ArevaEPRDCPEm Resource

From: Pederson Ronda M (AREVA NP INC) [Ronda.Pederson@areva.com]
Sent: Wednesday, July 15, 2009 6:02 PM
To: Tesfaye, Getachew
Cc: BENNETT Kathy A (OFR) (AREVA NP INC); DELANO Karen V (AREVA NP INC); KOWALSKI David J (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 243 (2991), FSARCh. 10
Attachments: RAI 243 Response US EPR DC.pdf

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 243 Response US EPR DC.pdf" provides a technically correct and complete response to the question.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which support the response to RAI 243 Question 10.02-6.

The following table indicates the respective pages in the response document, "RAI 243 Response US EPR DC.pdf," that contain AREVA NP's response to the subject question.

Question #	Start Page	End Page
RAI 243 — 10.02-6	2	6

This concludes the formal AREVA NP response to RAI 243, and there are no questions from this RAI for which AREVA NP has not provided responses.

Sincerely,

Ronda Pederson
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From: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Monday, June 15, 2009 8:18 PM
To: ZZ-DL-A-USEPR-DL
Cc: Reddy, Devender; Bloom, Steven; Segala, John; Hearn, Peter; Colaccino, Joseph; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 243 (2991), FSARCh. 10

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on June 5, 2009, and on June 12, 2009, you informed us that the RAI is clear and no further clarification is needed. As a result, no change is made to the draft RAI. The schedule we have established for review of your application assumes technically correct and complete responses within 30 days of receipt of RAIs. For any RAIs that cannot be answered within 30 days, it is expected that a date for receipt of this information will be

provided to the staff within the 30 day period so that the staff can assess how this information will impact the published schedule.

Thanks,
Getachew Tesfaye
Sr. Project Manager
NRO/DNRL/NARP
(301) 415-3361

Hearing Identifier: AREVA_EPR_DC_RAIs
Email Number: 666

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Subject: Response to U.S. EPR Design Certification Application RAI No. 243 (2991), FSARCh. 10
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From: Pederson Ronda M (AREVA NP INC)

Created By: Ronda.Pederson@areva.com

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Response to

Request for Additional Information No. 243 (2991), Revision 0

6/15/2009

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 10.02 - Turbine Generator
Application Section: 10.2 - Turbine Generator

QUESTIONS for Balance of Plant Branch 1 (AP1000/EPR Projects) (SBPA)

Question 10.02-6:

A. Follow Up RAI to EPR RAI 10.2-1

Item 1.A of the "SRP Acceptance criteria," in Section II, "Acceptance Criteria" of SRP Section 10.2, "Turbine Generator," states that the turbine generator (TG) overspeed protection system should meet single failure criterion and should be testable when the turbine is in operation. Also, Item 1 of Section III, "Review Procedures" of the SRP Section 10.2, describes that the reviewer confirms that the applicant has provided sufficient information, including the piping and instrumentation diagrams and other details to support staff's conclusions of the review. Further, Item 2.A of the SRP review procedure states that the reviewer verifies the adequacy of the TG control and overspeed protection system and determines that a single failure of any component or subsystem will preclude an unsafe turbine overspeed. Therefore, in U.S. EPR RAI 10.2-1 (Question RAI 91-10.2-1), the NRC staff requested the applicant (AREVA) to provide schematic and logic diagrams of all input signals to the triple processors and all outputs from the triple processors, so that the staff can verify fault-tolerant features that are described in EPR DCD FSAR Tier 2 Section 10.2.2.5. The staff also requested that AREVA to show all inter-channel signal paths between processors and to state whether signal paths are unidirectional or bi-directional. The staff further requested the applicant to provide the following clarifications, as they relate to the EPR TG control systems:

a. Define the term "fault-tolerant" as it relates to the "Single Failure Criterion."

b. Describe the method for meeting the single failure criteria for the TG control systems. If not, describe AREVA's plan on meeting this criterion.

The applicant responded to RAI 10.2-1 in RAI Response No. 91, Supplement 2 dated January 7, 2009, and stated that the Combined License (COL) applicant must select a TG design which is bounded by the requirements specified in the U.S. EPR FSAR and that such TG designs are commercially available. Schematic and logic diagrams showing the input and output signals for the triple processors are dependent on the TG selected for procurement by the COL applicant; and thus, were not provided in the response. Further, each COL applicant must demonstrate that the as-procured turbine performs within the bounding specifications or provide justification for the departure. With respect to the requested clarifications, the applicant defined fault tolerant and stated that the single failure criteria for these system is not applicable due to their non-safety related nature.

However, AREVA did not identify any COL information item in FSAR Tier 2 Table 1.8-2, "U.S. EPR Combined License Information Items," in order for the COL applicants to provide such information as schematics. Regarding TG system classification, the staff acknowledges that TG system is classified as a nonsafety-related system, and also the staff recognizes that the guidance/requirements provided in RG 1.52 and 1.53 and IEEE Standard 379-2000 do not explicitly apply to the single-failure criterion of the TG control system. However, to meet the requirements of GDC 4 and the SRP Acceptance criteria as stated earlier, the TG control and overspeed protection systems should meet the single failure criterion and should be testable when the turbine is in operation.

Therefore, the staff requests AREVA to provide the following additional information:

1) Identify a COL information item in the FSAR of the U.S. EPR DCD, to enable the COL applicants that use the EPR TG design, for providing the schematics and logic diagrams that were requested in the above U.S. EPR - RAI 10.2-1.
2) Address adequately with full justification the meeting of the single failure criteria by the EPR TG design as described in the SRP Section 10.2, Item 1.A of the SRP Acceptance Criteria.

Response to Question 10.02-6:

1) The response to Part 2) contains schematics for the turbine overspeed trip system.

   U.S. EPR FSAR Tier 2, Section 10.2.2.5 and Table 1.8-2—U.S. EPR Combined License Information Items will be revised to include a requirement for the COL applicant to provide schematics and logic diagrams for the turbine control system.

2) The steam turbine is provided with two redundant and diverse electrical overspeed systems. The two electrical overspeed systems meet the single failure criterion; however, they are non-safety related.

   Main steam and reheat stop and control valves are provided in series pairs. The stop valves are tripped by the trip system (overspeed and other trips); the control valves are modulated by the governing system and are also actuated closed by the trip system. The governing system controls turbine speed during normal operation. The governing system is the first line of defense against turbine overspeed. The governor starts closing the turbine control valves in response to overspeed (as would happen due to load rejection) and fully close them at approximately 103 percent of the rated speed to protect the turbine. The governing system is independent of the two overspeed trip systems.

   The two overspeed protection systems are redundant from the speed probes to the turbine trip relays. Both overspeed protection systems have three independent speed probes and processing modules acting on one of three electronic tripping channels. Each independent electrical overspeed trip system is designed and manufactured by a different vendor. Each vendor directly manufactures their system components (e.g., motherboards, sensors) and develops the software to transform the analog speed sensor signal into a digital signal. There are no common components or process inputs between the two systems. One overspeed protection system is installed in the turbine supervisory instrumentation cubicle and the other overspeed protection system is installed in the turbine governing control cubicle. The cubicles provide separate power supply to each electronic overspeed protection system. Figure 10.02-6-1 shows the separate source of power supply to each system and how the sensors are treated by independent mothercards. This provides sufficient diversity and defense-in-depth for the overspeed protection systems.

   The trip block provides interface between the electrical and hydraulic systems and consists of three trip solenoid valves. The trip block is non-safety related.

   The three independent electronic channels energize three fail-safe solenoid valves (trip by loss of power). Each solenoid valve acts on two hydraulic relays of the trip block in order to perform the hydraulic two-out-of-three trip voting. The turbine trips when at least two solenoid valves are de-energized.

The hydraulic fluid supply to the trip block is dumped into the hydraulic fluid tank by the trip block with two-out-of-three trip voting. This sends a low pressure signal to the safety relay on each valve actuator that diverts hydraulic fluid flow from the actuator to the hydraulic fluid tank. This causes the high pressure and intermediate pressure stop and control valves to close by a spring. Failure of the hydraulic tubing between the trip block and the valve actuator or between the hydraulic fluid tank and the valve actuator will cause a loss of fluid pressure which will close the valves. The trip block is designed fail safe, due to any failure (e.g., loss of power, loss of fluid pressure, fluid leak) causing a steam turbine trip. Figure 10.02-6-2 provides a schematic of the trip block.

A trip signal from the overspeed trip systems, failure of the trip block, or failure of the hydraulic oil systems will cause both the main steam stop, main steam control, reheat stop, and reheat control valves to close.

Due to two-out-of-three logic, each channel can be tested, one at a time, during normal turbine operation. During testing, a channel is taken out of service and a test frequency simulating overspeed is applied to verify that the channel trips. The steam turbine is protected during the test of a channel by the other two channels.

The overspeed trip systems are tested after the turbine has been installed. Refer to U.S. EPR FSAR Tier 2, Section 14.2.12.13.14, Pre-Core Turbine Overspeed (Test #174).

U.S. EPR FSAR Tier 2, Section 10.2.2.9 will be revised to include the information concerning the two electrical overspeed systems.

Figure 10.02-6-1—Overspeed Trip System Schematic

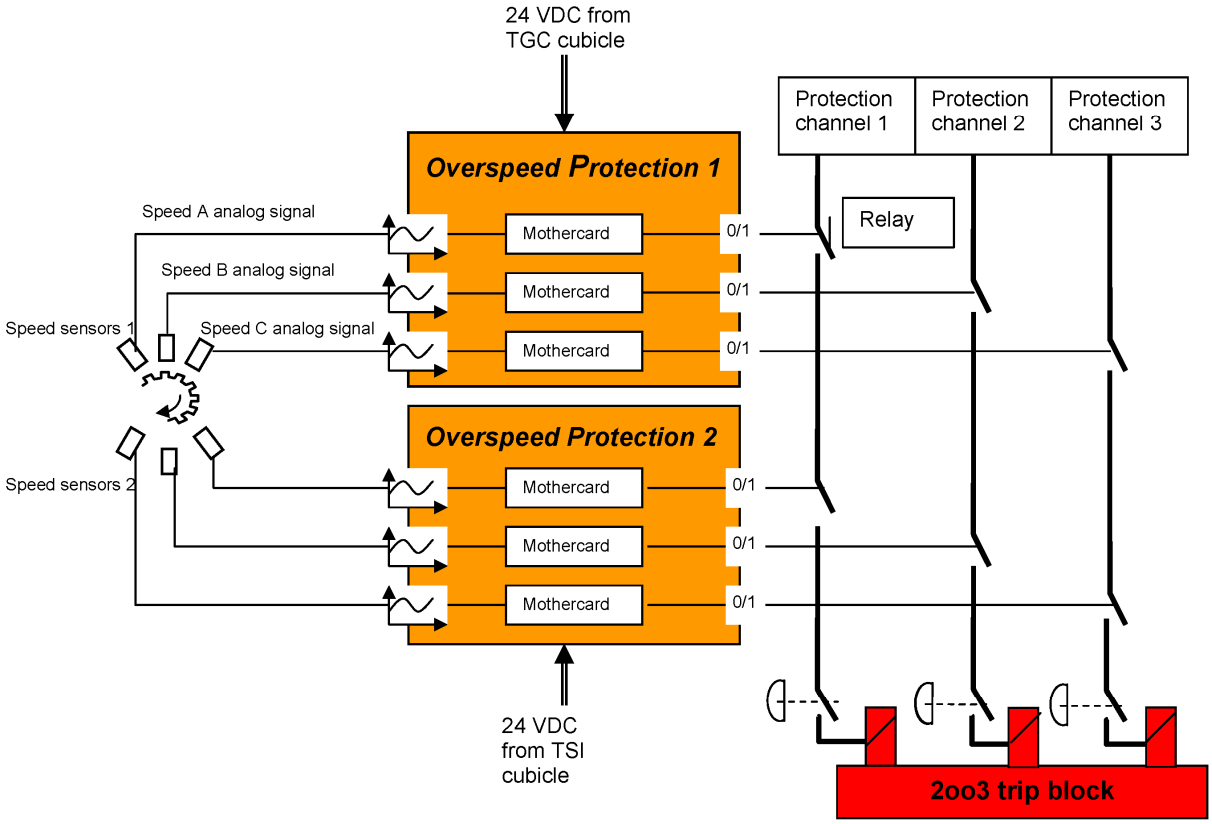
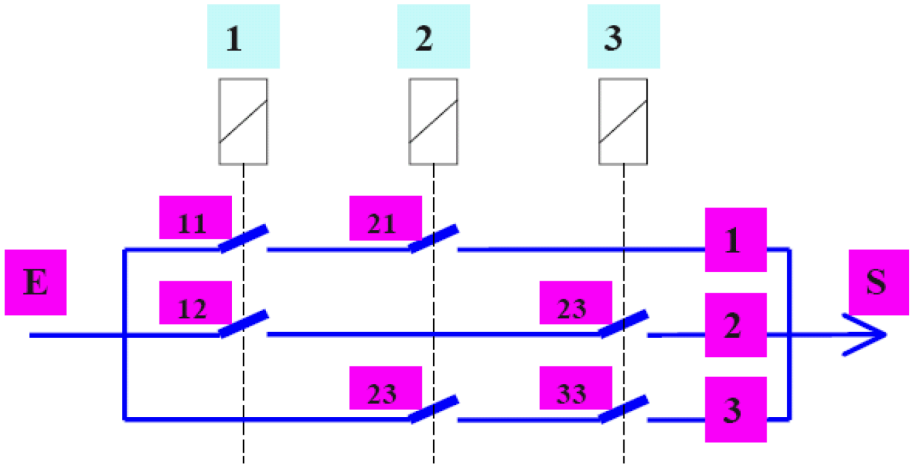


Figure 10.02-6-2—Turbine Trip Block Schematic



FSAR Impact:

U.S. EPR FSAR Tier 2, Sections 10.2.2.5 and 10.2.2.9, and Table 1.8-2 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR Final Safety Analysis Report Markups

- Provisions for manually initiated individual valve or valve pair on-line testing of the main steam stop, control, reheat stop and intercept valves.

Valve opening actuation is provided by the control oil (electro-hydraulic) system that is independent of the bearing lubrication system. Valve closing actuation is provided by springs and steam forces upon reduction or relief of hydraulic fluid pressure. The system is designed so that loss of fluid pressure for any reason leads to valve closing and subsequent turbine trip.

Steam valves are provided in series pairs. The stop valves are tripped by the trip system (overspeed and other trips); the control valves are modulated by the governing system and are also actuated closed by the trip system.

10.02.06 → A COL applicant that references the U.S. EPR design certification will provide schematics and logic diagrams for the turbine control system.

10.2.2.6 Speed Control

Speed control is used during startup and has a minimum adjustable setpoint range of zero to 100 percent of rated speed. It has the following features:

- The speed governor for normal speed-load control fully closes the control and intercept valves at 103 percent of rated turbine speed.
- The maximum rotational speed attainable upon loss of a single normal governing device does not exceed 103 percent of rated turbine speed.

10.2.2.7 Load Control

Load control is used during normal operation and has a setpoint range of zero to 100 percent of maximum capability. Load control controls megawatts (MW) based on the plant MW setpoint signal provided by the PAS. It has the following features:

- Automatic controls to avoid unnecessary turbine trip and to permit subsequent operation at house load (i.e., load required to run station auxiliaries) in the event of a load rejection from 100 percent load.
- Automatic controls for fast valving to rematch the TG loads following a momentary (7 Hz or less) mismatch between generator load and generator power, without loss of synchronization during load mismatch transients, up to full power.

10.2.2.8 Valve Control

The flow of main steam entering the HP turbine is controlled by four stop valves and four governing control valves. Each stop valve is controlled by an electro-hydraulic actuator, so that the valve is either fully open or fully closed. The function of the stop valves is to shut off the steam flow to the turbine when required. Actuation of the emergency trip system devices closes the stop valves.

The turbine control valves are positioned by electro-hydraulic servo actuators in response to signals from their respective flow control unit. The flow control unit signal positions the control valves for wide-range speed control through the normal turbine operating range and for load control after the TG unit is synchronized.

The reheat stop and intercept valves, located in the hot reheat lines at the inlet of the IP turbines, control steam flow to the IP turbines. During normal operation of the turbine, the reheat stop and intercept valves are fully open. The intercept valve flow control unit positions the valve during startup and normal operation and closes the valve rapidly on loss of turbine load. The reheat stop valves close completely on turbine overspeed and turbine trip.

10.2.2.9 Overspeed Protection

A protective trip system is provided to quickly close the main stop, control, reheat stop and intercept valves in the event of an unsafe condition or to provide overspeed protection. The system is designed to minimize false and spurious trips during normal operation and allow testing of the trip system during operation. A power load imbalance function is provided, which compares turbine and generator load and initiates an appropriate momentary control valve closure when the turbine load exceeds the generator load by a specified amount.

10.02.06

~~Two independent electrical overspeed trip devices are provided. Each independent electrical overspeed trip system is designed and manufactured by a different vendor. There are no common components or process inputs between the two systems. Each system will be installed in a separate cubicle and with separate power sources.~~The steam turbine has two redundant and diverse electrical overspeed systems that meet the single failure criterion. The two overspeed protection systems are redundant from the speed probes to the turbine trip relays. Both overspeed protection systems have three independent speed probes and processing modules acting on one of three electronic tripping channels. Each independent electrical overspeed trip system is designed and manufactured by a different vendor. Each vendor directly manufactures their system components (e.g., motherboards, sensors) and develops the software to transform the analog speed sensor signal into a digital signal. There are no common components or process inputs between the two systems. Each system will be installed in a separate cubicle with separate power sources.

The trip block provides an interface between the electrical and hydraulic systems and consists of three trip solenoid valves. The three independent electronic channels energize three fail safe solenoid valves (trip by loss of power). Each solenoid valve acts on two hydraulic relays of the trip block in order to perform the hydraulic two-out-of-three trip voting. The turbine will be tripped when a least two solenoid valves are de-energized. An interruption and discharge of the fluid supply by the trip block will cause the high pressure and intermediate pressure valves to close by spring action.

10.02.06

Failure of the hydraulic tubing between the trip block and the valve actuator, or between the hydraulic fluid tank and the valve actuator will cause a loss of fluid pressure, which closes the valves. Thus, the trip block is designed fail safe, due to the fact that any failure (e.g., loss of power, loss of safety fluid pressure, fluid leak) will cause a steam turbine trip.

The primary electrical overspeed trip system fully closes the valves at about 110 percent of rated speed. An independent and redundant backup electrical overspeed trip circuit is provided to fully close these valves at about 111 percent of rated speed. The TG rotor is designed to withstand 120 percent of rated speed.

The actuation of the turbine protection system does not rely on components in the electro-hydraulic control system. Conversely, turbine trip initiation devices are not used for normal control of the unit.

Provisions for online testing of the emergency trip system, including individual trip devices, are provided.

After receipt of a trip signal, the hydraulic controllers for the main stop, control, reheat stop and intercept valves close off these valves quickly to preclude an unsafe turbine overspeed. The response of the controllers considers the residual steam in the piping between the valves and the turbine.

10.2.2.10 Turbine Supervisory Instrumentation

TSI monitors thermal, hydraulic and electrical parameters; controls equipment components; and initiates automatic alarms and automatic shutdown of the TG in the event of an unsafe condition. Monitoring instrumentation interfaces with the plant PAS. The following conditions initiate a turbine trip:

- Low bearing oil pressure.
- Low control oil (hydraulic fluid) pressure.
- High condenser back pressure.
- Turbine overspeed.
- Thrust bearing excessive wear.
- Remote trip (includes manual and reactor trips).
- Excessive 'Time of Operation above No Flow Load' (initiated by generator reverse power relay after time delay specified by turbine designer).
- Loss of speed signals.

Table 1.8-2—U.S. EPR Combined License Information Items
Sheet 33 of 46

Item No.	Description	Section	Action Required by COL Applicant	Action Required by COL Holder
9.5-22	A COL applicant that references the U.S. EPR design certification will describe the site-specific sources of acceptable fuel oil available for refilling the EDG fuel oil storage tanks within seven days, including the means of transporting and refilling the fuel storage tanks, following a design basis event to enable each diesel generator system to supply uninterrupted emergency power.	9.5.4.4	Y	
	Deleted.			
	Deleted.			
10.2-2	A COL applicant that references the U.S. EPR design certification will provide applicable material properties of the turbine rotor after the site-specific turbine has been procured.	10.2.3.1		Y
10.2-3	A COL applicant that references the U.S. EPR design certification will provide applicable turbine disk rotor specimen test data, load-displacement data from the compact tension specimens and the fracture toughness properties after the site-specific turbine has been procured.	10.2.3.2		Y
10.2-4	~~Deleted.~~ A COL applicant that references the U.S. EPR design certification will provide schematics and logic diagrams for the turbine control system.			Y
10.2-5	A COL applicant that references the U.S. EPR design certification will provide the site-specific turbine rotor inservice inspection interval consistent with the manufacturer's turbine missile analysis.	10.2.3.6	Y	
10.3-1	A COL applicant that references the U.S. EPR design certification will identify the authority responsible for implementation and management of the secondary side water chemistry program.	10.3.5	Y	

10.02.06