PMSTPCOL PEmails

From: Tai, Tom
Sent: Thursday, July 08, 2010 12:02 PM
To: Price, John E
Cc: STPCOL; Chappell, Coley; Mookhoek, William; Joseph, Stacy
Subject: STP - Draft RAI 4860 (10.02)
Attachments: RAI 4860 10.02-xx.doc

John,

Attached for your information is a draft of RAI 4860 issued for Chapter 10.2. Please let Stacy know if you need a clarification phone call by Wednesday (July 14).

Since I'll be away from 7/9 to 7/16, please contact Stacy Joseph if you need help.

Regards

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Request for Additional Information No. 4860 Revision 3

South Texas Project Units 3 and 4
South Texas Project Nuclear Operating Co
Docket No. 52-012 and 52-013
SRP Section: 10.02 - Turbine Generator
Application Section: 10.2

QUESTIONS for Balance of Plant Branch 2 (ESBWR/ABWR) (SBPB)

10.02-***

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) 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) 4) 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 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) 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) 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.

10.02-***

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) 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) 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) 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) 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.

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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.

   a. The use of certain materials that are not subject to corrosion, conditioning equipment, desiccants, filters and design standards are examples of design considerations that may be pertinent for addressing common mode and common cause failures.

   b. Implementation of periodic surveillance and inspections (including diagnostic routines that assess the status of turbine generator control and overspeed protection functions), maintenance, testing, and corrective actions are examples of programmatic controls that may be applicable for assuring that common mode and common cause failures are prevented from occurring. For example, measures that assure the reliable performance of components and the quality of hydraulic and air systems are pertinent in this regard.

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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** inlet**s**."

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 power-load 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.