Nuclear Operating Company
South Texas Project Electric Generating Station P.O. Box 289 Wadsworth, Texas 77483

May 10, 2010
U7-C-STP-NRC-100106

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

South Texas Project
Units 3 and 4
Docket Nos. 52-012 and 52-013
Response to Requests for Additional Information

Attached are responses to NRC staff questions included in Request for Additional Information (RAI) letter number 324 related to Combined License Application (COLA) Part 2, Tier 2 Section 10.2 Turbine Generator. This letter completes the response to RAI letter number 324.

The attachments provide responses to the RAI questions listed below:

10.02-3

10.02-4

The COLA changes provided in these responses will be incorporated in the next routine revision of the COLA following NRC acceptance of the RAI responses.

There are no commitments in this letter.

If you have any questions regarding this response, please contact me at (361) 972-7136, or Bill Mookhoek at (361) 972-7274.

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NRO

STI 32674615

DESIGNATE AS ORIGINAL BY TOM TAI 7/21/2010

I declare under penalty of perjury that the foregoing is true and correct.

Executed on 5/10/10

Scott Head
Manager, Regulatory Affairs
South Texas Project Units 3 & 4

jaa

Attachments:

1. RAI 10.02-3 Response
2. RAI 10.02-4 Response

cc: w/o attachment except*
(paper copy)

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RAI 10.02-3

QUESTION:

The guidance in Item 2.B, Section III, "Review Procedure," of Standard Review Plan (SRP) Section 10.2, states that for normal speed control, the electro hydraulic control (EHC) system fully cuts off steam to the turbine at approximately 103 percent of the turbine rated speed by closing the control and intercept valves. In RAI 10.2-1 dated July 29, 2009, the staff requested the applicant.to provide clarification how this SRP guidance is complied.

In its response to RAI 10.2-1, the applicant noted that for the normal speed-control mode, the steam supply to HP and LP turbines is completely shut-off at 105 percent and 107 percent of the turbine rated speed, respectively. However, the applicant did not address the reason for elimination of the 103 percent value as recommended in the SRP. Furthermore, for the normal speed control, the system is supposed to re-open and modulate the control and intercept valves to achieve and maintain 100 percent rated speed at certain point of its normal overspeed. Therefore, the staff requests the applicant to provide clarifications and/or additional information explaining why the 103 percent value is eliminated for the normal speed-load control. The staff further requests the applicant to provide details on how the normal overspeed control system is supplemented by the Power-Load Unbalance function (that was described in the RAI 10.2-1 response), since the steam supply is completely shut-off to the HP and LP turbines at 105 and 107 percent.

RESPONSE:

The response below addresses the elimination of the 103% value as recommended in SRP 10.2, and provides additional information on the Power-Load Unbalance function. The initial response to RAI 10.02-1, provided in letter U7-C-STP-NRC-090123, Attachment 15, is superseded in its entirety by the following:

The Toshiba electrohydraulic control (EHC) system is not designed to cut off steam to the turbine at 103% of rated speed. For normal speed control, the EHC system (which is a triplicate channel turbine control system) tends to close the control and intercept valves in proportion to the speed increase above the speed setpoint. The EHC system is designed such that the control valves are fully closed at approximately 105% of rated turbine speed and the intercept valves are fully closed at approximately 107% of rated speed. However, before these overspeed points are reached, the control valves begin to close when turbine speed exceeds approximately 100.5%. In a BWR, an increase in turbine speed will cause a decrease in turbine steam flow demand and an increase in turbine steam bypass demand to control reactor pressure. The speed regulation of 5% for the control valves is chosen based upon considerations of operating experience, speed control stability, and reactor pressure control stability, and to prevent the peak transient speed from reaching the overspeed trip setpoint of approximately 110% of rated turbine speed upon a load rejection.

Normal turbine speed control is supplemented by the Power-Load Unbalance (PLU) function. The PLU function is implemented in the EHC system. The PLU uses the difference between turbine mechanical power and load indications to limit overspeed in the event of a full load rejection. Redundant measurements of high pressure turbine exhaust pressure are used for indications of turbine mechanical power, and generator current is used for indication of load. These signals are used as inputs to the PLU function. Upon a power/load unbalance condition greater than approximately 40%, as indicated by a two-out-of-three voted logic output, the fast acting solenoid valves of the control valves and the intercept valves are energized to trip these valves to cut off steam flow to prevent an overspeed trip at 110% of rated turbine speed with at least a 2% speed margin. When the control valves are tripped by the fast acting solenoid valves at high power levels, the reactor is tripped by control valve hydraulic pressure signals to the reactor protection system. This is followed by a turbine trip, in which turbine speed will coast down. Thus, control valves and intercept valves will not re-open to control turbine speed after a PLU actuation.

As a result of this revised RAI response, STP 3&4 COLA Part 2, Tier 2, Subsections 10.2.2.4, 10.2.5.2, and 14.2.12.1.70 and the Departures Report in COLA Part 7, Section 3.0 for STP DEP 10.2-3 will be revised as follows with changes indicated by gray shading.

In COLA Part 2, Tier 2, Subsection 10.2.2.4 the first two paragraphs are replaced by the following three paragraphs with changes indicated by gray shading.

10.2.2.4 Turbine Overspeed Protection System

The information in this subsection of the reference ABWR DCD is replaced in its entirety with the following information.

STP DEP 10.2-3

The normal speed control system (EHC) comprises a first line of defense against turbine overspeed. This system includes the main steam control valves, intermediate steam intercept valves, extraction system non-return valves, and fast-acting valve-closing functions within the EHC system. The normal speed control unit utilizes three speed signals. Loss of any two of these speed signals initiates a turbine trip via the Emergency Trip System. An increase in speed above setpoint tends to close the control and intercept valves in proportion to the speed increase. The EHC fully shuts off steam to the high pressure turbine (HP) at approximately 105% of the turbine rated speed by closing the turbine control valves, and the EHC fully shuts off steam to the low pressure turbines (LPs) at approximately 107% of the turbine rated speed by closing the intercept valves.

Rapid turbine accelerations resulting from a sudden loss of load at higher power levels normally initiate the fast-acting solenoids via the speed control system's Power-Load Unbalance (PLU) function, to rapidly close the control and intercept valves irrespective of the current turbine speed. The PLU function is the second line of defense against overspeed and is implemented in the EHC. The PLU uses the difference between turbine power and load indications, which are high pressure turbine exhaust steam pressure and generator current, respectively, to cause fast closure of the turbine control valves and intercept valves when the difference between power and load exceed approximately 40%, to limit overspeed in the event of a full load rejection. The normal speed control system, including the PLU function, is designed to limit peak overspeed resulting from a loss of full load, to at least ~~1%~~ 2% below the overspeed trip set point. Typically, this peak speed is in a range of ~~106-109%~~ 105-108% of rated speed, and the overspeed trip set point is typically close to 110% of rated speed. All turbine steam control and intercept valves are fully testable during normal operation. The fast closing feature, provided by action of the fast-acting solenoids, is testable during normal operation.

If the normal speed control and the PLU function should fail, the overspeed trip devices close the steam admission valves including the main and intermediate stop valves. This turbine overspeed protection system comprises the ~~second~~third line of defense against turbine overspeed. It is redundant, highly reliable and diverse in design and implementation from the normal speed control system and protection system. This overspeed protection system is designed to ensure that even with failure of the normal speed control system; the resulting turbine speed does not exceed 120% of rated speed. In addition, the components and circuits comprising the turbine overspeed protection system are testable when the turbine is in operation.

The values in the second paragraph of COLA Part 2, Tier 2, Subsection 10.2.5.2 are changed as indicated by gray shading.

10.2.5.2 Turbine Design Overspeed

The following site-specific supplement addresses COL License Information Item 10.2.

The highest anticipated speed resulting from loss of load is normally in the range of ~~106-109%~~ 105-108% of rated speed. Turbine components are designed such that calculated stresses do not exceed the minimum material strength at 120% of rated speed. Turbine rotors are spun to a speed of 120% rated as part of factory balance verification. This is approximately ~~10%~~ 12% above the highest anticipated speed resulting from loss of load.

The overspeed trip functions are added to COLA Part 2, Tier 2, Subsection 14.2.12.1.70 (3) (h) and revised as indicated by gray shading.

14.2.12.1.70 Main Turbine and Auxiliaries Preoperational Test

STP DEP 10.2-3

(3) General Test Methods and Acceptance Criteria

(h) Proper operation of the turbine overspeed protection system to provide ~~*mechanical overspeed trip and electrical backup overspeed trip*~~ primary overspeed trip and emergency overspeed trip functions *as specified by Subsection 10.2.2.4 and the manufacturer's technical instruction manual. This test can be performed in the startup test stage in conjunction with the major transient testing.*

The Departures Report in COLA Part 7, Section 3.0 for STP DEP 10.2-3 is revised by changing the second bullet and fourth paragraph of the description and the second paragraph of the evaluation summary as indicated by gray shading below.

STP DEP 10.2-3, Turbine Digital Control

Description

- Redundancy for overspeed trip is implemented using electrical overspeed trip devices based on a hardware configuration for the Primary Overspeed trip and a software/firmware configuration for the Emergency Overspeed trip function. The overspeed trip system consists of the Primary and Emergency overspeed trip functions with two-out-of-three logic employed in each trip circuitry for additional reliability.

The expected speed range resulting from sudden loss load as ~~106 to 109%~~ 105-108% and the limit of turbine speed when overspeed trip devices activate as 120% were defined.

Evaluation Summary

Reliability for the electrical trip system is achieved by using two sets of redundant speed sensing probes, which input to the independent Primary and Emergency Trip functions. ~~hardware logic in the control system. A common cause failure of the software-based logic cannot occur because the trip logic is based on a hardware configuration.~~ The control signals from the two overspeed trip systems are isolated from, and independent of, each other. Each trip is initiated electrically in separate systems. These trip systems have diverse hardware and software/firmware to eliminate common cause failures (CCFs) from rendering both trip functions inoperable.

RAI 10.02-4

QUESTION:

In STP response to staff's RAI 10.2-2, the staff noted that the turbine trip set-points for the primary and emergency backup electrical overspeed systems are 110 and 111 percent of its rated speed, respectively. The staff finds these overspeed trip systems conform to the guidance specified in Items 2.C and 2.D of SRP Section 10.2.III, as related to their set-points. However, the applicant did not provide the schematics and logic diagrams for the two electric overspeed systems, as requested in the RAI 10.2-2. The staff is unable to conclude that the applicant has provided sufficient information for the two electrical overspeed control systems without these schematics and an associated ITAAC in this regard. Therefore, the staff requests the applicant to provide the following:

1. the schematics and logic diagrams for the two electric overspeed systems;

2. explain whether each of these two emergency overspeed systems have their own power source and are installed in separate areas.

3. a site specific ITAAC in Part 9 of the COLA (which includes a report to confirm the design and hardware/firmware diversity of these two electric overspeed systems);

RESPONSE:

The response below provides additional information requested in this RAI, and also revises the response to RAI 10.02-2, provided in letter U7-C-STP-NRC-090123, dated August 28, 2009, Attachment 16. The response provided below supersedes the initial response to RAI 10.02-2 in its entirety.

The description of the normal overspeed control system is provided in the response to RAI 10.02-3. The descriptions of the primary and emergency overspeed trip functions are provided herein.

The overspeed protection system consists of the primary overspeed trip function and the emergency overspeed trip function, as illustrated in the attached figure. Relative to each other the primary and emergency overspeed trip functions are independent, redundant and diverse up to the solenoid operated pilot valves on the trip solenoid valves. The trip solenoid valves are redundant and independent.

The primary overspeed trip function utilizes three passive speed sensors that are separate from those used for normal speed control and emergency overspeed trip. Each speed signal is compared to a speed setpoint of approximately 110% of rated speed, and produces trip signals arranged in two-out-of-three logics, to de-energize the solenoid operated pilot valves of one of the two trip solenoid valves of the electro-hydraulic Emergency Trip Device (ETD). Both solenoid operated pilot valves must be de-energized to trip the primary trip solenoid valve.

The ETD has two redundant trip solenoid valves. Tripping of either redundant trip solenoid valve will drain the emergency trip fluid, resulting in a turbine trip.

The emergency overspeed trip function is also redundant and uses three active magnetic pickups to sense turbine speed that are separate from those used by the primary overspeed trip function. The speed setpoint for this trip function is approximately 111% of rated speed. The trip signals are arranged in two-out-of-three logics to de-energize the solenoid operated pilot valves of the emergency trip solenoid valve in the ETD to cause a turbine trip.

The overspeed trip functions are redundant and diverse up to the solenoid operated pilot valves on the trip solenoid valves. Each overspeed trip function (primary and emergency) itself uses two-out-of-three trip logics. Diversity is achieved between the primary and emergency trip functions by using hardware devices for the primary trip function and software/firmware for the emergency trip function. The emergency overspeed trip function uses the same sensors used for normal speed control. However, the failure of any two of these speed sensors will result in a turbine trip.

The control signals from the two turbine-generator overspeed trip systems are isolated from, and independent of, each other. The trip logic functions for the primary trip function are performed using hardware logic devices. The emergency trip functions are performed in software/firmware to eliminate common cause failures (CCFs) from rendering the trip functions inoperable. The two overspeed trip systems are installed in separate cabinets, each with its own redundant uninterruptible power sources.

A turbine trip will result in an orderly reactor shutdown. The scenarios and sequence of events following a turbine trip are discussed in COLA Part 2, Tier 2, Subsection 15.2.3. Periodic testing of the overspeed trip function components important to safety during operation at rated load is discussed in COLA Part 2, Tier 2 Subsection 10.2.2.7, "Testing" and Subsection 10.2.3.6, "Inservice Inspection."

As a result of this RAI response, COLA Part 2, Tier 2, Subsection 10.2.2.4 will be revised, a new Figure 10.2-5 added, and a new table will be added to COLA Part 9, Section 3.0 Site Specific ITAAC as follows.

In COLA Part 2, Tier 2 Subsection 10.2.2.4, paragraphs three through five are replaced by the first three paragraphs below. Paragraphs four and five below are new text to be inserted prior to the remaining text in that section. Changes are indicated by gray shading:

10.2.2.4 Turbine Overspeed Protection System

The overspeed trip system is electrical, redundant and diverse and consists of the ~~P~~primary and ~~E~~emergency overspeed trip functions. Reliability is achieved by using two sets of redundant speed sensing probes, which input to the independent and diverse ~~P~~primary and ~~E~~emergency ~~T~~trip modules in the control system. For additional reliability, two-out-of-three logic is employed in both the ~~P~~primary and ~~E~~emergency overspeed trip circuitry. Either trip module can de-energize one of the trip solenoids of the electro-hydraulic Emergency Trip Device (ETD). The ETD is composed of two independent trip solenoid valves, each with two normally energized solenoid operated pilot valves. The solenoid operated pilot valves de-energize in response to detection of an overspeed condition by the turbine speed control logic. De-energization of both solenoid operated pilot valves is necessary to cause the spool in their respective trip solenoid valve to reposition, which depressurizes the emergency trip fluid system, rapidly closing all steam inlet valves. Accordingly, the repositioning of only one of the two trip solenoid valves is necessary to trip the main turbine. A single component failure does not compromise trip protection, and does not result in a turbine trip. Each trip solenoid valve in the ETD is testable while the turbine is in operation.

The overspeed sensing devices are located in the turbine front bearing standard, and are therefore protected from the effects of missiles or pipe breakage. The hydraulic lines are fail-safe; if one were to be broken, loss of hydraulic pressure would result in a turbine trip. The ETD is also fail-safe. Each trip solenoid transfers to the trip state on a loss of control power to both of its associated pilot valves, resulting in a turbine trip. These features provide inherent protection against failure of the overspeed protection system caused by low trajectory missiles or postulated piping failures.

~~The Primary and Emergency electrical overspeed trip modules each consist of three independent circuits. Each circuit monitors a separate speed signal and activates trip logic at specific speed levels.~~ Refer to Figure 10.2-5, Turbine Overspeed Trip System Functional Diagram. The primary overspeed trip function is redundant and utilizes three passive speed magnetic pickups that are separate from the active speed sensors used for normal speed control emergency trip function. Each speed signal is compared to a speed setpoint of approximately 110% of rated speed, and produces trip signals arranged in two-out-of-three logics, to de-energize the solenoid operated pilot valves of one of the two trip solenoid valves of the electro-hydraulic ETD. Both solenoid operated pilot valves must be de-energized to trip the associated trip solenoid valve. The ETD has two redundant trip solenoid valves. Tripping of either redundant trip solenoid valve will drain the emergency trip fluid, resulting in a turbine trip.

The emergency overspeed trip function is also redundant and uses three speed sensors that are separate from those used by the primary overspeed trip function. The speed setpoint for this trip function is approximately 111% of rated speed. The trip signals are arranged in two-out-of-three logics to de-energize the solenoid operated pilot valves of one of the two trip solenoid valves in the ETD to cause a turbine trip.

The control signals from the two turbine-generator overspeed trip systems are isolated from, and independent of, each other. The trip logic functions for the primary trip function are performed using hardware logic devices, and the emergency trip functions are performed in software/firmware to eliminate common cause failures from rendering the trip functions inoperable. The two overspeed trip systems are installed in separate cabinets, each with its own redundant uninterruptible power sources.

The following figure will be added to COLA Part 2, Tier 2, Section 10.2.

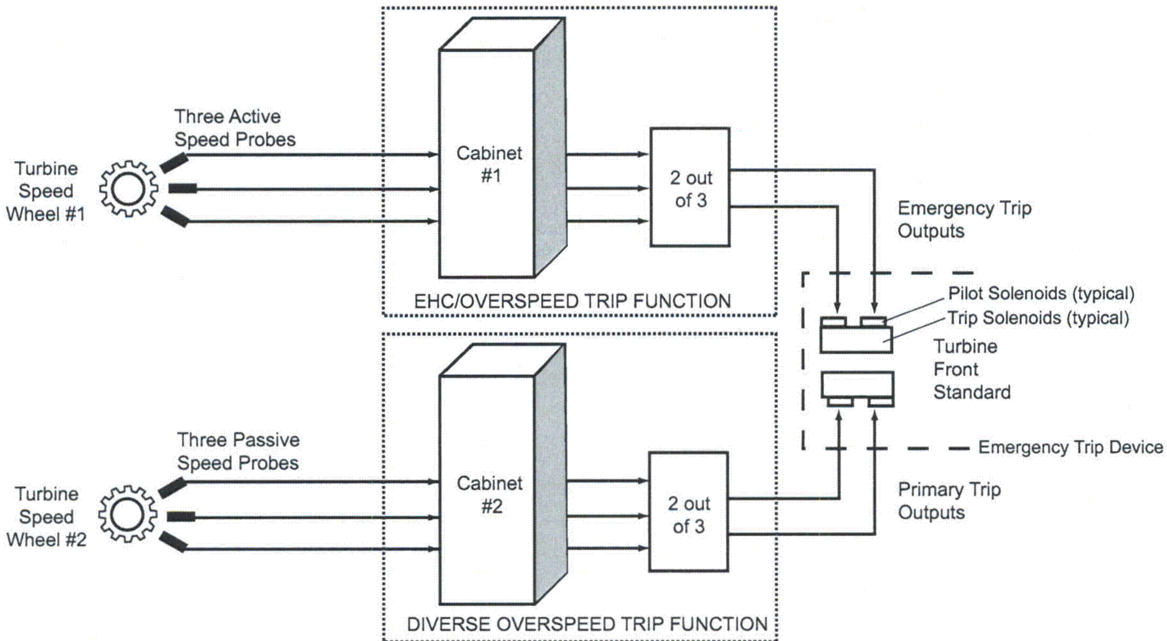

Figure 10.2-5 Turbine Overspeed Trip System Functional Diagram

The following site specific ITAAC table will be added to STP 3&4 COLA Part 9, Section 3.0.

Table 3.0-xx Main Turbine (MT) System

Design Requirement	Inspections, Tests, Analyses	Acceptance Criteria
MT System primary and emergency overspeed protective action signals for the two overspeed trip systems are generated from equipment diverse from one another.	Inspections of the as-built overspeed trip systems for the MT will be performed.	A report exists documenting that primary and emergency overspeed protective action signals are generated from equipment diverse from one another.