AP1000DCDFileNPEm Resource

From: Loza, Paul G. [lozapg@westinghouse.com]
Sent: Friday, November 05, 2010 10:33 AM
To: Buckberg, Perry
Cc: Melton, Michael A; Schwab, E Keith; Salsi, Nathan J; Ritterbusch, Stanley E; Ziesing, Rolf F.
Subject: RE: NRC Concern with AO/111% Overspeed Trip
Attachments: RAI-SRP10 2-SBPA-02 R4 PGL draft (NA-Schwab update).docx; NRC 111 Keith110410.doc

Perry,

Per your email and the discussions to date, Westinghouse is providing a draft revision of RAI-SRP10.2-SBPA-02 R4 to address the NRC Concern with AO/111% Overspeed Trip. Words have been added and a DCD markup made to better address SRP10.2 guidance of "However, the circuitry is reviewed to confirm that the control signals from the two systems are isolated from, and independent of, each other."

Also attached is the latest paper from NA (Ron Walko) with greater detail and clarification.

Please take the time to review and comment for submittal. Westinghouse would like assurance after your review that this will alleviate the final concern of ACRS member Charles Brown in this area.

Thanks,

Paul Loza

From: Buckberg, Perry [mailto:Perry.Buckberg@nrc.gov]
Sent: Tuesday, November 02, 2010 3:48 PM
To: Melton, Michael A
Cc: Schwab, E Keith; McKenna, Eileen; Sisk, Robert B.; Loza, Paul G.
Subject: RE: NRC Concern with AO/111% Overspeed Trip

Mike,

Based on the draft paper you sent in the e-mail below, the staff has a couple questions that could be answered in an e-mail response or in a phone conference (or both).

In order to address SRP guidance of *"However, the circuitry is reviewed to confirm that the control signals from the two systems are isolated from, and independent of, each other,"* request the applicant to provide further information about:

1) Based on the draft document's statement *"is accomplished by three speed modules located on three **separate** I/O branches."*

   Question/ Are these three independent I/O branches? If so, please provide modified wording to state the same. If not, describe failure modes.

2) Based on the draft document's statement *"The Speed Module is designed to operate **independently** and requires no intervention by the Ovation Controller to trip the turbine."*

   Question/ Describe how the design provides independence.

Thanks,

Perry Buckberg

Senior Project Manager
Nuclear Regulatory Commission
Office of New Reactors
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perry.buckberg@nrc.gov

From: Melton, Michael A [mailto:melto1ma@westinghouse.com]
Sent: Monday, November 01, 2010 2:53 PM
To: Buckberg, Perry
Subject: FW: NRC Concern with AO/111% Overspeed Trip

Draft paper - For discussion at 3 PM.

-Mike

Hearing Identifier: AP1000_DCD_Review
Email Number: 516

Mail Envelope Properties (27265BDD489F164BAB98F1FFF63719720257AC014F)

Subject: RE: NRC Concern with AO/111% Overspeed Trip
Sent Date: 11/5/2010 10:33:10 AM
Received Date: 11/5/2010 10:33:55 AM
From: Loza, Paul G.

Created By: lozapg@westinghouse.com

Recipients:
"Melton, Michael A" <melto1ma@westinghouse.com>
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"Buckberg, Perry" <Perry.Buckberg@nrc.gov>
Tracking Status: None

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Files	**Size**	**Date & Time**
MESSAGE	2478	11/5/2010 10:33:55 AM
RAI-SRP10 2-SBPA-02 R4 PGL draft (NA-Schwab update).docx	155513	
NRC 111 Keith110410.doc	5039168	

Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received:

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP10.2-SBPA-02
Revision: 4~~3~~

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: (Revision 0)

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.

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

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.

Additional NRC request via 7/15 email: (Revision 2)

Comment [PGL1]:

Open Items OI-SRP10.2-SBPA-01 and OI-SRP10.2-SBPA-02b appear to have been properly addressed with the RAI-SRP10.2-SBPA-02 R1 response ("AP1000 Response to Request for Additional Information (SRP 10)," DCP_NRC_002530, June 12, 2009). Therefore, these two open items should be considered closed.

However, this same RAI response does add an ITAAC, but this proposed ITAAC does not address the applicant's commitment to provide adequate diversity between the two electrical overspeed trips. Therefore, OI-SRP10.2-SBPA-02a is still an open item.

If Westinghouse would add an ITAAC item which would have ITAAC Acceptance Criteria wording to the effect of:

> "A report exists that shows that the two turbine electrical overspeed protection systems have diverse hardware and software/firmware."

then the [RAI-SRP10.2-SBPA-02 design commitment stated by applicant] design alternative could be considered sufficient, adequate, acceptable and would provide reasonable assurance that the plant's turbine overspeed protection means will operate in accordance with the design certification, the provisions of the Atomic Energy Act, and the NRC's regulations.

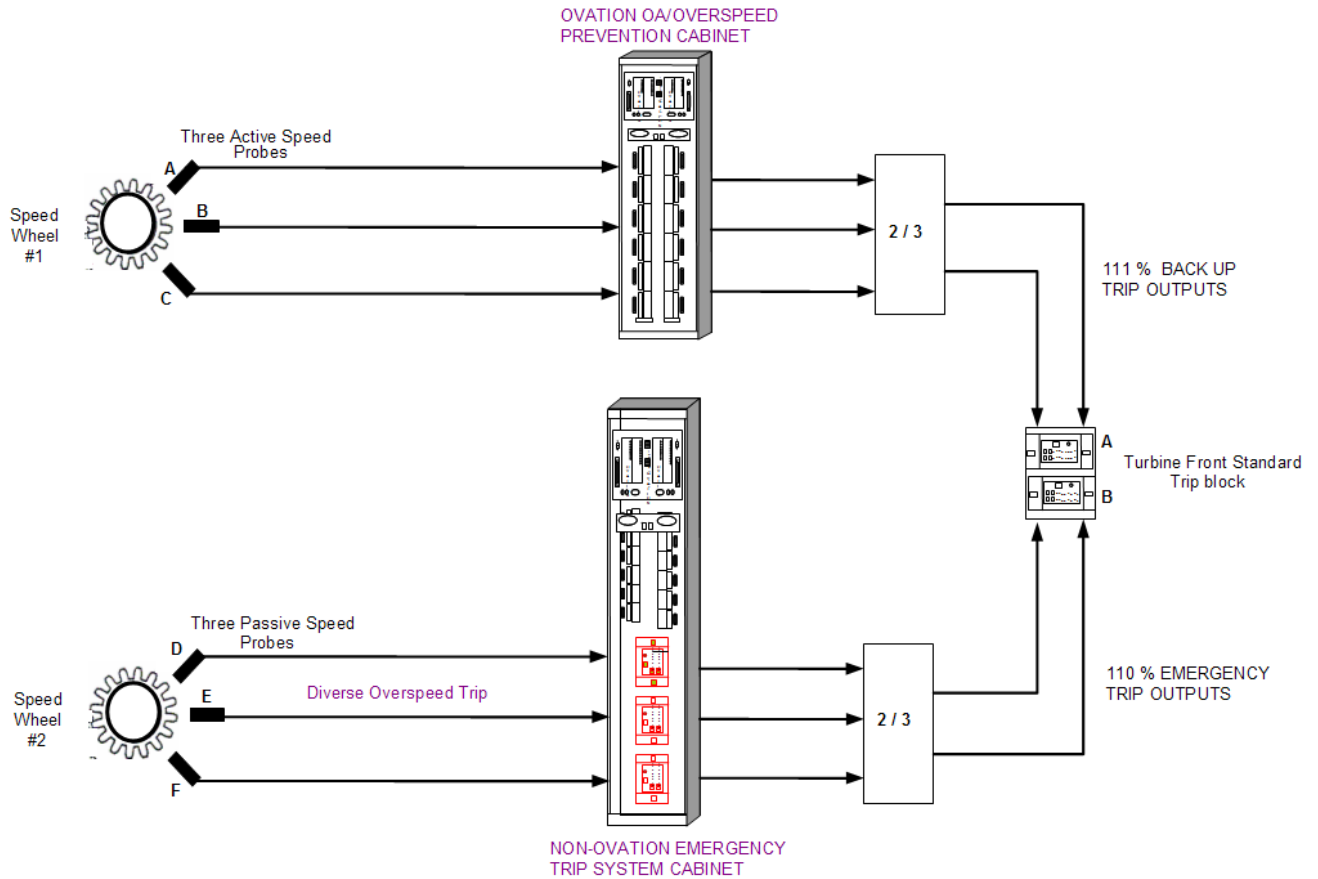
Additional Westinghouse Response per additional NRC request: (Revision 2)

An ITAAC item has been added to Tier 1 Table 2.4.2-1 which states, "A report exists and concludes that the two turbine electrical overspeed protection systems within the PLS have diverse hardware and software/firmware."

In addition, as a result of a conference call with the NRC on July 23, 2009, Westinghouse is proposing clarifications be made to Tier 2 DCD subsections 10.2.2.4.1, 10.2.2.4.5, and 10.2.2.5.3. Westinghouse stated in the conference call that both the 110% and 111% overspeed trip systems are not contained in a single controller and that one of the trips is contained in a non-Ovation controller. The commitment to separate these trips into separate, diverse controllers was made after DCD Revision 17 was issued in response to the staff's initial submittal of this RAI.

The DCD changes proposed below show and clarify that the 110% and 111% trip systems have diverse hardware and software/firmware to eliminate common cause failures (CCFs) from rendering the trip functions inoperable. A diagram is provided below to show the system configuration with a non-Ovation controller for the diverse 110% emergency trip system.

Also, the 110% and 111% trip discussions are removed at this time from Section 10.2.2.4.1, 'Speed Control,' for clarity. The term 'speed control' refers to normal turbine control/operation. The 110% and 111% overspeed trips are addressed in subsections 10.2.2.4.5 and 10.2.2.5.3, and were kept in Section 10.2.2.4.1 for DCD Revs 16 and 17 to stay consistent with the Rev 15 "format."



OVATION OA/OVERSPEED PREVENTION CABINET
Three Active Speed Probes
A
B
C
Speed Wheel #1
2 / 3
111 % BACK UP TRIP OUTPUTS
A
Turbine Front Standard Trip block
B
Three Passive Speed Probes
D
E
F
Diverse Overspeed Trip
Speed Wheel #2
2 / 3
110 % EMERGENCY TRIP OUTPUTS
NON-OVATION EMERGENCY TRIP SYSTEM CABINET

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

Additional NRC request via 10/9/09 email: (Revision 3)

Regarding the Westinghouse response to RAI-SRP10.2-SBPA-02 R2 (DCP NRC 002647, October 7, 2009), the staff feels that Tier 2 updates should include your diversity design description and the letter's figure. Tier 1 updates appear complete.

Additional Westinghouse Response: (Revision 3)

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The above description of the diversity design was reviewed. Additional changes are made in the DCD markup below to complete the Tier 2 description, as follows:

1. The word "separate" was added to Section 10.2.2.5.3, "Overspeed Trip Functions and Mechanisms" to make the portion read "in the separate OA controller."

2. The following sentences were added to the final paragraph of Section 10.2.2.5.3, "Overspeed Trip Functions and Mechanisms":

   "The control signals from the two turbine-generator overspeed trip systems are isolated from, and independent of, each other. Each trip is initiated electrically in separate systems. The 110% and 111% trip systems have diverse hardware and software/firmware to eliminate common cause failures (CCFs) from rendering the trip functions inoperable."

3. The figure showing the diversity design provided in Revision 2 of this response is improved and added below as a new DCD Figure 10.2-2, "Emergency Trip System Functional Diagram."

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

Additional NRC request via conference calls to Westinghouse on 10/21/10, 11/1/10, and 11/3/10: (Revision 4)(All Revision 4 text is in italics for clarity)

Provide additional clarification and DCD markup to address the normal turbine speed/load control function and the 111% overspeed trip function, both located in the same Ovation cabinet, to assure that the DCD review for SRP 10.2, Part III.2.D satisfies the final sentence: "However, the circuitry is reviewed to confirm that the control signals from the two systems [the electrohydraulic control system of Part III.2.B and the backup electrical overspeed trip circuit of Part III.2.D] are isolated from, and independent of, each other."

Additional Westinghouse Response: (Revision 4)

The following discussion pertains to the operator automatic (OA) normal turbine speed/load control functions and the backup 111% overspeed trip function.

Three active speed sensors provide signals for the turbine rotation rate. These are the 3 probes A,B,C shown on the preceding figure. The 3 signals are input to 3 separate speed detection modules each located on three separate I/O branches. Each of these modules has an onboard microprocessor which converts the sensor input to a turbine rpm value.

Independence of the three speed sensor signal branches is assured in that failure of the transmission of one branch of the signal does not affect the transmission of the signal in the other two branches. Each I/O branch is separately fused and fed by redundant power sources. Also, failure of a speed detection module (receiving one branch of the signal) does not affect the function of the remaining two speed detection modules from receiving their signals.

The rpm signals are also used by redundant Ovation controllers for normal speed and load control functions (SRP 10.2 Part III.2.B). The rpm signals are also monitored by a setpoint on each of the speed detection modules to support the backup overspeed trip at 111% overspeed (Part III.2.D). When the rpm speed reaches the backup turbine overspeed trip setpoint, the microprocessor located on each speed detection module issues a trip command to the onboard relay. When at least two out of three channels indicate a trip, a trip signal is sent to the turbine.

Independence of the electrohydraulic control system of SRP 10.2 Part III.2.B and the backup electrical overspeed trip circuit of Part III.2.D is assured in that failure of the Ovation controllers does not affect the ability of the speed detection module to trip the turbine at the backup turbine overspeed trip setpoint.

Any error detected in the function of one Ovation controller used for normal speed and load control functions will cause an automatic switchover to the redundant controller. If the redundant controller also fails, the turbine will trip.

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Redundant power supplies are provided for the speed detection modules, controllers, and I/O branches. The fail-safe design is set to send a trip signal to the turbine on loss of both power supplies to any of the control components. That is, the system is designed to de-energize to trip.

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Design Control Document (DCD) Revision: (RAI response revision shown by section)
(Revision 4 in italics)
~~None~~

Modify DCD Tier 1, Section 2.4.2 as shown: (Revision 1, 2)

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% (±1% each). Each trip is initiated electrically in separate systems. The control signals from the two turbine-generator overspeed trip systems are isolated from, and independent of, each other.

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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 trip signals from the two turbine electrical overspeed protection trip systems within the PLS are isolated from, and independent of, each other.	i) The system design will be reviewed. ii) Testing of the as-built system will be performed using simulated signals from the turbine speed sensors. iii) Inspection will be performed for the existence of a report verifying that the two	i) The system design review shows that the trip signals of the two electrical overspeed protection trip systems are isolated from, and independent of, each other. ii) The main turbine-generator trips after overspeed signals are received from the speed sensors of the 110% emergency electrical overspeed trip system, and, the main turbine-generator trips after overspeed signals are received from the speed sensors of the 111% backup electrical overspeed trip system. iii) A report exists and concludes that the two electrical overspeed

	turbine electrical overspeed protection systems have diverse hardware and software/firmware.	protection systems within the PLS have diverse hardware and software/firmware.

Modify Tier 2 Section 10.2.2.4.1 as shown (Revision 2, 4) *(Revision 4 in italics)*:

10.2.2.4.1 Speed Control (Normal Turbine Operation)

Three active speed sensors provide signals for the turbine rotation rate. These are the 3 probes A,B,C shown on the preceding figure. The 3 signals are input to 3 separate speed detection modules each located on three separate I/O branches. Each of these modules has an onboard microprocessor which converts the sensor input to a turbine rpm value.

Independence of the three speed sensor signal branches is assured in that failure of the transmission of one branch of the signal does not affect the transmission of the signal in the other two branches. Each I/O branch is separately fused and fed by redundant power sources. Also, failure of a speed detection module (receiving one branch of the signal) does not affect the function of the remaining two speed detection modules from receiving their signals.

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The speed control function of the turbine control and protection system's redundant controller provides speed control and acceleration functions for normal turbine operation. ~~*It also provides the backup 111% overspeed protection function as discussed in subsection 10.2.2.5.3.*~~ The speed error signal is derived by comparing the desired setpoint speed with the actual speed of the turbine. This error drives an algorithm that positions the control valves at the desired setpoint. Acceleration rates can also be entered by the operator or calculated by the control system in the auto start-up mode. A failure of one speed input generates an alarm. Failure of two or more speed inputs also generates an alarm and trips the turbine.

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The speed control function exists in triplicate channels, which include the load (frequency) control function if the main generator breaker is closed. If one channel fails, the lower signal of the remaining two channels is selected by the median value gate (MVG) and fed into the valve positioning control function.

The control system's operator automatic (OA) controller provides the speed control function. At 101% of rated speed the control valves and intercept valves begin to close, but do not trip the turbine.

The speed control function is designed to prevent the operator from holding the turbine speed at a bearing critical or blade resonance point.

Modify Tier 2 Section 10.2.2.4.2 as shown (Revision 4) *(Revision 4 in italics)*:

10.2.2.4.2 Load Control

The load control function of the *turbine control and protection system's OA controller* D-EHC develops signals that are used to regulate unit load. Signal outputs are based on a proper combination of the speed error and megawatt setpoints to generate a flow demand to the control valves.

When the first-stage pressure and megawatt control loops are out of service, steam flow is not controlled by feedback, but rather by a characterization of maximum nozzle flow (at rated pressure and temperature) per valve versus control valve position. Under this condition, the turbine operator requests a certain megawatt load target. The control system calculates the required flow demand to adjust the steam flow from the steam generators supplied to the turbine.

Modify Tier 2 Section 10.2.2.4.5 as shown (Revision 2):

10.2.2.4.5 Overspeed Protection

The turbine control and protection system has four functions to protect the turbine against overspeed. The first is the overspeed protection system (OSP), which at 101% of rated speed, begins to close the control and intercept valves as discussed in subsection 10.2.2.4.1. The second and third are the 110% and 111% overspeed trip functions also discussed in subsection 10.2.2.5. The fourth function is the partial load unbalance discussed in subsection 10.2.2.4.4.

Redundancy is built into the overspeed protection system. The failure of a single valve will not disable the trip functions. The overspeed protection components are designed to fail in a safe position. Loss of the hydraulic pressure in the emergency trip system causes a turbine trip. Therefore, damage to the overspeed protection components, results in the closure of the valves and the interruption of steam flow to the turbine.

Quick closure of the steam valves prevents turbine overspeed. Valve closing times are given in Table 10.2-4.

Modify Tier 2 Section 10.2.2.5.3 as shown (Revisions 1, 2, 3, and 4) *(Revision 4 in italics)*:

10.2.2.5.3 Overspeed Trip Functions and Mechanisms

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The overspeed trips for the AP1000 turbine consist of a *diverse* 110% trip in the emergency trip system (ETS) and a 111% backup trip ~~*in the separate OA controller*~~ *using three Ovation speed detection modules independent of the OA controller described in Section 10.2.4.4.1* (see *also* Figure 10.2-2). 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 110% 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% of rated speed.

The *diverse* 110% ETS trip system has triplicated passive speed sensors separate from the triplicated active speed sensors used in the backup 111% trip. Both trip functions use solenoid valves 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 diverse 110% ETS overspeed *trip* ~~*protection*~~ system combined with the 111% ~~*OA*~~ overspeed protection function of the *turbine* control system 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. The control signals from the two turbine-generator overspeed trip systems are isolated from, and independent of, each other. Each trip is initiated electrically in separate systems. The 110% and 111% trip systems have diverse hardware and software/firmware to eliminate common cause failures (CCFs) from rendering the trip functions inoperable. Additionally, the issues and problems with overspeed protection systems identified in NUREG-1275 (Reference 3) have been addressed.

The turbine rpm signals discussed in Subsection 10.2.2.4.1 are also used by redundant Ovation controllers for normal speed and load control functions (SRP 10.2 Part III.2.B). The rpm signals are also monitored by a setpoint on each of the speed detection modules to support the backup overspeed trip at 111% overspeed (Part III.2.D). When the rpm speed reaches the backup turbine overspeed trip setpoint, the microprocessor on each speed detection module issues a trip command to the onboard relay. When at least two out of three channels indicate a trip, a trip signal is sent to the turbine.

Independence of the electrohydraulic control system of SRP 10.2 Part III.2.B and the backup electrical overspeed trip circuit of Part III.2.D is assured in that failure of the Ovation controllers does not affect the ability of the speed detection module to trip the turbine at the backup turbine overspeed trip setpoint.

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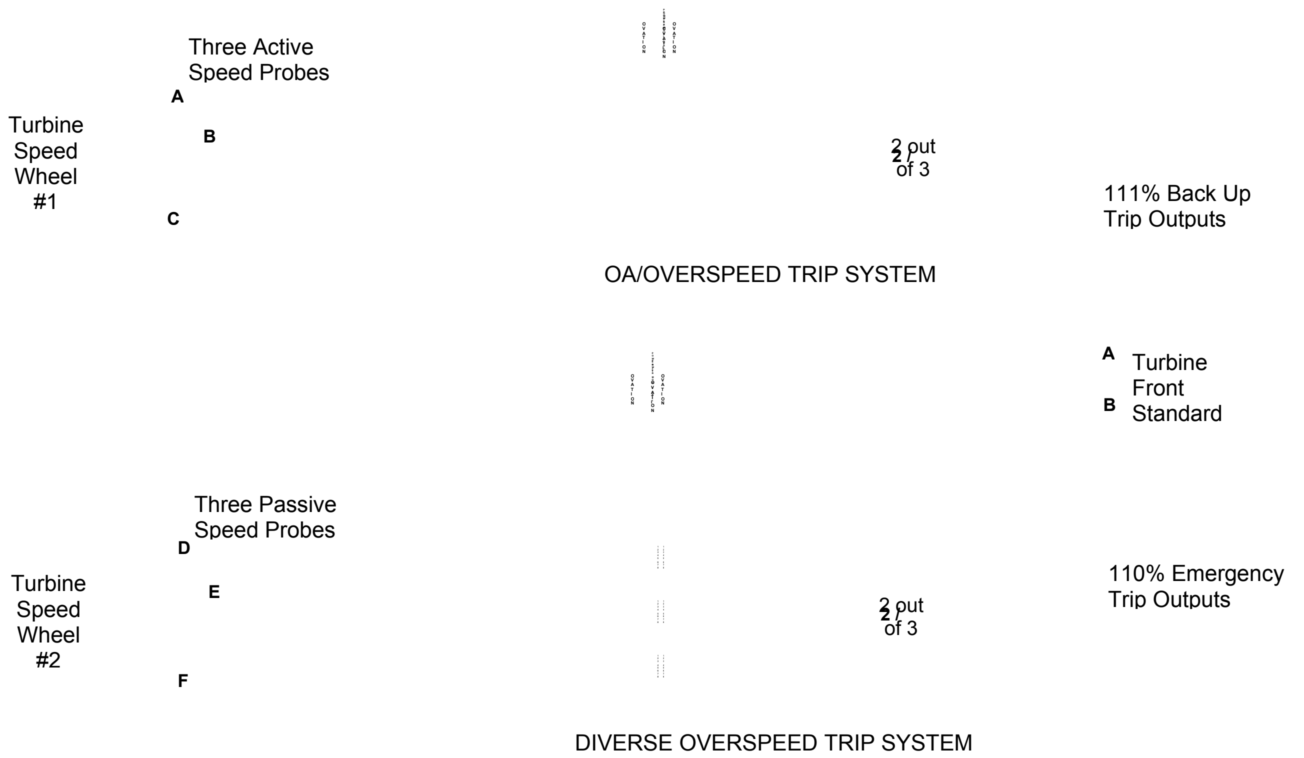
Add new DCD Figure 10.2-2, "Emergency Trip System Functional Diagram"



PRA Revision:
None

Technical Report (TR) Revision:
None

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November 4, 2010

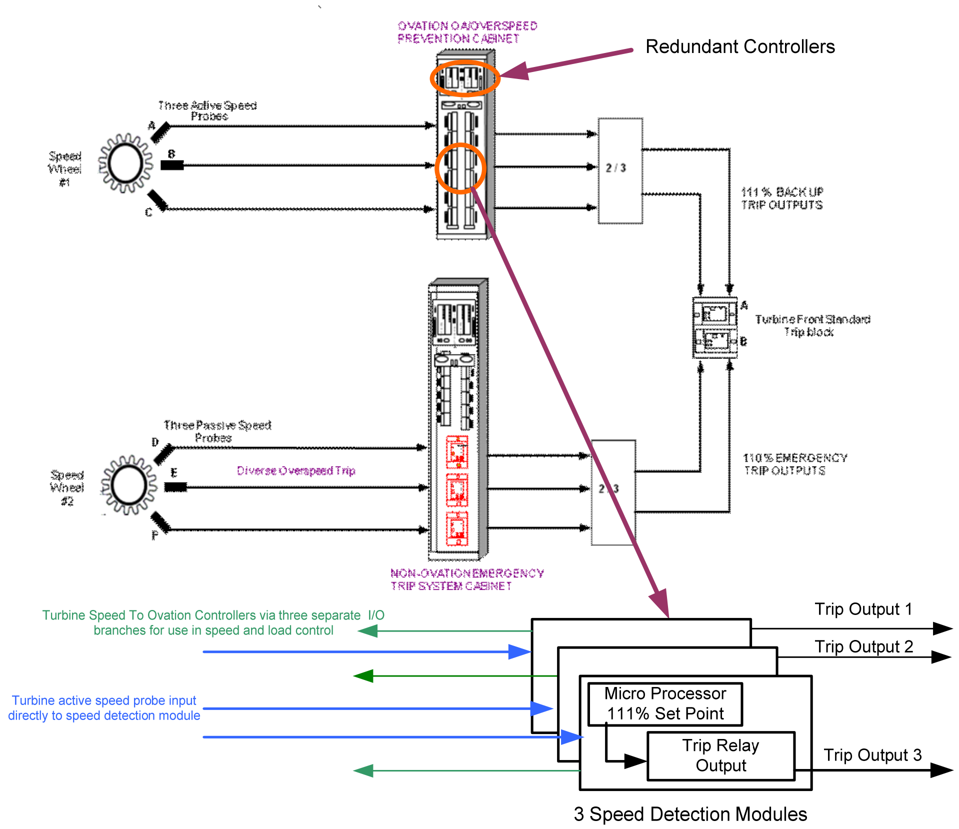
Overview OA/OSP drop

The Operator Auto cabinet Ovation redundant controllers perform the speed and load control functions of the turbine control system utilizing Speed Detection modules to determine turbine speed. The Ovation Controller cabinet contains four separate I/O branches. The three Speed Detection modules (one module per branch) are located on three of the four I/O branches. Each branch is separately fused and is fed from redundant power sources. Therefore, *independence is met* by the fact that a power loss or a ground fault in one branch does not affect the Speed Detection modules in the other two branches. The back up 111% Over Speed function is also performed in the Operator Auto cabinet by the Speed Detection modules.

111% Back Up Over Speed

The Speed Detection modules receive their input via three active speed sensors. Each of these modules has an on board micro processor which converts the sensor input to rpm. The Speed Detection Module *trip function is designed to operate independ*ently, each on a separate I/O branches and **requires no intervention** by the Ovation Controller to trip the turbine. The turbine **trip speed** is a **set-point** on the Speed Detection module – *not the Ovation Controllers*. Once the trip set points have been down loaded by the Ovation controller to the three Speed Detection modules there is no way the controllers can alter them during control operation, thus *achieving independence*. Due to this *independence* in order to change the trip set point in the Speed Detection modules, the controller must be taken out of service and a trained engineer with security access to an engineering work station must make the changes. Failure of the Primary Ovation controller will not affect the functioning of the Speed Detection modules 111% trip function. If both of the Ovation controllers fail or power is lost the turbine will trip. The design is fail safe: de–energize to trip.

When the Speed Detection module , operating independently of the Ovation Controllers, detects turbine speed equal to or greater than 111 %, the onboard microprocessor issues a trip command to the on board relay. When at least two out of three channels indicate a trip, the turbine will trip.



OVATION OA/OVERSPEED PREVENTION CABINET
Redundant Controllers
Three Active Speed Probes
Speed Wheel #1
A
B
C
2 / 3
111 % BACK UP TRIP OUTPUTS
Turbine Front Standard Trip block
Three Passive Speed Probes
Speed Wheel #2
D
E
F
Diverse Overspeed Trip
2 / 3
110 % EMERGENCY TRIP OUTPUTS
NON-OVATION EMERGENCY TRIP SYSTEM CABINET
Turbine Speed To Ovation Controllers via three separate I/O branches for use in speed and load control
Turbine active speed probe input directly to speed detection module
Micro Processor 111% Set Point
Trip Relay Output
Trip Output 1
Trip Output 2
Trip Output 3
3 Speed Detection Modules