PMSTPCOL PEmails

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Sent: Tuesday, November 12, 2013 12:08 PM
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Cc: STPCOL
Subject: Draft Supplemental RAI Concerning Bulletin 2012-01 (Public)
Attachments: Draft RAI_7287.pdf

Attached is the draft courtesy copy of the Supplemental RAI concerning Bulletin 2012-01. Please let me know, within 3 days, if a clarification conference call is needed.

Thanks you.

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Request for Additional Information

Issue Date:
Application Title: South Texas Project Units 3 and 4 - Dockets 52-012 and 52-013
Operating Company: South Texas Project Nuclear Operating Co
Docket No. 52-012 and 52-013
Review Section: 08.02 - Offsite Power System
Application Section: 08.02

QUESTIONS

In the revised response to Request for Additional Information 08.02-25 dated September 4, 2013, (Agencywide Documents Access and Management System (ADAMS) Accession No. ML13256A154), Nuclear Innovation North America, LLC (NINA), the applicant, discussed its response to NRC issued Bulletin 2012-01, "Design Vulnerability in Electric Power System," (ADAMS Accession No. ML12074A115) on the electric power system design, and recent operating experience that involved the loss of one of the three phases of the offsite power circuit (single-phase open circuit condition) at Byron Station.

1) The applicant states that in the scenario where a single-phase open circuit event on the grid side of the Main Transformer (MT), the feed from the MT and each of the associated UATs does not affect the safety-related or non-safety related loads since:

   - The wye-delta configuration of the MT regenerates the lost phase (open-circuited phase), and
   - The MT can carry the increased load on the remaining two phases because the MVA capacity of the MT is large relative to the combined safety-related and non-safety related loads on the UATs.

   Based on the statements above, address the following:

   a. Unbalanced operation is among the potential hazards to motor loads that result from abnormal conditions such as a system-induced loss of phase. The current produces flux in the motor air-gap rotating in the opposite direction to the actual motor direction which is essentially a double-frequency current in the rotor. The skin effect results in higher resistance which compounds with the already increased total current (resulting from both the positive- and negative-sequence current components) creating a heating effect. In the case of a loss of phase where the lost phase is induced in the secondary side of the transformer, increasing currents will be observed on the secondary upstream of the loads:

      i. Provide an analysis that shows that none of the safety-related or non-safety related loads will exceed their current ratings that would cause physical damage to motor windings, and other inductive elements.
      ii. Clarify how the phase angle change, as well as the presence of negative sequence currents, will be detected to preclude damage on inductive loads.
      iii. Provide your evaluation and analysis to show that sensitive instrumentation and control and protection circuits that are dependent on ac power quality are not adversely impacted by an unbalanced power system.
      iv. Provide supporting documentation from equipment vendors validating the capability of their equipment to function with current and voltage variations addressed in the above questions.

2) If the secondary side of the MT is regenerating the lost phase, there will be no change in voltage magnitude that would actuate the degraded voltage relays. However, there will be a change in the phase angle and the current on the secondary side of the transformer.

   a. Provide a means of detecting a loss of phase given the assumptions stated above since the degraded voltage relays will be incapable of detecting the loss of phase as a function of phase angle.
   b. Provide an ITAAC that demonstrates by testing that the selected means of protection will actuate and withstand the higher currents during the loss of phase condition.
   c. Provide a Technical Specifications (TS) Surveillance Requirements (SRs) that will provide assurance that the protective measures for a loss of phase condition are reliable and functional and able to preclude damage to safety related equipment.
   d. Provide details on any tests that will be performed on the plant electrical system to validate the analytical results for a loss of phase on high voltage side of transformers and successful operation of worst case plant loading for an extended duration without adverse effects.

3) If no plant design changes are planned to automatically detect and isolate the open phase condition (degraded offsite power sources) and transfer the important to safety buses to alternate power source(s), provide the applicant and/or the grid operator's evaluation to show that availability and reliability of offsite power system (capacity and capability) is

maintained in accordance with transmission system protocols and in accordance with 10 CFR 50 Appendix A, GDC 17 requirements.

4) The applicant states the following in the RAI response:

> This response provides the results of analyses of the design that is provided in COLA revision 9, and does not propose or rely upon any design features that are not included in COLA revision 9. The protection scheme for the onsite power system is described primarily in DCD Section 8.3, and is not changed significantly by the limited departures related to electric power system…
>
> Loss of a single phase on a Class 1E bus is specifically addressed in the certified ABWR design. As a result of loss of a single phase, the undervoltage protective circuitry will separate the Class 1E Safety buses from a connected failed offsite source due to loss of voltage or sustained degraded grid voltage with or without concurrent design basis accidents…
>
> Based on the above, the loss of voltage and degraded voltage relay schemes on each of the Class 1E Safety buses detect and respond to the postulated loss of phase scenarios on a Class 1E Safety bus that could prevent the Class 1E bus from performing its required safety function. The loss of voltage and degraded voltage functions start the EDGs, disconnect the affected Class 1E bus from the degraded offsite source and connect the EDG to the affected Class 1E bus…
>
> For a single-phase open circuit event on the grid side of the MT, the feed from the MT and each of the associated UATs does not affect the safety-related or non-safety related loads since the wye-delta configuration of the MT regenerates the lost phase (open-circuited phase). Also, the MT can carry the increased load on the remaining two phases because the MVA capacity of the MT is large relative to the combined safety-related and non-safety related loads on the UATs…
>
> For a single-phase open circuit event on the grid side of a RAT, the feeds from the RATs are affected because of the wye-wye configuration of the RATs…The loss of a single phase on the high side of the transformer will drop voltage low enough for the degraded undervoltage relays to detect and trip the feed…
>
> If a ground fault were located on the high side of the UATs or RATs, the ground fault would be expected to either burn off and clear or rapidly propagate to a ground fault that would actuate the protective relaying and disconnect the transformer from offsite power. This would result in a Loss of Preferred Power (LOPP) for the affected Class 1E Safety bus(es) which would then automatically realign to the EDG(s)…
>
> Licensing Strategy : As described in this response, NINA has demonstrated that loss of a single phase in an offsite circuit either has no effect on STP 3 & 4 Class 1E electrical bus safety functions or will be detected by existing Technical Specification undervoltage and/or degraded voltage functions which will disconnect the affected offsite circuit and power affected Class 1E buses from an EDG. This conclusion will be confirmed for the 'as-built' plant by the ITAAC proposed below… To ensure that the 'as-built' design of the STP 3 & 4 Electrical Power Distributions (EPD) System is appropriately protected for a lost phase, with or without a ground fault, on credited offsite power circuits supplying the MT and RATs, NINA will revise COLA, Part 9, Section 3.0, Site-Specific ITAAC

Based on the above statements the staff notes the following:

a. The design features described in COLA revision 9, DCD Section 8.3, is for addressing loss of voltage and degraded voltage conditions for a balanced 3-phase offsite power system.

b. The certified ABWR design mentioned in the above documents is referring to a loss of a single phase at the 4.16 kV bus level and not the loss of a single phase condition with and without a high impedance ground condition, on the high voltage side of a transformer connecting a credited GDC-17 offsite power circuit to the transmission system.

c. A single-phase open phase event on the grid side of a RAT cannot be detected for all operating configurations and design basis loading conditions by the existing degraded voltage protection scheme because the voltage response is dependent on transformer loading conditions. Refer to the various Bulletin responses provided to the NRC by the operating fleets.

d. As stated earlier, the existing scheme (loss of voltage instrumentation) does not automatically detect the open phase condition (Unbalanced AC power system condition) and therefore cannot take protective actions to enable proper functioning of important-to-safety structures, systems and components. The design vulnerability needs to be addressed to meet the ABWR certified design requirements specified in 10 CFR Part 52, Appendix A.

Therefore, the applicant is requested to provide sufficient analyses in the final safety analysis report (Sections 8.2 and 8.3 of Chapter 8) and ITAAC information (COLA, Part 9, Section 3.0, Site-Specific ITAAC) offsite power system) in accordance with § 52.79, "Contents of applications; technical information," and § 52.80, "Contents of applications; additional technical information," and 10 CFR 50.55a(h)(3) for the staff to determine whether the NINA COLA meets the requirements of 10 CFR Part 50, Appendix A, GDC 17 "Electric power systems," regarding the offsite power circuit and

onsite electrical power distribution system to provide adequate capacity and capability in view of the design vulnerability identified in NRC Bulletin 2012-01, “Design Vulnerability in Electric Power System.” The information should include, as a minimum, design and analyses and ITAAC information to automatically detect and take protective actions for a single phase open phase condition with and without a high impedance ground condition, on the high voltage side of a transformer connecting credited GDC-17 offsite power circuits to the transmission system (high voltage side MTs and RATs).

5) In the RAI revised response the applicant states that it will evaluate Nuclear Strategic Issues Advisory Committee (NSIAC) initiatives to ensure that STP 3 & 4 design and procedures remain consistent with industry accepted practices. The staff requests the applicant to provide a license condition to reflect this statement and also the proposed changes to the plant TS in terms of limiting conditions of operation and SRs.

6) Based on the Forsmark Operating Experience, address Questions 1 thru 5 for a loss of two phases condition with and without a high impedance ground condition on the high voltage side of a transformer connecting a credited GDC 17 offsite power circuits to the transmission high voltage side MTs and RATs.