trips after receiving a signal from the PMS.
2.c) The main turbine-generator trips after receiving a signal from the DAS.	Testing will be performed using real or simulated signals into the DAS.	The main turbine-generator trips after receiving a signal from the DAS.
3) The control signals from the two turbine-generator overspeed trip systems are isolated from, and independent of, each other.	The system design will be reviewed. Testing of the as-built system will be performed using simulated signals from the turbine speed sensors.	The system design review shows that the control signals of the two overspeed trip systems are isolated from, and independent of, each other. The main turbine-generator trips after overspeed signals are received from the speed sensors of electrical overspeed trip system, and, the main turbine-generator trips after overspeed signals are received from the speed sensors of the emergency electrical overspeed trip system.

Modify Tier 2 Section 10.2.2.5.3 as shown:

10.2.2.5.3 Overspeed Trip Functions and Mechanisms

The overspeed trips for the AP1000 turbine consist of a 110% and a 111% emergency electrical trip. The overspeed trip setpoints are identified in Table 10.2-2. The overspeed protection system will function for all abnormal conditions, including a single failure of any component or subsystem.

The AP1000 110 percent trip is implemented electronically rather than mechanically as indicated in the review procedure in SRP 10.2, part III-2-C. An independent and redundant backup electrical overspeed trip circuit senses the turbine speed by magnetic pickup and closes all valves associated with speed control at approximately 111 percent of rated speed.

The electrical overspeed trip system has triplicated speed sensors. These are separate from the emergency electrical overspeed trip speed sensors, which provide backup overspeed protection utilizing the master trip solenoid valves in the master trip device to drain the emergency trip hydraulic supply. The hydraulic fluid in the trip and overspeed protection control headers is independent of the bearing lubrication system to minimize the potential for contamination of the fluid.

The operator automatic (OA) speed control and overspeed protection function of the D-EHC combined with the overspeed protection system and hydraulic manifold trips provide a level of redundancy and diversity at least equivalent to the recommendations for turbine overspeed protection found in III.2 of Standard Review Plan (NUREG-0800) Section 10.2. Additionally, the issues and problems with overspeed protection systems identified in NUREG-1275 (Reference 3) have been addressed.

PRA Revision:
None

Technical Report (TR) Revision:
None