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February 21, 2011
U7-C-NINA-NRC-110006

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
Revised Responses to Requests for Additional Information

References:
1. Letter, Scott Head to Document Control Desk, "Response to Request for Additional Information", dated August 28, 2009, U7-C-STP-NRC-090123 (ML092450155)
2. Letter, Scott Head to Document Control Desk, "Response to Requests for Additional Information", dated May 10, 2010, U7-C-STP-NRC-100106 (ML102030020)
3. Letter, Scott Head to Document Control Desk, "Response to Request for Additional Information", dated October 15, 2010, U7-C-STP-NRC-100231 (ML102930097)

Attached are Nuclear Innovation North America LLC (NINA) revised responses to Requests for Additional Information (RAIs) related to Combined License Application (COLA) Part 2, Tier 2, Section 10.2, "Turbine Generator." The referenced letters collectively provided initial and supplemental responses to the RAIs. The attachments include additional information requested by NRC staff during discussions on January 5, 2011, February 2, 2011, and February 16, 2011, for the following RAIs:

10.02-1	10.02-3	10.02-5	10.02-7
10.02-2	10.02-4	10.02-6	10.02-8

When a change to the COLA is required, it will be incorporated into the next routine revision of the COLA following NRC acceptance of the RAI response.

There are no commitments in this letter.

If you have any questions regarding these responses, please contact me at (361) 972-7136 or

D091
NRO

STI 32816558

Bill Mookhoek at (361) 972-7274.

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

Executed on 2/21/11

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

jaa
Attachments:

1. RAI 10.02-1, Revision 1
2. RAI 10.02-2, Revision 1
3. RAI 10.02-3, Revision 1
4. RAI 10.02-4, Revision 1
5. RAI 10.02-5, Revision 1
6. RAI 10.02-6, Revision 1
7. RAI 10.02-7, Revision 1
8. RAI 10.02-8, Revision 1

cc: w/o attachment except*
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RAI 10.02-1, Revision 1

QUESTION:

In STP FSAR Tier 2, Section 10.2.2.4, "Turbine Overspeed Protection System," the applicant stated that the normal speed control is the first line of defense against the turbine overspeed. Also, it is stated that the system includes the turbine main control valves, intermediate steam intercept valves, extraction system non-return valves, and fast acting valve-closing functions within the electro hydraulic control (EHC) system. The normal speed control unit utilizes three speed signals, loss of any of these signals initiates a turbine trip via emergency trip system (ETS). Further, it is stated that an increase in speed above setpoint closes the control and intercept valves in proportion to the speed increase. It is not clear to the staff from the FSAR description at what percentage of rated speed the normal speed control function proportionally closes and fully closes steam valves.

The regulatory basis and review criteria that the staff used for the turbine generator (TG) system is specified by General Design Criterion (GDC) 4, "Environmental and Dynamic Effects Design Bases," as it relates to the TG system for protection of structures, systems, and components (SSCs) important to the safety from the effects of turbine missiles by providing a turbine overspeed protection system (with suitable redundancy) to minimize the probability of generation of turbine missiles. Also, SRP guidance in Item 2.B, Section III, "Review Procedure," of SRP Section 10.2, "Turbine Generator," states that for normal speed control, the EHC fully cuts off steam to the turbine at approximately 103 percent of the turbine rated speed by closing the control and intercept valves. Therefore, in order to meet this GDC 4 criteria and SRP guidance, the staff requests the applicant to provide clarification and/or additional information with respect to the details on the normal overspeed protection of the STP TG system, as it relates to GDC 4 criteria and SRP guidance in this regard.

RESPONSE REVISION 1:

The initial response to RAI 10.02-1, provided in letter U7-C-STP-NRC-090123, Attachment 15, on August 28, 2009 (ML092450155) was superseded in its entirety by the response to RAI 10.02-3, U7-C-STP-NRC-100106, Attachment 1, on May 10, 2010 (ML102030020).

The response to RAI 10.02-3 was further clarified in response to RAI 10.02-5, provided in letter U7-C-STP-NRC-100231, Attachment 1, on October 15, 2010 (ML102930097). Both responses are being revised and submitted concurrently with this revised response. The response to RAI 10.02-5 Revision 1 contains a consolidated markup for COLA Part 2, Tier 2 Subsection 10.2.2.4.

RAI 10.02-2, Revision 1

QUESTION:

STP FSAR Section 10.2.2.4, "Turbine Overspeed Protection System," it is stated that if the normal speed control should fail, the overspeed trip devices close the main steam and intermediate stop valves. It is also stated that this overspeed trip device is the second line of defense against the turbine overspeed. It is further stated that with failure of the normal speed control system, the resulting turbine speed does not exceed 120 percent of the turbine rated speed. However, Items 2.C and 2.D of the SRP Section 10.2.III describe that the second line of defense for the turbine overspeed are: 1) a mechanical overspeed trip device that will actuate the control, stop, and intercept valves to close at approximately 111 percent of the rated turbine speed, and 2) at approximately 112 percent, an independent and redundant backup electrical overspeed trip device senses the turbine speed and closes all the above cited turbine valves, and protects turbine against the overspeed.

STP FSAR Section 10.2.2.4 is not clear in its description of the primary and secondary overspeed trip devices/systems with respect to design features and trip actuation setpoints of these devices. Therefore, the staff requests the applicant to provide the following additional information and/or clarifications with full justifications:

1) Describe the setpoints for the normal overspeed and the primary and emergency overspeed systems, with full descriptions, how they function.
2) Provide how the two electrical overspeed (primary and emergency) systems are diverse. Describe, and also provide schematics and logic diagrams to depict how the overspeed systems are diverse and independent.
3) Clarify whether, all of these (normal and two) overspeed systems share any common components or processors/inputs. If so, provide an evaluation of the impact of failures of any such features/components.
4) Is there any software used for processors or performing trip logic actuations? If so, is it common to any of the above?
5) Explain the diversity and defense-in-depth used to defend against a common cause failure (CCF) of the processors.
6) More importantly, address how the STP turbine control and overspeed control systems meet the SRP acceptance criteria described in Section II, "Acceptance Criteria," of SRP Section 10.2, and also described in Item 2.A in Section III (Review Procedure) of SRP Section 10.2.

RESPONSE REVISION 1:

The response to this RAI provided by letter U7-C-STP-NRC-090123, Attachment 16, on August 28, 2009 (ML092450155) has been superseded in its entirety by the responses to RAI 10.02-4, provided in letter U7-C-STP-NRC-100106, Attachment 2, on May 10, 2010 (ML102030020), and the response to RAI 10.02-5, provided in letter U7-C-STP-NRC-100231, Attachment 1, on October 15, 2010 (ML102930097). Both responses are being revised and submitted concurrently with this revised response.

Revisions to the markup of COLA Part 2, Tier 2 Section 10.2.2.4 have been included in the consolidated mark-up included in response to RAI 10.02-5 Revision 1.

RAI 10.02-3, Revision 1

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 REVISION 1:

The mark-up for COLA Part 2, Tier 2, Subsection 10.2.2.4 provided in the previous response was superseded by the consolidated mark-up provided in response to RAI 10.02-5. The mark-up for COLA Part 2, Tier 2 Subsection 10.2.5.2 provided in the previous response was superseded by the consolidated mark-up provided in response to RAI 10.02-5, question 5. These responses were provided in letter U7-C-STP-NRC-100231, Attachment 1, on October 15, 2010 (ML102930097). Both responses are being revised and submitted concurrently with this revised response.

The mark-up for STP DEP 10.2-3 provided in the previous response has been deleted and included in the response to RAI 10.02-5 Revision 1 for ease of review.

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 dated August 28, 2009 (ML092450155), 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.

(Refer to the combined markup of COLA Part 2, Tier 2 Subsection 10.2.2.4 at the end of RAI 10.02-5 Revision 1)

(Refer to the combined markup of COLA Part 2, Tier 2 Subsection 10.2.5.2 in response to RAI 10.02-5 Revision 1, question 5.)

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.*

(Refer to the combined mark-up of the Departures Report in COLA Part 7, Section 3.0 for STP DEP 10.2-3 at the end of RAI 10.02-5 Revision 1.)

RAI 10.02-4, Revision 1

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 REVISION 1:

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 (ML092450155). The response provided below supersedes the initial response to RAI 10.02-2 in its entirety.

This response is revised as indicated with revision bars. Nomenclature has been updated for clarity and consistency with other RAI responses and the COLA mark-ups including Figure 10.2-5 (nomenclature was the only change to this figure).

The changes to the mark-up of COLA Part 2, Tier 2, Subsection 10.2.2.4 provided in the previous response and as detailed below have been superseded by the mark-up included in the response to RAI 10.02-5, Revision 1, submitted concurrently with this revised response.

The proposed site specific ITAAC table to be added to COLA Part 9, Section 3.0 provided in the previous response has been superseded by the table included in response to RAI 10.02-6, Revision 1, submitted concurrently with this revised response.

The description of the normal overspeed control system is provided in the response to RAI 10.02-3, Revision 1, submitted concurrently with this revised response. The descriptions of the primary and emergency overspeed trip functions are provided herein.

The electro-hydraulic Emergency Trip Device (ETD) has two redundant trip valves. Tripping of either redundant trip valve will drain the emergency trip fluid, resulting in a turbine trip.

The overspeed protection system consists of the diverse 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 trip pilot valve solenoids on the trip valves. The trip valves are redundant and independent.

The diverse 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 trip pilot valve solenoids of one of the two trip valves of the ETD. Both trip pilot valve solenoids must be de-energized to trip the primary trip valve.

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 trip pilot valve solenoids of the emergency trip valve in the ETD to cause a turbine trip.

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 functions are isolated from, and independent of, each other. The trip logic functions for the emergency trip function are performed using hardware and software/firmware. The primary trip functions are performed in diverse hardware and 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 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 (refer to the combined markup of COLA Part 2, Tier 2, Subsection 10.2.2.4 at the end of RAI 10.02-5), a new Figure 10.2-5 added, and a new table will be added to COLA Part 9, Section 3.0 Site Specific ITAAC. (The new table has been revised and is now included in the response to RAI 10.02-6, Revision 1).

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

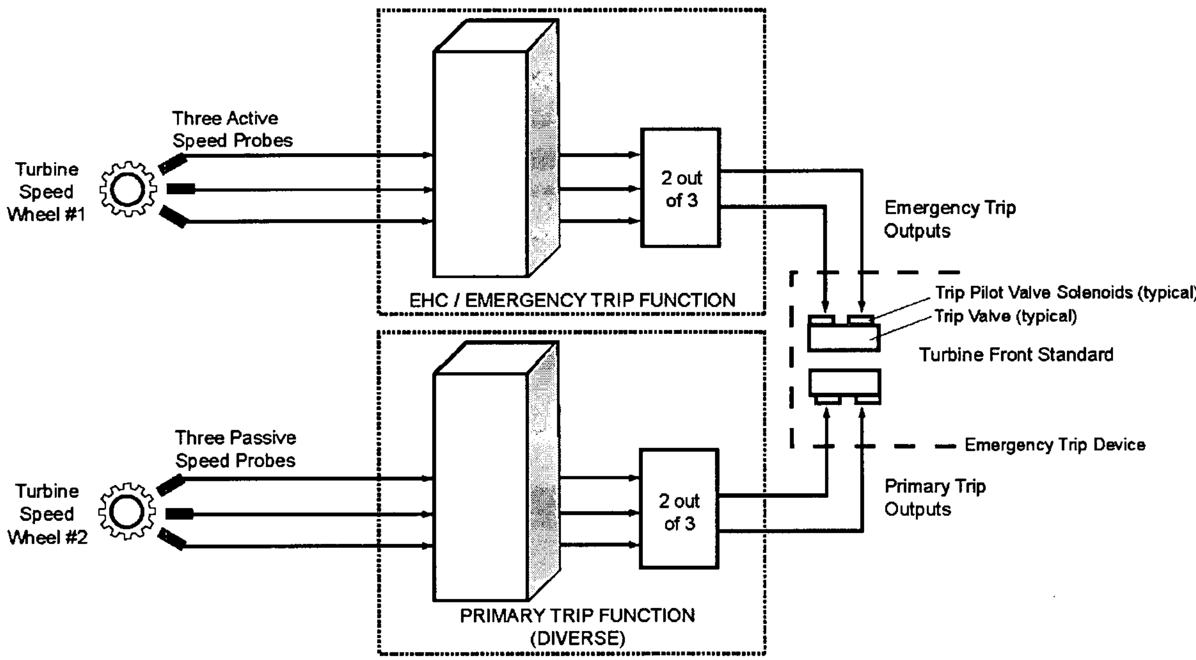


Figure 10.2-5 Turbine Overspeed Trip System Functional Diagram

RAI 10.02-5, Revision 1

QUESTION:

Follow Up to RAI 10.02-3 (eRAI 4103 Question 15830)

With respect to turbine–generator (T-G) normal speed control for Units 3 and 4 of the South Texas Project (STP), the staff issued RAI 10.02-3 (eRAI 4103) as a follow-up to RAI 10.02-1. In RAI 10.02-3, the staff requested the applicant to provide additional information regarding the normal speed control setpoints for closing the turbine control and intercept valves to prevent overspeed conditions, and to explain how these valves are modulated following a loss of load condition. In a response dated May 10, 2010, the applicant provided additional information to address the staff's request along with a markup of the FSAR to reflect the additional information that was provided.

Based on a review of the applicant's response to RAI 10.2-3 and FSAR markup, the staff found that additional information and clarification is needed with respect to T-G normal speed control. In particular, the following needs to be addressed and the FSAR needs to be updated as appropriate to include this information:

1. The response to RAI 10.2-3 indicated that 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 followed by a turbine trip. The FSAR needs to be clarified to reflect this information in the descriptions that are provided for the steam admission valves, extraction non-return valves, and for the turbine overspeed protection system, including why this provision is included in the design, the approximate power level where a reactor trip will occur, and how the power-load unbalance function operates when a loss of load actuates below the reactor trip threshold. The turbine overspeed protection system schematic also needs to be revised to include this design information.

2. Section 10.2.2.4, STP DEP 10.2-3: The FSAR markup that was provided in response to RAI 10.2-3 indicated that the normal turbine speed control system includes the extraction steam non-return valves. It's not clear how the extraction steam non-return valves function as part of the normal speed control system and the FSAR needs to be clarified accordingly.

3. Section 10.2.2.4, STP DEP 10.2-3: The FSAR markup that was provided in response to RAI 10.2-3 indicated that the power-load unbalance (PLU) function is the second line of defense against turbine overspeed. However, the PLU function provides turbine overspeed protection for situations that are different from those that are prevented by the normal speed control function, and both of these functions are implemented by the turbine electro-hydraulic control (EHC) system. Therefore the normal speed control and the PLU functions are somewhat complementary and together constitute the first line of defense against turbine overspeed. The second line of defense is provided by the turbine emergency trip system, which includes the primary and emergency turbine overspeed protection functions. Consequently, the FSAR description needs to be revised accordingly to properly reflect these considerations.

4. Section 10.2.2.4, STP DEP 10.2-3: The FSAR markup that was provided in response to RAI10.2-3 indicated that if the normal speed control and power-load unbalance (PLU) function should fail, the overspeed trip devices close the steam admission valves, including the main and intermediate stop valves. For completeness and clarity, the FSAR needs to be rewritten to state: "…the turbine primary and emergency overspeed trip devices close the steam admission valves (turbine stop, control, intermediate stop, and intercept valves) and the extraction steam non-return valves."

5. Section 10.2.5.2, COL License Information Item 10.2 (response to RAI 10.2-3): In order to properly address this COL item, the FSAR description needs to identify the highest turbine speed that will result due to a loss of load based on the results of a plant-specific analysis. The bounding assumptions that apply need to be identified such as the maximum allowed closure times for turbine steam admission valves and extraction non-return valves, and the maximum allowed turbine trip setpoints. Also, for completeness and to demonstrate adequacy of the design, the highest turbine speed that will result due to a loss of load needs to be compared to the acceptance criteria specified in FSAR Section 10.2.3.4(4).

6. Section 10.2.2.7 (STP DEP 10.2-3): The FSAR indicates that provisions are included for testing certain devices (as listed). The list needs to be updated to include the power-load unbalance function which was described in the FSAR markup in response to RAI 10.2-3, and other functions and components may need to be included as well based on RAI responses and associated changes being made to the FSAR.

RESPONSE REVISION 1:

The response below provides additional information requested by the staff. Nomenclature has been updated for clarity and consistency with other RAI responses and the COLA markups.

Changes to the mark-up of COLA Part 2, Tier 2, Subsection 10.2.2.4 included in this response supersede earlier mark-ups contained in responses to RAI 10.02-1, RAI 10.02-2, RAI 10.02-3 and RAI 10.02-4.

For ease of review the mark-up of STP DEP 10.2-3 in COLA Part 7 previously provided in response to RAI 10.02-3 in letter U7-C-STP-NRC-100106, Attachment 1 dated May 10, 2010 (ML102030020) has been included at the end of this response. The wording of the second bullet is revised to be consistent with other RAI responses.

This revision supersedes the original response to RAI 10.02-5 provided in letter U7-C-STP-NRC-100231, Attachment 1, on October 15, 2010 (ML102930097). Changes are indicated with revision bars.

1. The reactor trip functions based upon turbine trip and control valve fast closure are described in COLA Part 2, Tier 2 Subsections 7.2.1.1, 10.2.2.1, and 15.2.2.2.2.1. Specifically, the following provides the subsection references and the associated descriptions related to these functions:

   a) Subsection 7.2.1.1.4.2, items (9) and (10) describe RPS inputs from "turbine stop valve" and "turbine control valve fast closure", respectively. The systems and equipment that provide trip and scram initiating inputs to the RPS for these conditions are discussed in Items (6)(a), (6)(b), and (6)(d). Figure 7.2-3 provides the Division I trip logic for these functions.

   b) Subsection 7.2.1.1.4.3, item (4) describes the usage of the turbine first-stage pressure signal to bypass the trip functions. This is depicted in Figure 7.2-3.

   c) Subsection 7.2.1.1.7, items (4) and (5) describe the basis for the setpoints for these trip functions.

   d) Subsection 10.2.2.1 describes the safety-related instrumentation.

   e) Subsection 15.2.2.2.2.1 presents the transient analysis of a load rejection.

   f) Subsection 15.2.3 presents the transient analysis of a turbine trip.

   There are no inputs to the RPS from the extraction non-return valves.

   As described in the second paragraph of COLA Part 2, Tier 2, Subsection 10.2.2.4 (STP DEP 10.2-3) a PLU actuation above approximately 40% power will energize the fast-acting solenoid valves for the control valves and intercept valves, resulting in a reactor trip from the control valve hydraulic pressure instruments. A load rejection below approximately 40% power (reactor trip threshold) will not result in a PLU actuation and control valve fast closure. Instead, it will result in normal control valve closure under normal servo control to prevent turbine speed from exceeding the primary overspeed trip setpoint of 110%; and will result in opening of the turbine bypass valves. The PLU function is not shown on a schematic diagram because it is a software function and the purpose of the schematic diagram provided is to show diversity, separation, and redundancy of the overspeed protection systems.

   No further changes to the COLA are required as a result of the above response.

2. Extraction steam non-return valves are not part of the normal turbine speed control system. However, they contribute to overspeed protection by preventing back flow of steam from re-entering the turbine. To clarify this relationship, the reference to extraction non-return valves in relation to the normal speed control system in the first paragraph of COLA Part 2, Tier 2 Subsection 10.2.2.4 will be deleted.

   Refer to the combined COLA markup at the end of this RAI.

3. Clarification for description of the PLU in the second paragraph of COLA Part 2, Tier 2 Subsection 10.2.2.4 will be provided to state that it supplements the normal speed control function, and together they constitute the first line of defense against turbine overspeed. The third paragraph will be revised to indicate that the emergency turbine overspeed protection system, which includes the primary and emergency turbine overspeed protection functions, comprises the second line of defense against turbine overspeed.

   Refer to the combined COLA markup at the end of this RAI.

4. The second paragraph of COLA Part 2, Tier 2 Subsection 10.2.2.4 will be revised.

   Refer to the combined COLA markup at the end of this RAI.

5. A plant specific analysis has been performed. As previously stated in response to RAI 10.02-3, the highest anticipated speed resulting from a loss of load based on that analysis is in the range of 105-108%.

   The bounding assumptions are as follows:

   - Valve closure times used in the overspeed calculation are provided in Subsection 10.2.2.2. Closure times are discussed further in response to RAI 10.02-8 question 11.b.

   - The turbine steam admission valves are assumed to be initially at valve-wide-open positions, which are conservative.

   - The primary overspeed trip setpoint is 110% and the emergency overspeed trip setpoint is 111%.

   This speed has been compared with the design acceptance criteria in Subsection 10.2.3.4 (4) (design overspeed is at least 5% above the highest anticipated speed resulting from a loss of load). Using the site specific values, the design overspeed is approximately 12% above the highest anticipated speed resulting from loss of load. This satisfies the acceptance criteria, and is below the primary and emergency overspeed trip setpoints.

COLA Part 2, Tier 2 Subsection 10.2.5.2, will be revised as indicated below. Changes are indicated by gray shading. This supersedes the previous mark-up of Subsection 10.2.5.2 included in response to RAI 10.02-3 in letter U7-C-STP-NRC-100106, Attachment 1 on May 10, 2010 (ML102030020).

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, which meets the design criteria stated in Section 10.2.3.4 Item (4). The valve closure times used in the overspeed calculation are provided in Subsection 10.2.2.2. The turbine steam admission valves are assumed to be initially at valve-wide-open positions, which are conservative. The primary overspeed trip and the emergency overspeed trip setpoints are 110% and 111%, respectively.

6. The PLU function is incorporated as part of the normal speed control system, which is a three redundant channel microprocessor-based control system. This system includes extensive diagnostic features that continually monitor for abnormal conditions that will be alarmed in the main control room. One of three channel failure will result in a 1-of-3 trip (a 2-of-3 trip initiates a PLU actuation). Because of the continuous diagnostic features of this system, the PLU function is not required to be separately tested on-line and therefore is not included in Subsection 10.2.2.7.

   The primary overspeed trip valve or the emergency overspeed trip valve illustrated in Figure 10.2-5, provided in response to RAI 10.02-4, can be tested one at a time while the unit is operating by utilizing its associated lockout valve, without tripping the turbine. Testing of these devices is included as Item (4) in Subsection 10.2.2.7.

   No changes to the COLA are required as a result of the above response.

COLA Part 2, Tier 2 Subsection 10.2.2.4 will be revised to incorporate the changes addressed in responses to RAI 10.02-3 Revision 1, RAI 10.02-4 Revision 1, RAI 10.02-5 Revision 1 questions 2, 3 and 4 above; RAI 10.02-6 Revision 1 questions 1, 2 and 3; RAI 10.02-7 Revision 1 question 1, and RAI 10.02-8 questions 6 and 8. Changes from COLA Rev 4 are 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 electro-hydraulic control (EHC) system provides the normal speed control ~~system~~ for the turbine and comprises a first line of defense against turbine overspeed. This system includes the main steam control valves (CV), intermediate steam intercept valves (IV), ~~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 (ETS). 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 valves and intercept valves irrespective of the current turbine speed. Normal speed control is supplemented by the PLU function which is implemented in the EHC, and together they form the first line of defense against turbine overspeed. 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 exceeds approximately 40%, to limit overspeed in the event of a full load rejection. A load rejection below approximately 40% power (reactor trip threshold) will not result in a PLU actuation and subsequent control valve fast closure. Instead, it will result in normal control valve closure under normal servo control to prevent turbine speed from exceeding the primary overspeed trip setpoint of 110%; and will result in opening of the turbine bypass valves for reactor pressure control. 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 turbine primary and emergency overspeed trip devices close the steam admission valves ~~including the main and~~ (turbine stop, control, intermediate stop and intercept valves), and the extraction steam non-return valves through the actuation of the air relay dump valve. This turbine overspeed protection system, which includes the diverse primary and emergency turbine overspeed protection functions, comprises the second 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 overspeed trip system is electrical, redundant and diverse and consists of the Primary and redundant Emergency overspeed trip functions.~~ The primary trip function is independent and diverse from the emergency trip function as explained below (refer to Figure 10.2-5, Turbine Overspeed Trip System Functional Diagram). ~~Reliability is~~

achieved by using two sets of redundant speed sensing probes, which input to the independent Primary and Emergency Trip modules in the control system. For additional reliability, tTwo-out-of-three logic is employed in both the Pprimary and Eemergency overspeed trip circuitry. EitherEach trip module function can de-energize its associated the trip pilot valve solenoids of the electro-hydraulic Emergency Trip Device (ETD). The ETD is composed of two independent trip solenoid valves, each with two normally energized fail-safe solenoids operated pilot valves. For each trip valve, each trip pilot valve solenoid is powered from a separate power source. The solenoids 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 trip pilot valve solenoids 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 and indirectly closing the steam extraction non-return valves. Accordingly, the repositioning of only one of the two trip solenoid valves is necessary to trip the main turbine. A single electrical 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 diverse primary overspeed trip function utilizes three passive speed sensors that are separate from the active speed sensors used for normal speed control and emergency trip function. Speed sensors are diverse (passive and active sensors) between primary overspeed and emergency overspeed trip. Speed sensing for primary and emergency overspeed trip functions also use separate speed wheels (refer to Figure 10.2-5). Each speed signal for the primary trip function 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 both trip pilot valve solenoids of one of the two trip valves of the ETD. Both trip pilot valve solenoids must be de-energized to trip the associated trip valve. The ETD has two redundant trip valves. Tripping of either redundant trip valve will drain the emergency trip fluid, resulting in a turbine trip.

The emergency overspeed trip function is the redundant backup electrical overspeed trip 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 the emergency overspeed trip function is approximately 111% of rated speed.

The control signals from the two turbine-generator overspeed trip functions are isolated from, and independent of, each other. The two overspeed trip functions use diverse electronic means (hardware and 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 redundant uninterruptable power sources.

The emergency electrical overspeed trip function uses the same turbine speed sensing techniques and the same speed sensors as the normal speed control system. The normal speed controllers and emergency overspeed protection trip controllers may be located in the same cabinet (refer to Figure 10.2-5). However, the control signals from the normal speed control system and the trip signals from the emergency overspeed protection trip function are separate from each other. This means that the emergency overspeed protection trip function is implemented in three separate trip controllers, and that these trip controllers are separate from the normal speed controllers, so that the control signals from the two systems are isolated from, and independent of, each other. The trip output signals from the trip controllers are arranged in two-out-of-three logic to de-energize the trip pilot valve solenoids of one of the two trip valves in the ETD to cause a turbine trip. Redundant power sources are provided for the trip controllers and normal speed controllers. Loss of power to a one trip controller will result in a single channel trip signal to the two-out-of-three trip logic with no turbine trip. Functional independence of the normal speed control system and the emergency overspeed trip system is assured in that failure of the normal speed controllers does not affect the ability of the emergency overspeed trip function.

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 valve transfers to the trip state on a loss of control power to both of its associated trip pilot valve solenoids, 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.

Each turbine extraction line is reviewed for potential energy and contribution to overspeed. The number and type of extraction non-return valves required for each extraction line are specified based on the enthalpy and mass of steam and water in the extraction line and Ffeedwater heater. Higher energy lines are provided with power-assisted closed non-return valves, controlled by an air relay dump valves, which in turn, are is activated by the emergency trip fluid system. The air relay dump valves, actuated on a turbine trip, dumps air from the extraction non-return valve actuators to provide rapid closing. The closing time of the extraction non-return valves is sufficient to minimize steam contribution to the turbine overspeed event.

The following component diversities redundancies are employed to guard against excessive overspeed:

(1) Main stop valves/control valves
(2) Intermediate stop valves/intercept valves
(3) Normal speed control/primary overspeed control/emergency overspeed control
(4) Fast-acting solenoid valves/emergency trip fluid system (emergency trip device)
(5) Speed control signals/primary overspeed trip/emergency overspeed trip

(6) Spring assisted non-return check valves where needed/ air relay dump valve for spring assisted non-return valves

The main stop valves and control valves provide full redundancy ~~and diversity~~ in that these valves are in series and have independent control signals and operating mechanisms. Closure of all four stop valves or all four control valves effectively shuts off all main steam flow to the HP turbine. The intermediate stop and intercept valves are also fully redundant ~~and diverse~~ in that they are in series and have ~~independent~~ separate control signals and operating mechanisms. Closure of either valve or both valves in each of the six sets of intermediate stop and intercept valves effectively shuts off steam flow to the three LP turbines. This arrangement is such that failure of a single valve to close does not result in a maximum speed in excess of design limits. To ensure water flashing to steam from the feedwater heaters, moisture separators/reheaters, and the gland seal evaporator does not contribute to acceleration of the turbine after a trip, spring assisted non-return check valves are installed on lines that could contain high amounts of entrained energy.

The following is a summary of the shared hydraulic components and system interfaces.

- The fluid trip system supply (FTS) provides hydraulic fluid to the trip valves. Failure of this supply line will fail safe because loss of oil pressure will cause all valves to fast close.

- The hydraulic power unit (HPU) has one central reservoir, two redundant pumps, associated filters and control valves. These pumps supply high-pressure hydraulic fluid for the fluid trip system, normal control of turbine valves and the main steam bypass valves.

- There is one hydraulic fluid drain header for the main stop valves (MSV) and one drain header for the control valves (CV). These two headers drain to the HPU reservoir through a common drain line.

- There is one hydraulic fluid drain header for three intermediate stop valves (ISV) and three intercept valves (IV), with one common drain line to the HPU reservoir. A similar arrangement exists for the other three ISVs and three IVs.

- The hydraulic fluid drain headers and drain lines are large diameter pipes, and are arranged with the appropriate slope to drain to the HPU reservoir.

- Each pair of ISVs and IVs share a common valve body, also referred to as a CIV, but each valve has its own separate valve disk, actuator, and instrumentation. The ISVs and IVs operate separately from each other as discussed in COLA Part 2, Tier 2, Subsection 10.2.2.2.

- The trip valves and lockout valves drain emergency trip system (ETS) fluid to a common drain header, where it is drained to the HPU reservoir through a common drain pipe. The header drain will be a one-inch nominal, or greater, pipe.

- The drain header has one vent line to the HPU reservoir.

- Periodic surveillance testing of valves and trip devices ensure that the drain lines are not plugged.

- There is one air relay dump valve that controls air to the steam extraction non-return valves. Venting of the air through the air relay dump valve will enable spring assisted closure of the non-return valves. The instrument air system supplies clean and filtered air to the non-return valves and the relay dump valve. See COLA Part 2, Tier 2, Subsection 9.3.6 for more details of the instrument air system. The extraction non-return valves are check valves and, should the air fail to vent, they would close on reverse flow without the spring assist.

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

Several modifications to the control logic for the turbine generator are described in Section 10.2. These modifications resulted from implementation of digital turbine controls for machine protection and reliability. This departure implements the following modifications:

- The control system uses electronic monitoring for control and overspeed protection of the main turbine .

- Redundancy for overspeed trip is implemented using two electrical overspeed trip devices ~~based on a hardware configuration~~ that use diverse hardware and software / firmware functions. 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 of load ~~as is~~ ~~106 to 109%~~ 105-108% and the limit of turbine speed when overspeed trip devices activate ~~as is~~ 120% ~~were defined~~.

Evaluation Summary

These modifications allow for full online testability of any protective function and significantly reduce the possibility of tripping the main turbine during testing. Most major components of the overspeed monitoring and control system are located in low radiation areas and are designed for safe, online troubleshooting and maintenance of mission critical components (e.g. turbine trip logic circuit and turbine valve control function).

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.

Also this departure defines the frequencies to exercise main turbine valves, which will provide a basis for improved component reliability.

The main turbine and turbine control system are classified as nonsafety-related. The turbine digital controller increases plant availability because a single failure will not result in a turbine trip and plant shutdown. There is no effect on the frequency or consequences of any accidents or malfunctions of SSC important to safety previously evaluated in the ABWR DCD. The overspeed protection system is not identified as equipment needed for any fission product barrier or mitigation of ex-vessel severe accidents. Therefore, this change has no impact on the probability of an ex-vessel severe accident, there is no possibility of a new type of accident, and there is no impact on fission product barriers or ex-vessel severe accident events.

This departure has been evaluated pursuant to the requirements in 10 CFR 52, Appendix A, Section VIII.B.5. There is no impact on Tier 1 or Tier 2* DCD, Technical Specifications, Bases of Technical Specifications, or operational requirements as a result of the changes. Therefore, this departure has no adverse impact on the safety analysis and does not require prior NRC approval.

RAI 10.02-6, Revision 1

QUESTION:

Follow Up to RAI 10.02-4 (eRAI 4103 Question 15856)

With respect to turbine–generator (T-G) overspeed protection for Units 3 and 4 of the South Texas Project (STP), the staff issued RAI 10.02-4 as a follow-up to RAI 10.02-2. In RAI 10.02-4, the staff requested the applicant to provide schematics, a description of power supplies and locations, and site specific inspections, tests, analyses and acceptance criteria (ITAAC) for the primary and emergency turbine overspeed protection subsystems. Note that ITAAC were deemed necessary by the staff to confirm that the as-built turbine overspeed protection subsystems are diverse consistent with the description in FSAR Section 10.2. In a response dated May 10, 2010, the applicant provided additional information to address the staff's request along with a markup of the FSAR to reflect the additional information that was provided. The applicant proposed to include site-specific ITAAC in Part 9, Section 3, of the application to address the staff's request. The proposed ITAAC requires confirmation that the primary and emergency turbine overspeed protection systems are diverse. A mark-up showing the proposed changes to Part 9, Section 3, was included in the response.

Based on a review of the applicant's response to RAI 10.02-4 and FSAR markup, the staff found that additional information and clarification is needed with respect to the T-G primary and emergency turbine overspeed trip subsystems. In particular, the following items need to be addressed and the FSAR needs to be updated as appropriate to include this information:

1. Section 10.2.2.4: Consistent with the response that was provided to RAI 10.02-4; the FSAR description of the turbine overspeed trip subsystems needs to be revised to distinguish which parts are independent, redundant and diverse from those that are independent and redundant. Also, from the response it is not clear which of these two categories the solenoid operated pilot valves are in and additional explanation is needed in this regard.

2. Section 10.2.2.4: In describing the turbine overspeed protection system, the FSAR markup that was provided in response to RAI 10.02-4 indicated that a single component failure will not result in a turbine trip. However, additional explanation is needed for why the failure of a trip solenoid valve to remain open will not result in a turbine trip, such as due to a loss of power to the two solenoid operated pilot valves for either the primary or emergency trip solenoid valve.

3. Section 10.2.2.4: For clarity, the FSAR description needs to be revised to indicate that the primary overspeed trip function is redundant to the emergency overspeed trip function, and vice-versa. While the proposed FSAR markup that was provided in response to RAI 10.02-4 indicated that the primary and emergency turbine trip subsystems are each redundant, it didn't clearly indicate what they are redundant to.

4. The response to RAI 10.02-4 indicated that a turbine trip will cause a reactor shutdown to occur. Section 10.2 of the FSAR markup did not include a discussion and design details

about this turbine trip/reactor trip function and the FSAR (including schematics) needs to be revised accordingly to include this information.

5. The proposed site-specific ITAAC that was provided in response to RAI 10.02-4 is incomplete in that sufficient specificity to enable inspectors to close this ITAAC was not provided. In particular, design provisions that are referred to in Section 10.2 of the FSAR and considered necessary to ensure adequate diversity between the primary and emergency turbine overspeed protection subsystems need to be specified.

RESPONSE REVISION 1:

The response below provides additional information requested by the staff. Changes are indicated with revision bars. This revision supersedes the original response to RAI 10.02-6 provided in letter U7-C-STP-NRC-100231, Attachment 2 dated October 15, 2010 (ML102930097).

1. COLA Part 2, Tier 2 Subsection 10.2.2.4 is revised to be consistent with the RAI 10.02-4 response.
   In that section the relationship of the normal speed control and emergency overspeed controls to the diverse primary overspeed controls are discussed.

   It clarifies that the emergency overspeed trip function is redundant to the primary overspeed trip function. Each overspeed trip function has a separate pilot-operated trip solenoid valve. They are redundant because tripping one of the two trip solenoid valves will cause loss of oil pressure resulting in a turbine trip.

   The primary overspeed function and the emergency overspeed function use diverse electronic means (diverse speed detection, and diverse hardware and software/firmware).

   The primary overspeed trip function uses a separate speed wheel and diverse speed detection modules from that used for the normal speed control and the emergency overspeed function thus making it independent and diverse.

   The emergency overspeed trip function is also independent of the normal control functions because the trip functions are implemented in separate trip controllers from the normal speed control function.

   (Refer to the combined markup of COLA Part 2, Tier 2, Subsection 10.2.2.4 at the end of RAI 10.02-5, Revision 1, provided concurrently with this revised response.)

2. The paragraph referenced in this RAI refers to the electrical portion of the electro-hydraulic overspeed trip system. For both the primary and emergency overspeed trip functions, each turbine trip valve is operated by two trip pilot valves. The solenoids for both pilot valves of a trip valve must de-energize to cause a turbine trip. The trip pilot valve solenoids are normally energized by separate power sources. The primary overspeed trip function and the

emergency overspeed trip function are supplied by the same redundant power sources. One power source supplies power to one trip pilot valve solenoid in the primary overspeed trip function and to one trip pilot valve solenoid in the emergency overspeed trip function while a separate power source supplies power to the other trip pilot valve solenoids in the primary and in the emergency overspeed trip functions. Thus, a single power source failure can cause only one trip pilot valve solenoid in the primary and emergency overspeed trip function to de-energize, which would not trip the turbine. Using the same redundant power sources to the primary and emergency overspeed trip functions does not affect the diversity or independence of the trip functions, since the trip functions are designed to be fail safe. A loss of power to one trip channel will result in a trip signal to the two-out-of-three trip logic. If power is lost to two trip channels, the two out of three logic will be satisfied and the turbine would be tripped. Also, since the same power sources provide power to the trip pilot valve solenoids of the trip valves in the primary and the in the emergency overspeed trip functions, a power loss to both of the trip pilot valve solenoids will result in a turbine trip by the primary overspeed trip function and the emergency overspeed trip function. However, the redundancy of the hydraulic trip functions requires that the turbine be tripped on actuation of either the primary or emergency trip valves. Subsection 10.2.2.4 will be revised accordingly.

(Refer to the combined mark-up of COLA Part 2, Tier 2, Subsection 10.2.2.4 at the end of RAI 10.02-5, Revision 1, provided concurrently with this revised response.)

3. The description in COLA Subsection 10.2.2.4 will be revised to clarify the relationship between the primary overspeed trip function and the emergency overspeed trip function.

   For STP Units 3 & 4 the primary overspeed trip function, which uses electronic devices replaces, the mechanical overspeed trip device discussed in SRP 10.2 III 2.C. The emergency overspeed trip function is the redundant backup discussed in SRP 10.2 III 2.D. Furthermore, each trip function utilizes three channels arranged in a two-out-of-three voting for the trip outputs. Subsection 10.2.2.4 will be revised accordingly. Additional clarification related to SRP 10.2 III 2.D is provided in response to RAI 10.02-8 question 6.

   (Refer to the combined mark-up of COLA Part 2, Tier 2, Subsection 10.2.2.4 at the end of RAI 10.02-5, Revision 1, provided concurrently with this revised response.)

4. The turbine trip and reactor shutdown functions and instrumentation are described in COLA Part 2, Tier 2 Subsection 7.2. The response to RAI 10.02-05 Item (1) provides specific subsections of Chapter 7 for various aspects of this function.

   No changes in Part 2, Tier 2 Section 10.2 are required.

5. The following site specific ITAAC table replaces the previously proposed table and will be added to a future revision of STP 3&4 COLA Part 9. Changes are indicated by gray shading:

(This table supersedes the table included in response to RAI 10.02-4, provided in letter U7-C-STP-NRC-100106, attachment 2 on May 10, 2010 (ML102030020).)

Table 3.0-xx Main Turbine (MT) System

Design Requirement	Inspections, Tests, Analyses	Acceptance Criteria
1. The trip signals from the two turbine electrical overspeed protection trip functions are isolated from, and independent of, each other.	1. Inspections will be performed verifying that the two turbine electrical overspeed protection functions have diverse hardware and software/firmware.	1. A report exists and concludes that the two electrical overspeed protection functions have diverse hardware and software/firmware that are isolated from, and independent of, each other.
2. The trip signals from the emergency overspeed protection trip function are separate from the control signals from the normal speed controllers.	2. Inspections will be performed verifying that the emergency overspeed protection function is implemented in trip controllers that are separate from the normal speed controllers.	2. A report exists and concludes that the emergency overspeed protection function is implemented in trip controllers that are separate from the normal speed controllers.

RAI 10.02-7, Revision 1

QUESTION:

SRP Section 10.2 specifies that turbine overspeed protection systems should include both redundancy and diversity. Additionally, operating experience insights need to be addressed in accordance with 10 CFR 52.79(a)(37) requirements. The May 10, 2010, response to RAI 10.02-4 described the diversity that is provided by the primary and emergency overspeed trip subsystems for the STP turbines and included a markup of FSAR Section 10.2.2.4 to incorporate this information. In general, the response indicated that diversity is provided by design and manufacturing strategies that are used. However, because the STP design does not provide the same level of diversity as that called for by SRP Section 10.2 (i.e., one electrical and one mechanical overspeed trip system), it tends to be more subject to common cause and common mode failures than designs that include a mechanical overspeed trip system.

In accordance with 10 CFR 52.79(a)(41), Section 1.8 of the STP FSAR needs to be revised to indicate that a mechanical trip device is not used to provide overspeed protection for the STP turbines and appropriate justification for this exception to the SRP needs to be included in FSAR Section 10.2. The discussion in the FSAR should be sufficient for the staff to find that the level of overspeed protection provided for the STP turbines is at least equivalent to the level of protection that would be provided by the diverse design called for by SRP Section 10.2. The following items are pertinent to the staff's evaluation in this regard and should be addressed in response to this RAI and reflected in the FSAR as appropriate:

1. The description of the turbine overspeed protection systems (including air and hydraulic systems/interfaces as applicable) need to clearly indicate what parts are shared between the primary and emergency turbine trip systems. For example, shared air and hydraulic dump lines and components such as dump valves and reservoirs need to be described in the FSAR. For clarity, the response should include schematic diagrams that show these flow paths, applicable components, and valves being actuated.

2. A summary description of the results of a reliability comparison of the two types of overspeed trip systems (or other analysis) is needed that establishes the basis for concluding that the reliability of the proposed design is at least equivalent to those that include a diverse mechanical overspeed trip system.

3. Factors and assumptions that are important for the analysis referred to in (2) to be valid need to be described, and provisions to ensure these considerations are properly implemented and maintained by COL applicants need to be described. For example, the amount of time that either the primary or emergency overspeed trip system can be out of service for maintenance without inserting a turbine trip for the affected channel is an important factor. Periodic inspections, maintenance, testing, and corrective actions that are necessary to ensure reliable performance is another important factor in this regard.

4. The results of a failure modes and effect analysis for the electrical, mechanical, and hydraulic portions of the turbine control and overspeed protection system confirms that the failure of a single component will not cause or otherwise allow the turbine to exceed 120 percent of rated speed.

5. Common mode and common cause failure vulnerabilities that could prevent the turbine overspeed trip systems from functioning properly and are pertinent to the design need to be addressed. For example, NUREG-1275, Volume 11, "Operating Experience Feedback Report – Turbine-Generator Overspeed Protection Systems," dated April 1995, describes problems that have been identified and should be considered in this regard. Based on operating experience considerations, the performance of solenoid valves, steam isolation valves, hydraulic systems and air systems have historically been problematic. Also, the potential for flow restrictions to occur in hydraulic dump lines is of concern (especially in those cases where redundant flow paths are not provided) and need to be addressed. Design and programmatic measures that will be implemented to ensure that these and other common mode and common cause failures are not likely to occur need to be described.

RESPONSE REVISION 1:

The revised response below provides additional information requested by the staff. This revision supersedes the original response to RAI 10.02-7 provided in letter U7-C-STP-NRC-100231, Attachment 3, on October 15, 2010 (ML102930097) in its entirety. Changes are indicated with revision bars.

The turbine overspeed protection system was revised in COLA Part 2, Tier 2, Subsection 10.2.2.4. Departure STP DEP 10.2-3 was revised in response to RAI 10.02-3 and 10.02-4. Further clarifications are provided in response to RAI 10.02-5 questions 2, 3 and 4; RAI 10.02-6 questions 1, 2 and 3; and RAI 10.02-8 questions 6 and 8. The latest description provides the same level of discussion as contained in the approved DCD. It includes sufficient information to demonstrate compliance with SRP 10.2-3 Subsection II, specific acceptance criteria 1 A., B. & C. Although not required to be in the FSAR, the following information related to shared systems is offered as further clarification to assist in following the SRP review procedures "as may be appropriate."

1. The components in the digital electrohydraulic control (D-EHC) system that are shared between the primary and emergency turbine trip systems are discussed below.

   Figure 10.2-5, Turbine Overspeed Trip System Functional Diagram, was added to COLA Part 2, Tier 2, Section 10.2 in response to RAI 10.02-4, and depicts the electrical portion of this system. As indicated in that figure, the primary overspeed trip system and the emergency overspeed trip system are completely separate and independent, up to and including the trip valves.

Refer to the attached Main Turbine Overspeed Trip Hydraulic Control Diagram, which illustrates the hydraulic portion of this system, including the trip devices and the drain flow paths. Below is a summary of the shared components in that portion of the system:

- The fluid trip system supply (FTS) provides hydraulic fluid to the trip valves. Failure of this supply line will fail safe because loss of oil pressure will cause all valves to fast close.

- The hydraulic power unit (HPU) has one central reservoir, two redundant pumps, associated filters and control valves. These pumps supply high-pressure hydraulic fluid for the fluid trip system, normal control of turbine valves and the main steam bypass valves.

- There is one hydraulic fluid drain header for the main stop valves (MSV) and one drain header for the control valves (CV). These two headers drain to the HPU reservoir through a common drain line.

- There is one hydraulic fluid drain header for 3 intermediate stop valves (ISV) and 3 intercept valves (IV), with one common drain line to the HPU reservoir. A similar arrangement exists for the other 3 ISVs and 3 IVs.

- The hydraulic fluid drain headers and drain lines are large diameter pipes, and are arranged with the appropriate slope to drain to the HPU reservoir.

- Each pair of ISVs and IVs share a common valve body, also referred to as a CIV, but each valve has its own separate valve disk, actuator, and instrumentation. The ISVs and IVs operate separately from each other as discussed in COLA Part 2, Tier 2, Subsection 10.2.2.2.

- The trip valves and lockout valves drain emergency trip system (ETS) fluid to a common drain header, where it is drained to the HPU reservoir through a common drain pipe. The header drain will be a 1" nominal, or greater, pipe.

- The drain header has one vent pipe to the HPU reservoir.

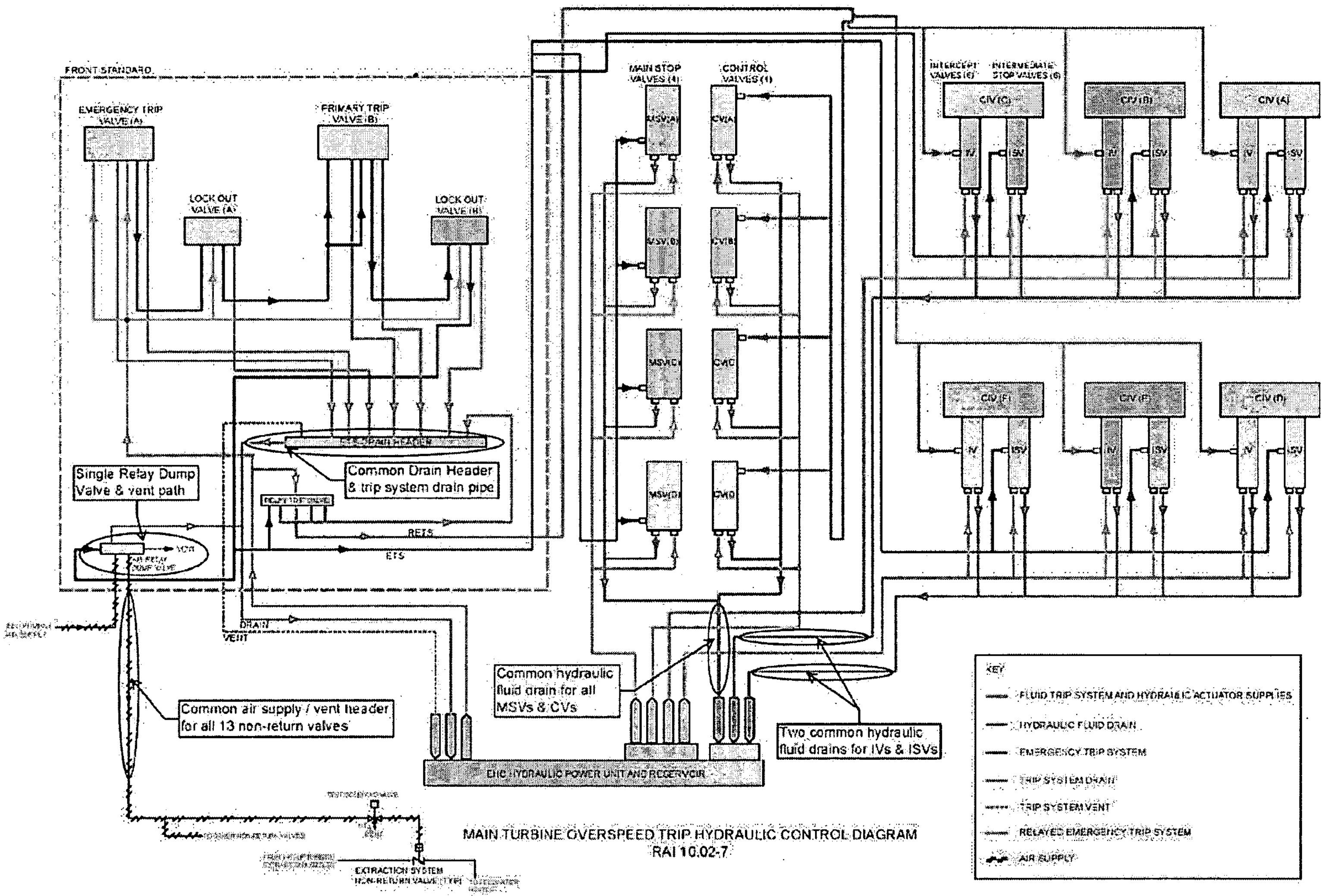
  Periodic surveillance testing of valves and trip devices ensure that the drain pipes are not plugged.

- There is one air relay dump valve that controls air to the steam extraction non-return valves. Venting of the air by the air relay dump valve will cause the spring assisted non-return valves to close. The instrument air system supplies clean and filtered air to the non-return valves and the relay dump valve. See COLA Part 2, Tier 2, Subsection 9.3.6 for more details of the instrument air system. The extraction non-return valves are check valves and, should the air fail to vent, they would close on reverse flow.

Description of these hydraulic components and system interfaces will be added to the turbine overspeed protection system description in COLA Part 2, Tier 2 Subsection 10.2.2.4. Refer to the combined COLA markup submitted at the end of RAI 10.02-5, Revision 1, submitted concurrently with this revised response.

Although detailed design is not included in the COLA, the attached diagram is included in this RAI response for clarity.

(The diagram has been replaced in Revision 1 with a clearer copy. It has been color coded for ease of review.)



MAIN TURBINE OVERSPEED TRIP HYDRAULIC CONTROL DIAGRAM
RAI 10.02-7

2. A qualitative assessment has been completed to compare the two types of overspeed systems. The results of that assessment are summarized as follows:

   The primary overspeed trip function replaces the mechanical overspeed trip device. The primary overspeed trip function uses separate speed sensors on a separate speed wheel from the sensors used for the emergency overspeed trip function. It is independent and diverse from the emergency overspeed trip function, and utilizes a two-out-of-three trip logic arrangement for turbine trip initiation.

   The turbine overspeed trip design provides acceptable diversity comparable to SRP 10.2. Both the previous and new design generate a turbine trip by dumping EHC oil pressure. The new electronic design is more robust because the older mechanical trip design was "unsupervised" between turbine startups. The older mechanical trip mechanism could not be verified on-line and could only be tested with a real overspeed test. This required the normal overspeed system to be bypassed. This entails a considerably more dangerous situation compared to the testing capability of the electronic systems. Because the new design can be tested on-line and will indicate if signals are out of tolerance or have failed, the proposed electronic design will provide a more robust system for verifying the trip channels, and will improve trip reliability due to minimum setpoint drift.

   A trip lever at the turbine front standard is no longer necessary due to the elimination of the mechanical overspeed trip device. This trip lever was used primarily to support testing and calibration of the mechanical overspeed trip device. As reported in NUREG-1275 Vol. 11, this trip lever was susceptible to human errors that might have contributed to prior overspeed events. Instead of the trip lever, an electrical switch will be provided at or near the front standard, which can directly interrupt power to the turbine trip solenoid valves to cause a turbine trip.

   Eliminating potential human errors, introducing on-line verification, and eliminating the requirement to cause an actual overspeed condition in order to set the mechanical trip mechanism, the reliability of the electrical overspeed trip system is judged to be more reliable than the mechanical trip device.

   No changes to the COLA are required as a result of the above response.

3. Turbine overspeed protection is implemented in two independent functions, each using its separate speed sensors and logic arranged in two-out-of-three trip logic outputs to its associated trip solenoid valve. The primary overspeed protection function is independent and diverse from the emergency overspeed protection function. With the exception of the relay trip modules, these functions have continuous monitoring and diagnostic capability. Failures are alarmed in the main control room. Except for speed sensors and trip solenoid valves, the overspeed protection system components can be replaced on-line. The time out of service for maintenance of either overspeed protection function will be specified in the appropriate maintenance procedure and included as part of the turbine inservice inspection program in

Subsection 10.2.3.6. Furthermore, the inservice testing provisions specified in COLA Part 2, Tier 2 Subsection 10.2.3.6 will contribute to maintaining the reliability of overspeed protection.

The inservice inspection detailed in COLA Part 2, Tier 2 Subsection 10.2.3.6 Item (2) will be revised. Refer to the combined COLA markup submitted in response to RAI 10.02-8 item 11.

4. An initial failure modes and effects analysis for the electrical, mechanical, and hydraulic portions of the turbine control and overspeed protection system has been performed. This analysis confirms that the failure of a single component will not cause the turbine to exceed 120 percent of rated speed. This analysis also addresses the operating experience reported in NUREG-1275 Vol. 11. A final report has been prepared and made available for NRC review.

   No changes to the COLA are required as a result of the above response.

5. The Instrument Air System supplies clean control air to the extraction non-return valves, instruments, and solenoid valves. Subsection 9.3.6 discusses the Instrument Air System, and specifies the quality requirements for air (water vapor dewpoint, particle size limit). Air filters are inspected periodically for cleanliness, and periodic testing of air quality is performed to ensure compliance with specifications. These provisions will preclude common mode failures from air contamination.

   As discussed in response to RAI 10.02-7 question 1, the hydraulic control system for the turbine admission valves provides multiple hydraulic oil return and drain lines.

   Due to the periodic testing of the active components, and the inservice inspections, problems can be identified and corrected to preclude common-mode or common-cause failures affecting turbine overspeed protection. Furthermore, the issues and problems associated with overspeed protection systems identified in NUREG-1275 have been addressed (see response to RAI 10.02-7 question 4).

   No changes to the COLA are required as a result of the above response.

RAI 10.02-8, Revision 1

QUESTION:

SRP Section 10.2, Subsection III, specifies review considerations that pertain to turbine-generator systems. Sufficient information needs to be provided to enable the reviewer to evaluate the turbine generator system, including subsystems and components that are considered essential for the safe integrated operation of the facility. Additionally, operating experience insights need to be addressed in accordance with 10 CFR 52.79(a)(37) requirements. The responses that were provided to RAIs 10.02-3 and 10.02-4, and associated FSAR markups, provided additional information and clarification concerning the design of the turbine generator control and overspeed protection systems. However, the information in the FSAR continues to be incomplete and confusing in some respects. Consequently, additional information is needed and the description in the DCD needs to be revised accordingly to address the following considerations:

1. Section 10.2.1.2 (STP DEP 10.2-2): The FSAR description for Power Generation Design Basis Five needs to be clarified to specify "...EOS **trip setpoint**."

2. Section 10.2.2.2 (STP DEP 10.2-1): The description in the FSAR of the Intermediate Stop and Intercept Valves needs to be clarified to state: "Hydraulically operated intermediate stop and intercept valves are provided...just upstream of the low pressure (LP) **turbine** inlets."

3. Section 10.2.2.2 (STP DEP 10.2-1): With respect to the extraction non-return valves, the locations where these valves need to be installed to prevent turbine overspeed must be specified, single-failure considerations need to be addressed, and the description needs to indicate that the non-return valves prevent (not minimize the potential for) turbine overspeed due to reverse steam flow through the extraction steam lines.

4. Section 10.2.2.2 (STP DEP 10.2-4): The potential impact of hydrogen detonation on structures, systems and components located in the vicinity of the bulk hydrogen storage facility and measures necessary to prevent consequences adverse to safety, including the uncontrolled release of contaminated material, need to be addressed.

5. Section 10.2.2.3 (STP DEP 10.2-1): For clarity, the FSAR needs to be revised to state "...six intermediate stop valves and **six** intercept valves." The current description could be interpreted to mean three intermediate stop valves and three intercept valves for a total of six valves, but this would be incorrect.

6. SRP Section 10.2, under Item 2.D of Section III, indicates that the emergency overspeed trip circuitry and control signals need to be isolated from and independent of the circuitry and control signals that are used for normal speed control, which includes the powerload unbalance (PLU) function. This aspect of the design needs to be addressed and described in the FSAR.

7. As specified in SRP Section 10.2, under item 1 of Section III, the staff reviews the general arrangement of the turbine with respect to safety-related SSCs. As described in FSAR Section 3.5.1.1.1.3 (STP DEP 3.5-1), the turbines for STP Units 3 and 4 are unfavorably oriented with respect to these two STP units. However, the impact of STP Units 3 and 4 turbine failures on STP Units 1 and 2 and vice-versa were not addressed and the FSAR for STP Units 3 and 4 needs to be revised accordingly to include this information. Also, turbine orientation and licensing basis considerations for STP Units 1 and 2 relative to the placement of STP Units 3 and 4 need to be considered and addressed.

8. Section 10.2.2.4 (STP DEP 10.2-3): The FSAR description states: "The following diversities are employed to guard against excessive overspeed..." This is incorrect in that the items listed are redundancies and the FSAR needs to be revised accordingly. Also, other redundancies that exist need to be recognized and included, such as extraction non-return valves.

9. Section 10.2.2.5 (STP DEP 10.2-3): The FSAR indicates that the emergency trip system (ETS) will close the main stop, control, intermediate stop, and intercept valves on certain protective signals as listed. However, additional clarification is needed for the following items:

   a. It's not clear why the extraction non-return valves are also not closed along with the turbine steam admission valves and this needs to be explained. Note this comment also pertains to a similar FSAR description that is provided at the end of the listing of protective signals.

   b. One of the protective signals is the emergency trip at the front standard (item 9). This local trip device and related circuitry needs to be described in the FSAR, such as how it accomplishes its function and any interfaces or dependencies that exist with software/firmware, the normal turbine speed control system, the ETS, as well as with the control room manual trip device. Similarly, the manual turbine trip device located in the control room (item 1) also needs to be described.

   c. One of the protective signals is a loss of two speed signals for either the normal speed control or emergency overspeed trip (item 15). This is misleading in that the same three speed signals are shared by the normal speed control and emergency overspeed trip functions. The FSAR description needs to be clarified accordingly such as by stating: "Loss of two of the three speed signals that are shared by the normal speed control and emergency overspeed trip functions."

10. Section 10.2.2.7 (STP DEP 10.2-3): The FSAR describes testing provisions that have been established related to the main turbine. Additional information and clarification is needed to address the following items that pertain to this section:

a. It isn't clear from the description to what extent testing is performed for the manual trip devices located in the control room and at the turbine front standard and the FSAR needs to be clarified accordingly.

b. This section includes a description of testing that will be completed for the turbine steam admission valves. Consistent with the guidance provided in SRP Section 3.5.1.3, the description also needs to include inspection and testing provisions for the extraction steam non-return valves.

c. The FSAR indicates that the turbine steam admission valves are exercised quarterly or as required by the turbine missile probability analysis. However, SRP Section 3.5.1.3 specifies a frequency of weekly for exercising these valves, as well as for the extraction steam non-return valves. The guidance in the SRP only allows the frequency to be established in accordance with the turbine missile probability analysis if the methods and procedures used for calculating turbine missile probabilities have been approved by the NRC. The FSAR needs to be revised accordingly to establish appropriate test frequencies for the turbine steam admission and extraction non-return valves consistent with the SRP guidance, or an exception to the SRP needs to be recognized and justified. Note that this item also applies to FSAR Section 10.2.3.6 (STP DEP 10.2-1).

d. SRP Section 3.5.1.3, Section II, Item 5.C.iii under SRP Acceptance Criteria specifies monthly testing during normal operation of each component of the electro-hydraulic turbine speed control system (which includes the power-load unbalance function), as well as the primary and emergency turbine overspeed trip devices. This item needs to be addressed and described in the FSAR as appropriate.

e. SRP Section 3.5.1.3, Section II, Item 5.C specifies that online test failure of a turbine overspeed protection subsystem mandates repair or replacement of failed components within 72 hours. These subsystems include normal turbine speed control (including the power-load unbalance function), as well as the primary and emergency turbine overspeed trip devices. This item needs to be addressed and described in the FSAR as appropriate.

11. Section 10.2.3.6 (STP DEP 10.2-1): The FSAR describes in-service testing provisions that have been established related to the main turbine. Additional information and clarification is needed to address the following items that pertain to this section:

a. Item (1) under the description of inservice inspection of valves needs to be revised to state that some load reduction may be necessary before testing...intermediate **stop** and intercept valves.

b. Items (2) and (3) under the description of inservice inspection of valves specify tightness testing and inspection provisions for turbine steam admission valves.

Consistent with the guidance in SRP Section 3.5.1.3, the FSAR needs to be revised to also include similar provisions for the extraction steam non-return valves. The FSAR also needs to describe how valve closure times are confirmed to be acceptable and maintained over time for the turbine steam admission valves (for both the high pressure and low pressure turbines) and for the extraction steam non-return valves.

c. Item (3) under the description of inservice inspection of valves indicates that all turbine steam admission valves will be inspected within the first three refueling or extended maintenance shutdowns. However, consistent with the guidance in SRP Sections 10.2 and 3.5.1.3, at least one of each valve type also needs to be inspected at intervals of approximately 3 years. Therefore, the FSAR needs to be revised as appropriate to reflect this information.

d. The discussion after (3) under the description of inservice inspection of valves needs to be revised to include extraction steam non-return valves consistent with the guidance in SRP Section 3.5.1.3.

12. Section 10.2.4: The FSAR provides an evaluation of the turbine generator design features. Additional information and clarification is needed to address the following items that pertain to this section:

a. STP DEP 3.5-1 provided additional information that indicates that the probability of a turbine missile striking any component has been determined to be less than $1x10^{-7}$ per year; and that failure of the turbine-generator and associated equipment cannot preclude the safe shutdown of the reactor. This description is not entirely accurate and needs to be revised to indicate something similar to: "The probability of a turbine missile adversely impacting SSCs important to safety will be maintained less than $1x10^{-7}$ per year as discussed in Subsections....Thus failure of a turbine-generator should not preclude the safe shutdown of the reactor." Also, conclusion needs to reflect the impact of turbine failure on all STP nuclear units.

b. A departure needs to be established to address the impact that a failure of the connection joint between the low pressure turbine exhaust hood and the condenser will have on safety-related equipment located in the turbine building. The existing description is based on no safety-related equipment being located in the turbine building, which is not the case for STP Units 3 and 4.

RESPONSE REVISION 1:

This revision corrects editorial errors noted in the previous response to questions 10, 11 and 12 and references COLA Rev 4 instead of Rev 3 as appropriate.

The response below also provides additional information requested by the staff. This revision supersedes the original response to RAI 10.02-8 provided in letter U7-C-STP-NRC-100231, Attachment 4, on October 15, 2010 (ML102930097). Changes are indicated with revision bars.

1. The description in Subsection 10.2.1.2 for Power Generation Design Basis Five will incorporate the words "trip setpoint."

COLA Part 2, Tier 2 Subsection 10.2.1.2, will be revised as indicated below. Changes are indicated by gray shading:

> ***Power Generation Design Basis Five***—*The failure of any single component will not cause the rotor speed to exceed the ~~design speed~~* Emergency Overspeed (EOS) trip setpoint.

2. The description in Subsection 10.2.2.2 will be clarified to provide complete component descriptions.

COLA Part 2, Tier 2 Subsection 10.2.2.2, will be revised as indicated in response to RAI 14.02-15 (copy provided below for ease of review). Additional changes are indicated by gray shading:

> ***Combined Intermediate*** **~~Stop and Intercept~~** ***Valves*** **(Intermediate Stop Valves and Intercept Valves)** — *~~Two combined intermediate valves (CIVs) are provided for each LP turbine, one in each steam supply line, called the hot reheat line.~~* *The* combined intermediate valves (*CIVs*) *consist~~s~~ of two valves—the intercept valve and the intermediate stop valve, which share a common casing. Although they utilize a common casing, these valves have entirely separate operating mechanisms and controls.* *~~The function of the CIVs is to protect the turbine against overspeed from steam and water energy stored between the main stop and control valves and the CIVs. One CIV is located on each side of each LP turbine.~~* Hydraulically operated intermediate stop valves (ISVs) and intercept valves (IVs) are provided in each hot reheat line just upstream of the Low Pressure (LP) turbine inlets. Upon loss of load, the intercept valves first close then throttle steam to the LP turbine, as required to control speed. The intermediate stop valves close on a turbine trip. The intermediate stop valves and intercept valves are designed to rapidly close to control turbine overspeed.

3. There are thirteen (13) extraction non-return valves. Seven are located on high pressure extraction steam lines to the two No. 5 and two No. 6 feedwater heaters, the two MSRs, and the turbine gland seal evaporator. Six are located on low pressure turbine extraction lines to the three No. 3 and three No. 4 low pressure heaters. The locations of the non-return valves are provided in Figures 10.3-2, 10.4-2, 10.4-7, and 10.4-8. Air is supplied to the non-return valve actuators from the instrument air system through the relay dump valve to assist in opening. If the relay dump valve fails to vent, the non-return valves will close on reverse steam flow. Failure of a single non-return valve to close after a full load rejection will not cause the turbine speed to exceed its design overspeed (120% of rated speed)
(See response to RAI 10.02-7 question 4).

COLA Part 2, Tier 2 Subsection 10.2.2.2, will be revised as indicated below. Changes are indicated by gray shading:

> ***Extraction Non-return Valves***—*Upon loss of load, the steam contained downstream of the turbine extractions could flow back into the turbine, across the remaining turbine stages, and into the condenser. Associated condensate could flash to steam under this condition and contribute to the backflow of steam or could be entrained with the steam flow and damage the turbines.* ~~*Extractionn*~~Non-return valves are ~~*installed in the*~~employed in selected extraction lines to ~~*the first, second, third and, if required, forth stage of turbine extractions to guard against this backflow and the resulting potential damage due to water entrainment or overspeed condition*~~ ~~minimize the potential for~~ prevent overspeeding.
>
> The non-return valves are spring assisted closure type check valves. Spring assisted non-return valves are held open with instrument air. They close on loss of air. When the air is released the springs act to close the valves. Closure time is within 2 seconds from tripping the air relay dump valve. If the air relay dump valve fails to vent the air to the non-return valve actuators, they will close on reverse steam flow.
>
> There are thirteen (13) extraction non-return valves. Seven are located on high pressure extraction steam lines to the two No. 5 and two No. 6 feedwater heaters, the two MSRs, and the turbine gland seal evaporator. Six are located on low pressure turbine extraction lines to the three No. 3 and three No. 4 low pressure heaters. A single failure of an extraction non-return valve will not cause the turbine speed to exceed its design overspeed of 120% of rated speed after a full load rejection.
>
> Non-return valves are not used on extraction lines to the three No. 1 and three No. 2 low-pressure heaters and, because of the relatively low potential energy for increasing the turbine speed, are not required for turbine overspeed protection.

4. STP DEP 1.1-2 & STP DEP 10.2-4 changed the location of the bulk hydrogen storage facility to be well away from the power block buildings. Part 2, Tier 2 Subsection 10.2.2.2 was changed to state the following:

> "A single bulk hydrogen storage facility will be used to store hydrogen compressed gas cylinders for STP 3 & 4. *The bulk hydrogen storage is located outside* ~~*but near*~~ *the Turbine Building* and at least 100m from any safety-related building."

The location of the bulk hydrogen storage facility was approved in the DCD. The departures cited above, including STP DEP 10.2-4 cited in the RAI, were evaluated in accordance with 10 CFR 52 Appendix A Section VIII.B.5. The VIII.B.5 assessment concludes that this change does not adversely affect the frequency of occurrence or impact of an accident on any SSCs, since any risk of damage to the Power Block by inadvertent explosion, fire or missile generated due to bulk hydrogen tank failure will be reduced by increasing the distance between the Bulk Hydrogen Storage Building and the Power Block. In addition, this departure only moves the location of the Bulk Hydrogen Storage System and does not make any other changes. Therefore, this change does not result in new potential accident scenarios or new analysis methodologies. Therefore the change satisfies the criteria in the regulation for changes that can be made without prior NRC approval. Therefore STPNOC believes that the change is acceptable from a regulatory perspective.

As noted on Figure 10.2-4, where the hydrogen line enters the turbine building, it is encased in a vented guard pipe up to the first isolation valve. This provides protection against detonation.

Onsite chemical storage of hydrogen is further addressed in the site-specific supplement contained in COLA Part 2, Tier 2, Section 2.2S. The analysis is documented in Tables 2.2S-6, 2.2S-9 (Design Basis Events – Explosions), 2.2S-10 (Design Basis Events – Flammable Vapor Clouds (delayed ignition) and Vapor Cloud Explosions), 2.2S-11 (Design Basis Events – Toxic Vapor Clouds). These tables analyze the STP 1 & 2 main gas storage, which is located approximately 1500 feet southeast of Units 3 Reactor Building, and concludes that using the quantity of hydrogen stored for STP 1 & 2, the distance for an explosion to have less than 1 psi of peak incident pressure is 1,048 feet, the safe distance for vapor cloud explosions is 1,557 feet, and the peak overpressure at the Reactor Building is < 1 psi. For purposes of review, it should be noted that the design for Units 3 & 4 has not been finalized, but the current plan has the bulk hydrogen storage facility located southwest of the protected area, approximately 700 feet from the southwest corner of the Unit 4 Ultimate Heat Sink, about 1100 feet from the Unit 4 Reactor Building or Radioactive Waste Building, and approximately 300 feet outside the protected area vehicle barrier system. The detailed design of the Unit 3 & 4 bulk hydrogen storage facility has yet to be determined, however that facility will be located at the same or greater distance as the STP 1 & 2 main gas storage if required per the final detailed design.

Based on the location and design of the bulk hydrogen system, no credible scenarios exist that involve consequences adverse to safety or the uncontrolled release of radioactive material.

No changes to the COLA are required as a result of the above response.

5. STP DEP 10.2-1 revised the description of the Combined Intermediate Valves (CIV) to discuss that each CIV consists of two valves (an intermediate stop valve and an intercept valve), each with its own actuator but with two valve disks contained in a common valve body. There are a total of twelve (12) valves (six intermediate stop valves and six intercept valves). The editorial correction noted will be incorporated.

In COLA Part 2, Tier 2 Subsection 10.2.2.3, the first paragraph will be revised as indicated below. Changes from COLA Rev 4 are indicated by gray shading:

10.2.2.3 Normal Operation

STP DEP 10.2-1

During normal operation, the main stop valves ~~and CIVs~~, intermediate stop valves and intercept valves are wide open. Operation of the T-G is under the control of the Electro-Hydraulic Control (EHC) System. The EHC System is comprised of three basic subsystems: the speed control unit, the load control unit, and the flow control unit. The normal function of the EHC System is to generate the position signals for the four main stop valves, four main control valves, ~~and~~ six ~~CIVs~~ intermediate stop valves, and six intercept valves.

6. SRP Chapter 10.2 Section III.2.D states, "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. This backup electrical overspeed trip system may use the same sensing techniques as the electrohydraulic control system. However, the circuitry is reviewed to confirm that the control signals from the two systems are isolated from, and independent of, each other."

The backup electrical overspeed trip system (referred to in the STP 3&4 design as the emergency overspeed trip function) uses the same sensors as the normal turbine electrohydraulic control system (referred to as the normal speed control function). Though not explicitly required by Section III.2.D of the SRP Chapter 10.2, independence of the sensor signals for the two systems cannot be maintained because the sensors are shared. However, as described in the following paragraphs, the isolation and independence of the normal speed control function and the emergency overspeed trip function control circuits, the redundancy inherent in each system, and the fail-safe circuit design prevents the coincident loss of normal turbine electrohydraulic speed control and emergency overspeed trip function without causing an immediate turbine trip. The design satisfies the Single Failure Criterion, the SRP Chapter 10.2 Section II Acceptance Criteria, and GDC 4.

The normal speed control function utilizes the same speed sensors and speed monitors as the emergency overspeed trip function. Each active magnetic pickup sends a signal to each of the speed monitors where the signals are converted to a speed value. The speed monitor then sends a signal separately to the normal speed control function and to the emergency trip function.

The emergency overspeed trip control is isolated from, and independent of, the normal speed control. Each speed monitor performs a setpoint comparison of the sensor input and then performs a two out of three vote to determine the trip channel status. The speed monitor then outputs a trip channel status to the trip controllers. The trip controllers then perform a final two out of three vote to implement the turbine trip.

The normal turbine speed control function (electro-hydraulic control system) is implemented using three speed control channels. The speed control channels use triple redundant controllers. The control signals from each function (emergency overspeed trip and normal speed control) are isolated from, and independent of each other.

Each of the three separate channels (speed sensors, speed monitors, and trip controllers) are powered by separate power sources. A loss of power to a single speed sensor, speed monitor, or trip controller associated with one channel would result in a trip of the associated channel in the emergency trip function, leaving the remaining two trip channels to respond to an overspeed condition in a one out of two configuration. Power loss to a single speed sensor, and speed monitor would also result in a loss of the signal to one of the normal speed controllers; however, normal speed control uses triplicated controllers that use mid-value gate logic to process the signals and would not be impacted by the loss of one signal. Upon power loss to two or more channels in the normal speed control or the emergency overspeed trip, the turbine will trip.

A failure (other than loss of power) of a single speed sensor or speed monitor will only impact one of the three input signals. The remaining speed signals and speed monitors would continue to function normally. The use of triplicated trip controllers allows for a single speed sensor or speed monitor failure by utilizing two-out-of-three logic in the trip controllers. Single speed sensor or speed monitor failure could also result in an erroneous signal to one of the normal speed controllers; however, normal speed control uses triplicated controllers that use mid-value gate logic to process the signals and would not be impacted by a single erroneous signal. Upon failure of two or more channels in the normal speed control or the emergency overspeed trip, the turbine will trip.

The speed sensors and speed monitors are the only shared components between the normal speed control function and the emergency trip function. A loss of one power source will only cause the loss of one of three signals in each function maintaining functionality for both the emergency overspeed trip and the normal speed control functions. A loss of two or more speed signals, normal speed controllers or trip controllers will cause a turbine trip. Additionally, if the redundant AC power sources are lost, the fail safe design of the trip pilot valves will cause them to de-energize and trip the turbine.

In COLA Part 2, Tier 2 Subsection 10.2.2.4, will be revised as indicated in the markup included with the response to RAI 10.02-5. Changes are indicated by gray shading:

7. The postulated failure of a STP Unit 1 or 2 turbine resulting in missiles representing an external hazard to the safe operation of STP Units 3 and 4 has been addressed in STP response to RAI 03.05.01.05-1 (U7-C-STP-NRC-090096, Attachment 7), submitted on August 6, 2009

   In that response it was demonstrated that the resulting probability of damage for safety related systems at Units 3 and 4 from a turbine failure at Units 1 and 2 is less than 10^{-7} per year per plant, which meets the acceptance criterion of SRP 3.5.1.3 for damage probability.

The RAI response concluded that, "Therefore, the statement in the reference ABWR DCD Tier 2 Subsection 3.5.1.5, Site Proximity Missiles Except Aircraft, 'External missiles other than those generated by tornados are not considered as a design basis (i.e. $< 10^{-7}$ per year),' is valid for a turbine missile from either Unit 1 or Unit 2 impacting Unit 3 and Unit 4." It was noted that no change to the FSAR was required as a result of that RAI.

The potential hazard that Unit 3 and Unit 4 pose to Unit 1 and Unit 2 can be evaluated by examination. On November 14, 2002, STPNOC submitted a Proposed License Amendment to Eliminate the Turbine Missile Design Basis (ref NOC-AE- 02001335). In section 3 the following was noted:

> "The results of the turbine missile analysis have demonstrated that the probability of damage to safety-related components is less than 10^{-7} per year, which satisfies regulatory requirements. This probability is maintained below this value by maintaining the probability of turbine missile generation below 10^{-4} per year, which is accomplished by the South Texas Turbine System Maintenance Program described in section 3.5.1.3.4."

Results from Toshiba technical report UTLR-008-P Rev.1 for the Unit 3 and Unit 4 fully integral turbine rotor indicate that the probability of rotor burst at 120% overspeed with a 28-year inspection interval is less than 10^{-5} per year. That is less than the acceptance criteria for Unit 1 and Unit 2, which resulted in an overall probability of damage to safety-related components of less than 10^{-7} per year for those units. This satisfies the regulatory requirements.

No additional COLA change is required as a result of this response.

8. Section 10.2.2.4 is revised to replace the word "diversities" with "redundancies", and to add the non-return valves and the air relay dump valve to the list of items. In addition, a sentence is added to the end of Section 10.2.2.4 to describe the use of the non-return valve.

The changes to COLA Part 2, Tier 2 Subsection 10.2.2.4 described above will be as indicated in the markup included at the end of the response to RAI 10.02-5. Changes are indicated by gray shading:

9.
   a) The extraction non-return valves will also be closed on actuation of the Emergency Trip Device (ETD). This will be added to COLA Part 2, Tier 2, Subsection 10.2.2.5.

   b) In subsection 10.2.2.5, the description of the manual turbine trip device located in the control room (item 1) is revised to "Manual trip switch in the control room".

      The manual turbine trip switch located in the main control room can be used by the operator to initiate a turbine trip. It is hardwired and will directly cut off power to the trip solenoid valves independently of the normal turbine control system.

Likewise, item 9, emergency trip at front standard, is clarified as "Manual trip switch near the front standard." This replaces the word "manual", which is in the DCD and was removed in the early COLA markup.

The manual switch located near the front standard can be used to interrupt power to both turbine trip solenoids which will result in a turbine trip. The local switch can be used to support testing during a plant maintenance outage.

Both switches are operated separately from software/firmware, and the normal speed control system.

c) Subsection 10.2.2.5, Item 15 is revised to state that one of the signals that causes the ETS to close the referenced valves in order to shut down the turbine is the, "Loss of two of the three speed signals that are shared by the normal speed control and emergency overspeed trip functions."

As a result of this RAI response, COLA Part 2, Tier 2 Subsection 10.2.2.5 will be revised. Changes from COLA Rev. 4 are indicated with grey shading as follows:

10.2.2.5 Turbine Protection System

STP DEP 10.2-3

In addition to the overspeed trip signals discussed, the ETS closes the main stop valves and control valves, ~~and~~ *the* ~~CIVs~~ intermediate stop valves and intercept valves, and the extraction non-return valves *to shut down the turbine on the following signals.*

(1) Manual ~~*Emergency*~~ *trip* ~~*pushbutton*~~switch *in* the *control room*
(2) *Moisture Separator high level*
(3) *High condenser pressure*
(4) *Low lube oil pressure*
(5) *LP turbine exhaust hood high temperature*
(6) *High reactor water level*
(7) *Thrust bearing wear*
(8) ~~*Overspeed (electrical and mechanical)*~~ Not Used
(9) *Manual* ~~Emergency~~ *trip* ~~*handle on*~~ switch ~~at~~ near the *front standard*
(10) *Loss of stator coolant*
(11) *Low hydraulic fluid pressure*
(12) ~~*Any*~~ Selected *generator trip*
(13) *Loss of EHC electrical power*
(14) *Excessive turbine shaft vibration*

(15) *Loss of two* of the three *speed signals* that are shared by the normal speed control and emergency overspeed trip functions~~, either Normal Speed Control or Emergency Overspeed Trip~~

(16) *Loss of two pressure control channels*

All of the above trip signals except generator trips, loss of power, and *vibration and manual trips use* ~~*2/3 or 2/4*~~ two-out-of-three *coincident trip logic.*

When the ETS is activated, it overrides all operating signals and trips the main stop valves, ~~*and*~~ *control valves,* ~~*and combined*~~ *intermediate* stop valves, and intercept ~~*by way of their disk/dump*~~ *valves.* The extraction non-return valves also close by venting air through the relay dump valve.

The manual trip switches in the control room and near the front standard are directly hardwired to interrupt power to the ~~trip solenoid valves~~trip pilot valve solenoids, resulting in dumping of the ETS fluid and a turbine trip.

10.

a) The manual turbine trip device in the main control room is normally tested during a plant shutdown sequence where a manual turbine trip is initiated at sufficiently low power level, or during refueling outages prior to turbine startup or if maintenance work could have introduced a potential for loss of functionality. The manual turbine trip at the front standard can be tested during an outage. Because Subsection 10.2.2.7 lists the devices that can be tested while the unit is operating, these manual turbine trip devices are not listed in this section.

b) Subsection 10.2.2.7 Item (5) includes the turbine extraction non-return valves. Operability testing of non-return valves can be performed using test solenoid valves that vent operator air supply and by monitoring motion of the valve. Stroke time testing can only be performed at shutdown.

c), d), and e):

SRP 3.5.1.3 provides specific acceptance criteria to meet the relevant requirements of the NRC's regulations contained in Section II. In Item 5 it is stated that, "Applicants are expected to commit to the referenced program if turbines are obtained from manufacturers that have NOT SUBMITTED (emphasis added), or received NRC approval for, reports describing their methods and procedures for calculating turbine missile generation probabilities:" To demonstrate compliance with that criteria and consideration of operating experience obtained from the Japanese ABWR plants, the following two Toshiba technical reports were submitted with letter U7-C-STP-NRC-100231, Attachments 5 through 9 dated October 15, 2010 (ML102930097):

10.2-4 J. Tominaga, "Analysis of the Probability of the Generation of Missiles from

Fully Integral Nuclear Low Pressure Turbines," Toshiba Technical Report UTLR-0008-P, Revision 1, September 2010.

10.2-5 K. Jibiki, "Probabilistic Evaluation of Turbine Valve Test Frequency," Toshiba Technical Report UTLR-0009-P, Revision 1, September 2010.

The above two reports will be added as References 4 and 5 in Section 10.2.6. The existing Reference 4 in 10.2.6 referring to NUREG-1048 will be deleted.

The maintenance and inspection program plan for the turbine assembly and valves is based on turbine missile probability calculations, operating experience of similar equipment, and inspection results. The methodology for analysis of the probability of generation of missiles for fully integral rotors is submitted in UTLR-0008-P (reference 10.2-4). The methodology used for analysis of the missile generation probability calculations was used to determine turbine valve test frequency as described in UTLR-0009-P (reference 10.2-5).

This information and the FMEA. which is discussed in response to RAI 10.02-7. will be used as the basis for the manufacturer's inservice inspection and testing program. This program will include the program requirements contained in COLA Subsection 10.2.3.6 (COL License Information Item 10.3) and incorporate changes due to RAI 10.02-7 question 3 and RAI 10.02-8 question 11 responses.

No additional changes to COLA Subsection 10.2.3.6 are required as a result of the above response.

As a result of this RAI response, COLA Part 2, Tier 2, Subsection 10.2.6 will be revised. Changes from COLA Rev. 4 are indicated with grey shading as follows:

10.2.6 References

The following supplement adds the following references.

10.2-3 Electric Power Research Institute, "Guidelines for Permanent BWR Hydrogen Water Chemistry Installations – 1987," EPRI NP-5283-SR-A, September 1987.

~~10.2-4 USNRC, "Safety Evaluation Report Relating to the Operation of Hope Creek Generating Station", NUREG-1048, Supplement No. 6, July 1986~~

10.2-4 J. Tominaga, "Analysis of the Probability of the Generation of Missiles from Fully Integral Nuclear Low Pressure Turbines," Toshiba Technical Report UTLR-0008-P, Revision 1, September 2010.

10.2-5 K. Jibiki, "Probabilistic Evaluation of Turbine Valve Test Frequency," Toshiba

Technical Report UTLR-0009-P, Revision 1, September 2010.

11.

a) STP DEP 10.2-1 revised the description of the Combined Intermediate Valves (CIV) to discuss that each CIV consists of two valves, an intermediate stop valve. and an intercept valve, each with its own actuator but with two valve disks contained in a common valve body. The description in Subsection 10.2.3.6 will be revised to correct this editorial error.

As a result of this RAI response, COLA Part 2, Tier 2, Subsection 10.2.3.6 item (1) will be revised. Changes from COLA Rev. 4 are indicated with grey shading as follows:

> *(1) All main stop valves, control valves, extraction nonreturn valves,* intermediate stop valves~~,~~ and intercept valves ~~*and CIVs will be*~~ are *tested under load. Test controls installed* ~~*on*~~ in *the main control room* ~~*turbine panel*~~ *permit full stroking of the stop valves, control valves, and* ~~*CIVs*~~ intermediate stop valves and intercept valves. *Valve position indication is provided* ~~*on the panel*~~ in the main control room. *Some load reduction* ~~*is*~~ may be *necessary before testing main stop* valves, ~~*and*~~ *control valves,* intermediate stop valves *and* intercept valves ~~*CIVs*~~. *Extraction nonreturn valves are tested by equalizing air pressure across the air cylinder. Movement of the valve arm is observed* ~~*upon action of the spring closure mechanism.*~~ by the main control room valve position indication.

b) COLA Subsection 10.2.3.6 describes in-service testing provisions for the main turbine. Valve closure times for the main stop valves, control valves, intermediate stop valves, and intercept valves are discussed in Subsection 10.2.2.2. STP DEP 10.2-1 will be revised to change the closure time for the main stop valves and control valves to be approximately 0.30 seconds. Valve closure time for the extraction non-return valves is also discussed in Subsection 10.2.2.2.

A summary is provided below:

Turbine-Generator Valve Closure Times

Valve	Closing Time (seconds)	Reference Section
Main Stop Valves (MSV)	approximately 0.3	10.2.2.2
Control Valves (CV)	approximately 0.3	10.2.2.2
Intermediate Stop Valves (ISV)	approximately 0.2	10.2.2.2
Intercept Valves (IV)	approximately 0.2	10.2.2.2
Extraction Non-Return Valves	within 2.0	10.2.2.2

Details of how the extraction non-return valves are tested and maintained over time will be added to COLA Part 2, Tier 2, Subsection 10.2.3.6, Item (2).

c) Inspection of the non-return valves is included in revised Section 10.2.3.6.

d) The extraction steam non-return valves will be included in the Inservice Inspection in Subsection 10.2.3.6.

STP DEP 10.2-1 will be revised to change the main stop and control valve closure times in ABWR DCD Subsection 10.2.2.2. Changes are indicated with grey shading as follows:

Main Stop and Control Valves—
Four high-pressure main stop and control valves admit steam to the high-pressure (HP) turbine. The primary function of the main stop valves is to quickly shut off the steam flow to the turbine under emergency conditions. The primary function of the control valves is to control steam flow to the turbine in response to the turbine control system.

The main stop valves are operated in an open-closed mode either by the emergency trip, fast acting valve for tripping, or by a small solenoid valve for testing. The disks are totally unbalanced and cannot open against full differential pressure. A bypass is provided to pressurize the below seat areas of the four valves. Springs are designed to close the main stop valve in approximately ~~0.20~~ 0.30 second under the emergency conditions listed in Subsection 10.2.2.5.

Each stop valve contains a permanent steam strainer to prevent foreign matter from entering the control valves and turbine.

The control valves are designed to ensure tight shutoff. The valves are of sufficient size, relative to their cracking pressure, to require a partial balancing. Each control valve is operated by a single acting, spring-closed servomotor opened by a high pressure fire-resistant fluid supplied through a servo valve. The control valve is designed to close in *approximately* ~~0.20~~ 0.30 *second.*

As a result of this response and the response to RAI 10.02-7 question 3, the inservice inspection detailed in COLA Part 2, Tier 2, Subsection 10.2.3.6 Item (2) will be revised to include these inspections and make other editorial corrections. Changes from COLA Rev. 4 are indicated with grey shading as follows:

(2) *Main stop valves, control valves, extraction nonreturn valves,* ~~*and CIVs*~~ intermediate stop valves, and intercept valves ~~*will be*~~ are *tested* *by the COL applicant* ~~*in accordance with the BWROG turbine surveillance test program,*~~ as required by the turbine missile probability analysis *by closing each valve and observing by the* main control room *valve position* ~~*indicator*~~ indication *that* ~~*it*~~ the valves *move*~~*s*~~ *smoothly to a fully closed position. Closure of each main stop valve, control valve*, ~~*and CIV*~~ intermediate stop valve and intercept valve *during test* ~~*will be*~~ is *verified by* ~~*direct*~~ *observation of the* main control room *valve* ~~*motion*~~ position indication. This test also verifies the fast closure function during the last portion of the valve travel.

Tightness tests of the main stop and control valves are performed at least once per maintenance cycle by checking the coastdown characteristics of the turbine from no load with each set of four valves closed alternately, or using warm-up steam as an indicator with the valves closed.

Extraction nonreturn valves are tested at power, using the air supply test solenoid valves, to verify operability.

During each refueling outage, the main stop valves, control valves, intermediate stop valves, intercept valves, and nonreturn valves are tested to verify their closure times are less than the times provided in FSAR Section 10.2.2.2.

The turbine overspeed protection trip devices are tested quarterly, to verify operability of these devices. The time out of service for either the primary or emergency overspeed protection system for maintenance will be specified in the appropriate maintenance procedure.

The first paragraph in the discussion after Item (3) of COLA Part 2, Tier 2, Subsection 10.2.3.6 will be revised to include the non-return valves and make other editorial corrections. Changes from COLA Rev. 4 are indicated with grey shading as follows:

(3) *All main stop valves,* ~~*main*~~ *control valves,* ~~*and CIVs,*~~ intermediate stop valves, ~~and~~ intercept valves, and extraction nonreturn valves are disassembled and visually ~~*will be*~~ *inspected once during the first three refueling or extended maintenance shutdowns. Subsequent inspections* ~~*will be*~~ are *scheduled* ~~*by the COL applicant*~~ *in* ~~*accordance with the recommendations of the BWROG turbine surveillance test program*~~ as required by the turbine missile probability analysis. *The inspections will*

be conducted for:

The last paragraph of COLA Part 2, Tier 2, Subsection 10.2.3.6 will be revised to include the non-return valves. Changes from COLA Rev. 4 are indicated with grey shading as follows:

> *Inspection of all valves of one* functional *type* (i.e., stop, control, intercept, nonreturn) are ~~*will be*~~ *conducted* ~~*if any unusual condition is discovered*~~ for any detrimental, unusual condition (as defined by the turbine valve in-service inspection program) if one is discovered during the inspection of any single valve.

12.

a) Section 10.2.4 will be revised to more accurately describe the turbine missile evaluation. Refer to RAI 03.05.01.05-1 response for separate discussion of site proximity missiles.

COLA Part 2, Tier 2, Subsection 10.2.4 will be revised accordingly. Changes from COLA Rev. 4 are indicated with grey shading as follows:

> The probability of a turbine missile adversely impacting SSCs important to safety will be maintained ~~striking any component has been determined to be~~ less than 1x10^{-7} per year as discussed in ~~(~~Subsection 3.5.1.1.1.3~~)~~, which meets the guidelines of Regulatory Guide 1.115 for not considering turbine missile damage to specific components. Refer to Subsection 3.5.1.1.1.3 for a discussion of compliance with Standard Review Plan 3.5.1.3 and the guidelines of Regulatory Guide 1.115. Thus failure of a turbine generator should not ~~T-G and associated equipment cannot~~ preclude the safe shutdown of the reactor.

b) COLA Subsection 10.2.2.1 General Description provides a description of the safety-related equipment located in the turbine building and its purpose. STD DEP Admin and STD DEP T1 2.4-2 (Feedwater Line Break Mitigation) were incorporated to amend COLA subsection 10.2.2.1 to state, in part:

> "The safety-related instruments located within the Turbine Building are the safety-related Reactor Protection System (RPS) sensors on the T-G unit used to detect fast closure of the turbine control valves and closure of the main stop valves and the Leak Detection and Isolation System (LDS) sensors used to detect high main condenser shell pressure, low main steam header pressure and main steam line leakage. The safety-related instrumentation is fail safe, hence any local failure associated with the T-G equipment cannot preclude safe shutdown of the reactor."
>
> "The Turbine Building contains the safety-related electrical switchgear and trip breakers for the condensate pumps for the mitigation of a postulated feedwater line break in accordance with Subsection 8.3.1.1.1."

The connection between the low pressure turbine exhaust hood and the condenser is made by means of a stainless steel expansion joint. Because there are no essential systems or components located in the condenser expansion joint area, and the condenser is at sub-atmospheric pressure during all modes of turbine operation, failure of the joint has no adverse effects on safety-related equipment

ABWR DCD Subsection 10.2.4 paragraph 11 will be revised and reference STD DEP T1 2.4-2 accordingly. Changes from COLA Rev. 4 are indicated with grey shading as follows:

10.2.4 Evaluation

STD DEP T1 2.4-2

The connection between the low-pressure turbine exhaust hood and the condenser is made by means of a stainless steel expansion joint.

Since there ~~*is*~~are *no* ~~*nuclear safety related mechanical equipment in the turbine*~~essential systems or components located in the condenser expansion joint *area and since the condenser is at subatmospheric pressure during all modes of turbine operation, failure of the joint will have no adverse effects on nuclear safety related equipment.*