Project Number 694

January 28, 2005

WOG-05-37

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Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

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Subject: **Comments on Draft Report, Evaluation of Loss of Offsite Power Events at Nuclear Power Plants: 1986 – 2003**

Reference: NRC Letter, Charles E. Ader to G. Bischoff, "Request for Peer Review of Draft Report Entitled, "Evaluation of Loss of Offsite Power Events at Nuclear Power Plants: 1986 – 2003", dated December 6, 2004

Dear Mr. Ader:

The purpose of this letter is to provide comments on the subject report. The comments are provided in response to your request, Reference 1.

The Westinghouse Owners Group and Westinghouse appreciate the opportunity to provide comments on the report. The attached comments primarily focus on the LOOP characterizations contained in the report and the justification for placing LOOP events into five categories.

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If you have any questions, please contact Paul Hijeck at (860) 731-6240.

Sincerely,

Frederick P. "Ted" Schiffley, Chairman
Westinghouse Owners Group

FPS:PJH:las

Enclosure

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Comments on INEEL/EXT-04-02326: LOOP Events 1986-2003

The comments below address the LOOP characterizations made in INEEL/EXT-04-02326. In summary, the comments are; (1)there was only one grid-event on 14Aug2003 and there is no "cause and effect" in terms of grid reliability between the 14Aug2003 grid-event and the number of operating NPPs on that day, (2) depending on the NERC region, there is a seasonal variation in the number of grid-events, (3) there is insufficient justification for putting LOOP events into five groups and (4) the detailed statistical analysis described in Appendix C is difficult to reproduce as new events occur over time. The below sections describe the comments in more detail.

Characterizing the 14Aug2003 Grid-Event

The 14Aug2003 is routinely noted to have caused nine plant LOOPs and ten trips. It would be better to describe the 14Aug2003 event on a site level as that better characterizes the effect of the grid on the NPPs that day. One event caused five American sites to loose high-voltage power. Nine-Mile 2 kept an intermediate voltage supply available throughout the course of the day on 14Aug2003. One event caused 10 American plants to scram their reactors for various reasons. One can question whether the event becomes more or less significant as a result of 12 other CANDU plants also scramming on that day. If a plant were to count the number of events that caused a relevant LOOP, the 14Aug2003 event would count once for any given plant in the northeast. It would be absolutely incorrect to describe the LOOP frequency as 9/year at, for example, Indian Point 3 for 2003. The 14Aug2003 should be referred to as a single event. The frequency of this type of event has nothing to do with the number of NPPs on-line. Page xvi among others describes the 14Aug2003 grid-event as highly unusual in that it affected nine reactors. While this is true, there is an excessive repetition of the consequence of the grid-event – see pages xi, xvi, 1, 8, 19, 25, 47, 50 (twice), 57, and 61. There is no "cause and effect" in terms of grid reliability between the 14Aug2003 grid-event and the number of operating NPPs on that day. Several other events including Aug1996 in the west and Jul1989 in the vicinity of V.C. Summer were no less far reaching. In addition, two of the three major northeast grid events occurred well before deregulation – once in Jul1977 and once in Nov1965. Having many NPPs on-line during 14Aug2003 is an unrelated coincidence resulting from independent economic choices to build large central power plants using nuclear energy.

LOOP Propensity to Occur in the Summer

Defining "summer" to have five months skews the conclusion that LOOP events are predominantly in the summer. Plants from Kewanee to Pilgrim are at a latitude that would challenge the assumption that May is part of the "summer season." A more conventional view of "summer" in the various regional grids shows that some of them have more than an expected number of grid-events and LOOPs. However, it is unfair to characterize all regional grids to have the same summertime propensity to cause a LOOP. The definition of summer affects the values that appear on Table 6-1 (see page 46).

LOOP Categories

The custom at many NPPs is to categorize LOOPs into three groups: plant-centered, weather-related, and grid-centered. Other plants, such as Palo Verde, include the switchyard explicitly in the PRA model. Thus, some plants represent the effect of the off-site AC supply with a single LOOP frequency number. The draft-NUREG does not present a compelling statistical argument for sub-dividing plant-centered and weather-related events. Having five categories adds to the already existing problem of having little empirical data for any particular category of LOOP event. The current draft of the NUREG will inappropriately force PRA staffs around the country into a recurring job to explain and defend the use of the three groups (or single LOOP frequency) rather than the five selected by the NRC contractor. Although it may be statistically interesting, it is not particularly useful to the PRA community to sum all LOOP frequencies associated with (1) power operation and (2) LPSD (see Section 3.1 and Section 3.4 of the draft NUREG). Each initiator in a model is married to a particular event tree. It is customary in LOOP models to run post-processing recovery rules to correctly represent the probability of extended

LOOP durations. The event tree needed to represent the mitigation of a LOOP transient starting from full-power conditions is wholly different from an event tree that handles the LPSD condition. Combining all LOOP frequencies is thus confusing and unnecessary. The numbers proffered in the draft-NUREG should meet the purpose described in the Abstract, that is "... to accurately model current risk from LOOP and associated station blackout scenarios."

As plant status is not particularly relevant to weather-events, there seems to be no reason to have an at-power weather-related LOOP separate from the LPSD weather-related LOOP. With the same reasoning, grid-events due to high-voltage equipment failures far away from the NPP again do not depend on the on/off status of any NPP station generator.

Extreme weather includes a criterion for 125mph winds that is not well defined (compare page xxii and page 3). A hurricane may have 125mph winds at the eye-wall with a substantial drop off in velocity within a few miles. An eye-wall approach to a site inevitably leads to a plant transition to one of the LPSD modes either voluntarily or as a result of consequential grid-events. The draft-NUREG does not make a strong statistical case for treating extreme-weather separately from other weather phenomenon. By design, the NPPs have the capability of running on-site AC systems for up to seven days without off-site assistance (see ANSI Standard N195-1976, Regulatory Guide 1.9 and Regulatory Guide 1.137 and FSAR commitments to implement them). Even the most spectacular NPP-weather event (hurricane Andrew, 1992) caused a LOOP of only five days. The low frequency of such extreme weather and the relatively long LOOP durations of all weather-related LOOPs make treating "extreme-weather-events" separately from any other weather-related LOOP an unproductive means of identifying NPP vulnerabilities. It would be more appropriate to handle extreme-weather events in sensitivity studies as warranted by the application.

Section 2 describes the sub-division of traditional plant-centered-LOOP into plant-centered and switchyard-centered. The distinction is generally not crucial because the standard-error for the LOOP-duration statistic is quite large whether the events are lumped or not. As demonstrated by the NUREG, selecting a particular duration for any LOOP is a challenging exercise. Separating plant-centered and switchyard-centered events makes the subjective judgments on event duration more important than they should be. Some sites, such as Diablo Canyon, have distinct switchyards that (1) distribute power produced from (2) the switchyard that supplies house-loads. See additional discussion in Section 6.9 of the draft NUREG. It would be best to allow the PRA staff studying a particular plant to determine which events are plant-centered and leave some switchyard-events in the grid-centered category. Generalizations made in the draft-NUREG of the near-plant switchyards are bound to oversimplify a complex situation.

The costal versus inland distinction is an interesting observation and has potential to well characterize grid-centered and weather-related events. However, the assignment of an NPP to one of these two groups needs to be done with more than simply an "80-miles to the ocean" criterion. For example, the draft-NUREG characterizes Indian Point as a costal plant. However, there exists large mountains and other geographic obstacles between Indian Point and the south shore of Long Island. The Indian Point 3 FSAR, Chapter 2 (Section 2.6.1) describes the predominant wind direction as controlled by the topography, i.e., the shape of the Hudson Valley.

Statistical Analysis of LOOP Frequency and LOOP Duration

The "LOOP Frequency" section (e.g., page 12) describes the use of gamma and 'constrained non-informative' distributions. The "LOOP Duration" section describes log-normal distributions and Weibull distributions. Neither section has much discussion on why this level of complexity is necessary.

The technique of matching LOOP data to a particular probability distribution typically has little effect on the mean values loaded into PRA models. The curve fitting compensates for an absence of empirical data with statistical approximations. Discussion on page 26 shows that curve-fit values can result in noticeable differences from mean values. The bigger problem comes when the curves are used to represent the 5% and 95% bounds on the likelihood estimate. Because the regulations and guidance on assessing CDF and LERF changes focus on particular numerical values, using an over-estimated 95% value in an application sensitivity study can unrealistically distort the "bounding risk estimates."

Given the epistemic uncertainties in LOOP modeling, there is no strong argument given for using these distributions and the associated advanced statistical techniques to describe LOOP frequency and LOOP duration. It is difficult to rigorously select relevant LOOP events for a particular plant PRA. Furthermore, once a LOOP event is selected as relevant, the determination of LOOP duration is at least as difficult as described later in the draft-NUREG. More transparent and less costly approaches to establishing the LOOP frequencies such as those currently in use by the industry serve all stakeholders well.

Regarding Appendix D, the primary numbers that should change from plant to plant are those for weather and grid. The second approach described in Section 3.4 (using Table 3-5) gives large variations between regions, but either doesn't vary enough for weather (St. Lucie is much more likely to have a weather event than Oconee) or give adequate credit for grid reliability (but at the same time too much penalty for those affected by the 14Aug2003 event). The third approach (using Bayesian updates with plant-specific data using priors from Table 3-3) gives no variation in extreme weather, essentially no variation in severe weather, and very large differences in grid related categories compared to the grid related values from the applicable region of the 2nd approach. Note that adopting approach 2 versus approach 3 can result in a factor of 10 differences in the grid-centered LOOP frequency. This is particularly significant for plants in the regions with relatively high grid reliability. Thus, the use of either approach should be used with caution as neither accurately represents grid-reliability for an individual plant.

One way to establish the reliability of a node in a grid system would be to exercise a model such as the ones used by grid-operators in their "contingency analyses." A more generic model could have been used. However, using a general model of a grid system would be akin to a building a generic PWR risk model and applying conclusions from it to a particular plant. In the absence of either a detailed grid model for a particular region or sub-region, the draft-NUREG statistically established the regional trend of grid events. The regional frequencies are provided without the associated error factor. The error factor was provided only for the national data. When the regional grid- event frequency is used, the regional EF becomes another important input to estimate the uncertainty that supports risk-based change applications to the NRC. The EF for national grid events data was estimated to be approximately 8. Since there was a clear regional trend, the regional data EF should not exceed 4.

The frequency of applicable grid events and the choice of statistical technique used (such as Bayesian Updating with an assumed distribution) should remain flexible for PRA analysts to apply their appropriate favored techniques.

The data in Appendix A (as well as data from EPRI and the Department of Energy) indicates that the number of grid-events leading to LOOP at an NPP is strongly dependent on the NERC region in which the NPP is located. Regions with long-distance power flows operate differently than those with shorter distances. NPCC, ECAR, and MAIN exchange power and MVARs routinely; whereas, the WSCC has little to do with ERCOT. The rigor of regional operation and administration varies widely as described in the Department of Energy joint task force report on the 14Aug2003 event. It would be thus, incorrect to assign grid-centered-LOOP frequencies to an individual NPP based on a national average. There are many grid-events documented with the Department of Energy that had no effect on a particular NPP. It is incorrect to characterize the reliability of the grid-system unless the analysis considers a more complete list of large grid-events.

Comments on INEEL/EXT-04-02326: LOOP Events 1986-2003

Section 4.1 of the draft NUREG ignores the wide-spread grid-centered LOOPs of Aug1996 and Jul1989.

Table 6-4 in the draft ignores EPRI Category III LOOP events at Comanche Peak (May2003) and Limerick (Feb1995). The listed Peach Bottom event of Sep2003 was only a momentary LOOP according to the LER filed on that event (re ADAMS Accession number ML033230324).

Appendix C of NUREG-1784 has additional errors beyond the one noted for Byron 2 in Section 6.3. See the shaded areas in the table below.

Corrected Version of NUREG-1784 Table 6-12

LOOP Category	LER	Plant	Event Date	Recovery Time in Minutes			CCDP	Cause
				Actual	Assumed Availability			
					NRC	EPRI		
Consequential LOOP (as a result of a reactor trip)	219/97-010	Oyster Creek 1	8/1/1997	90 E	90	40	< 1E-06	Note[1]
	247/99-015[2]							
LOOPs (with reactor trip)	275/00-004	Diablo Canyon #1	5/15/2000	1980	480	2014[3]	< 1E-06	12kV (RCP motor) phase-phase fault
	265/01-001	Quad Cities #2	8/2/2001	154	214	15 (x-tie to Unit 1)		Note[4]
	346/98/006	Davis Besse	6/24/1998	1506	1359[5]	1383	5.40E-04	tornado hit 345kV switchyard at 2044 24Jun1998
	443/01-002	Seabrook	3/5/2001	2236[6]	43 (31 min RCP start)	0	-	Note[7]
	456/98-003	Braidwood #1	9/6/1998	688	528 (UE duration)	528	< 1E-06	Note[8]

1 SUT voltage regulator not properly set. See LER (219) 97-010 dated 09/02/97

2 Neither this LER nor any close or on this date exists in INPO, nor in ADAMS for Indian Point (or any other plant on or around that date).

3 IE time, (15May2000 0025) to UE-off (16May2000, 0959)

4 Lightning hit 345kV line, noise, and switchyard relay

5 First off-site source at 1926 25Jun1998

6 SUT voltage regulator not properly set. See LER (219) 97-010 dated 09/02/97

6 Neither this LER nor any close or on this date exists in INPO, nor in ADAMS for Indian Point (or any other plant on or around that date).

6 IE time, (15May2000 0025) to UE-off (16May2000, 0959)

6 Lightning hit 345kV line, noise, and switchyard relay

6 First off-site source at 1926 25Jun1998

6 UE time 2110

7 345 kV switchyard bushing flashovers from snow

8 Unit 1 in SG replacement outage. Wind blew plant lighting arrestor cable onto startup plant transformer.

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LOOP Category	LER	Plant	Event Date	Recovery Time in Minutes			CCDP	Cause
				Actual	Assumed Availability			
					NRC	EPRI		
	289/97-007	Three Mile Island #1	6/21/1997	90	90	90	9.60E-06	230kV switchyard circuit breaker failure
Non-initiating LOOPs (no reactor trip)	266/98-002	Point Beach #1	1/8/1998	600	Note [9]	-	< 1E-06	plant equipment failures
	454/98-017	Byron #1	8/4/1998	501	Note[10]	-	< 1E-06	Note[11]

9 LER says first bus ~ 3 hours

10 UE duration 554; 4Aug98 1301 to 4Aug98 0347

11 Error in plant recovery from lightning strike tripped 345kV transmission lines that only affects SAT. Plant uses fast-transfer to stay on-line.