Westinghouse

Westinghouse Electric Company
Nuclear Power Plants
P.O. Box 355
Pittsburgh, Pennsylvania 15230-0355
USA

U.S. Nuclear Regulatory Commission
ATTENTION: Document Control Desk
Washington, D.C. 20555

Direct tel: 412-374-6206
Direct fax: 724-940-8505
e-mail: sisk1rb@westinghouse.com

Your ref: Docket No. 52-006
Our ref: DCP_NRC_002800

March 2, 2010

Subject: AP1000 Response to Proposed Open Item (Chapter 7)

Westinghouse is submitting the following responses to the NRC open item (OI) on Chapter 7. These proposed open item response are submitted in support of the AP1000 Design Certification Amendment Application (Docket No. 52-006). The information included in these responses is generic and is expected to apply to all COL applications referencing the AP1000 Design Certification and the AP1000 Design Certification Amendment Application.

Enclosure 1 provides the response for the following proposed Open Item(s):

OI-SRP7.2-ICE-03

Questions or requests for additional information related to the content and preparation of this response should be directed to Westinghouse. Please send copies of such questions or requests to the prospective applicants for combined licenses referencing the AP1000 Design Certification. A representative for each applicant is included on the cc: list of this letter.

Very truly yours,

Robert Sisk, Manager
Licensing and Customer Interface
Regulatory Affairs and Standardization

/Enclosure

1. Response to Proposed Open Item (Chapter 7)

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cc:	D. Jaffe	-	U.S. NRC	1E
	E. McKenna	-	U.S. NRC	1E
	S. Mitra	-	U.S. NRC	1E
	T. Spink	-	TVA	1E
	P. Hastings	-	Duke Power	1E
	R. Kitchen	-	Progress Energy	1E
	A. Monroe	-	SCANA	1E
	P. Jacobs	-	Florida Power & Light	1E
	C. Pierce	-	Southern Company	1E
	E. Schmiech	-	Westinghouse	1E
	G. Zinke	-	NuStart/Entergy	1E
	R. Grumbir	-	NuStart	1E
	B. Seelman	-	Westinghouse	1E

ENCLOSURE 1

AP1000 Response to Proposed Open Item (Chapter 7)

AP1000 TECHNICAL REPORT REVIEW

Response to SER Open Item (OI)

RAI Response Number: OI-SRP7.2-ICE-03
Revision: 0

Question (RAI-SRP7.2-ICE-05):

In Section 2.2.5 of WCAP 16675-P (Page 2-18) states, *"[To reduce wear on the breakers through excessive tripping, and to avoid a potential plant trip resulting from a single failure while testing is in progress, the test sequence is designed so that the actual opening of the trip breakers is only required when the trip breaker itself is being tested.]"* Explain exactly how this activity is being accomplished. Include in the explanation exactly when during testing and other maintenance activities the Reactor Trip Circuit Breakers will actually be opened and at what periodicity.

Revised Westinghouse Response (RAI-SRP7.2-ICE-05):

The surveillance requirement 3.3.1.5 requires the performance of Trip Actuating Device operational Test (TADOT) on both reactor trip breakers associated with a single division. The required frequency is 92 days on a staggered test basis, which means with 8 breakers they all get tested once a year. The arrangement of the breakers is such (see page 2-2 WCAP 16675-P) that one division can be tripped without removing power to the Control Rods.

Referring to the PMS Architecture TR, Figure 5.7-1, the MTP contains two pushbuttons. One pushbutton is labeled "UV TEST" and the other pushbutton is labeled "SHUNT TEST". Both pushbuttons are hardwired to the circuits directly controlling power to the RTCB UV and ST coils, respectively. Depressing the "UV TEST" pushbutton interrupts power supplied to both RTCB UV coils associated with that division, causing then to de-energize. De-energizing the RTCB UV coils results in the opening of both RTCBs associated with that division. Depressing the "SHUNT TEST" pushbutton interrupts power supplied to the interposing relay "XIR". De-energizing interposing relay XIR causes its contacts to close, which results in power being supplied to both of the RTCB shunt trip coils associated with that division. Energizing the RTCB shunt trip coils results in the opening of both RTCBs.

The PMS Architecture TR, Sections 6.2.3 and 6.2.4 describe how manual testing of the RTCB coincidence logic can be accomplished in the PMS.

Since the "UV TEST" and "SHUNT TEST" pushbuttons mounted on the MTP only control the breakers associated with that division, only the RTCB associated with that division are tested with the pushbuttons. Due to the fact that the RTCBs are arranged in a true two-out-of-four configuration, opening the RTCBs associated with only one division will not interrupt power to the Control Rods.

Question: OI-SRP-7.2-03

7.2.2.3.7 Capability for Test and Calibration
WEC stated that each individual RTCB would be opened during a trip actuation device operational test once per year. However, WEC has not provided an analysis demonstrating how the annual periodicity of RTCB cycling is sufficient to demonstrate the functional reliability of the RTCBs when called upon to do so. In current licensed plants, the typical maximum length of time between openings of RTCBs (or equivalent) is 92 days. Since WEC has presented no analysis demonstrating the increased reliability of the RTCBs, the staff is unable to conclude that an annual test is acceptable. WEC should present the staff with an evaluation demonstrating why the RTCBs only need to be cycled once per year and should incorporate the RAI response to RAI-SRP7.2-ICE-05, which deals with the RCTB trip path, into the DCD or WCAP 16675-P. **The NRC staff identified this as OI-SRP-7.2-03.**

Westinghouse Response (OI-SRP-7.2-03):

Westinghouse believes this Open Item is primarily a Chapter 16 Tech Spec issue, not a PMS design, architecture, or testing issue. The PMS is designed such that the RTCBs can be tested anytime, as frequently as required, at power, even with a single failure in one other RTCB, without causing the rods to drop.

The AP1000 Tech Spec TADOT 92 day staggered testing is in the certified design and the basis for the change in periodicity from the conventional WEC plants is as follows:

Basis for RTCB TADOT SR 3.3.1.6 Surveillance Frequency

RTCB Reliability

The AP1000 RTCBs are considered to be equivalent to the RTCBs at current plants, such that the reliability of an individual breaker is equivalent.

The RTCBs are typically rated at 100,000 cycles (WNA-AR-00001-SSP). However, these circuits are characterized by very low frequency of use, generally only activated for the purpose of testing. If the RTCBs are exercised 10 times per year, only 600 cycles, or 0.6% of the expected life, would be accumulated over a 60 year period of operation. Therefore, wear should be insignificant.

The reliability of the AP1000 reactor trip function is improved compared to current plants by the redundancy and fault tolerance provided by the 8-breaker arrangement actuated by 4 Divisions.

Redundancy

Current Plants

Reactor Protection Systems at current plants have two Trains of RTCBs with one RTCB per Train (2 RTCBs, total). Actuation of one of the two Trains will trip the reactor.

In the current two Train RTCB design, safety function is maintained with the failure of one Train (one RTCB).

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The AP1000 PMS system has 4 Divisions, each with 2 RTCBs (8 RTCBs, total). Actuation of two out of the four Divisions will trip the reactor.

In the four Division AP1000 RTCB design, the safety function is maintained with the failure of two Divisions (four RTCBs).

Fault Tolerance

Current Plants

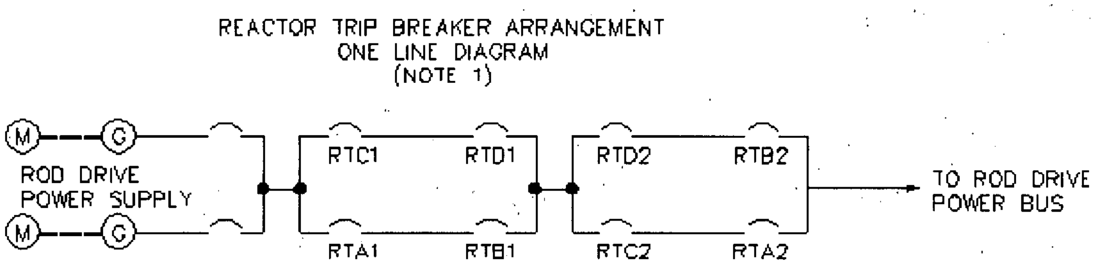
The safety function can be accomplished with the failure of one RTCB (one Division).

AP1000

The safety function can be accomplished with the failure of from 3 to 6 RTCBs in the AP1000 system, due to the additional redundancy. Failure of any three RTCBs will not defeat the safety function. The safety function can be achieved with the failure of up to six RTCBs provided the remaining operable RTCBs open the parallel circuit paths in the breaker array (e.g., RTA1 and RTC1 operable – see figure below).

Further, each RTCB can accomplish its safety function with either the shunt-trip (ST) mechanism or the under-voltage (UV) mechanism. Since the ST is an energize-to-actuate design and the UV is a de-energize-to-actuate design, the ST and UV mechanisms are diverse and not subject to CCF. For an RTCB to completely fail, the ST and UV mechanisms must both fail due to independent causes. In the AP1000 RTCB design, safety function can be maintained with more mechanism failures than in the current conventional plant design.

The increased failure tolerance of the AP1000 breaker array, allows at least double the number of failures which may occur concurrently without defeating the safety function as compared to the current plants.



(DCD Figure 7.2-1, APP-PMS-J1-102)

Reduced Spurious Trips

Current Plants

Spurious actuation of one Train will trip the reactor.

AP1000

Opening the breakers of one Division will neither cause the spurious reactor trip function, nor will it prevent the actuation of a reactor trip through the other divisions should this action be necessary.

Spurious actuation of two Divisions is necessary to trip the reactor, such as by a combination of loss of power, equipment failure, or technician errors.

Surveillance Frequency

The NUREG-1431 RTCB Surveillance Frequency (SR 3.3.1.4), 62 days on a Staggered Test Basis (STB), requires testing of one Train (RTCB) each 62 days, such that both Trains are tested every 124 days.

The AP1000 RTCB Surveillance Frequency (SR 3.3.1.6 (DCD Rev. 15), 92 days on a STB, requires testing of one Division each 92 days, such that all 4 Divisions are tested every 368 days. Testing on a Staggered Test Basis provides verification every three months that a CCF/CMF has not occurred, due to conditions such as an adverse environment or maintenance practices.

With this frequency, two Divisions are tested each 184 days, (similar to the 124 days for the current plants for both Trains). Operability of two Divisions is sufficient to achieve the safety function with the failure of up to two selected RTCBs within those divisions.

The surveillance frequency and failure tolerance of two Trains in the current plants and two AP1000 Divisions are comparable. Considering that the AP1000 has an additional two Divisions, the reliability of the AP1000 eight RTCB array is judged to be as good as or better than current plants when tested at a frequency of 92 days on a STB.

The reactor trip function reliability contribution from the RTCBs is significantly improved by the failure tolerance of the new 8 RTCB design and more than compensates for the Surveillance Frequency relaxation, based on engineering judgment.

Reference:

1. WCAP-16675-P (APP-GW-GLR-071, Technical Report 89), “AP1000 Protection and Safety Monitoring System Architecture Technical Report”, Revision 0, February 2007

Design Control Document (DCD) Revision: None

PRA Revision: None

Technical Report (TR) Revision: None