February 8, 2012

Frederick P. Schiffley
BWROG Chairman
Exelon Generation Co., LLC
Cornerstone II at Cantera
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: FEEDBACK ON BWROG-11061, "BWROG [BOILING WATER REACTOR (BWR) OWNERS' GROUP] ECCS [EMERGENCY CORE COOLING SYTEM] SUCTION STRAINERS CHEMICAL EFFECTS STRATEGY OUTLINE

Dear Mr. Schiffley:

By letter dated November 29, 2011 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML11335A264), the BWROG submitted for U.S. Nuclear Regulatory Commission (NRC) staff informal review and feedback BWROG-TP-11-026, Revision 0, "BWROG ECCS Suction Strainer Chemical Effects Resolution Strategy Plan and Flowchart, 'BWROG Emergency Core Colling System Suction Strainers Committee's strategy for resolving ECCS-related concerns over chemical effects after a LOCA [loss-of-coolant accident].'".

The NRC staff's feedback is provided below. Since the chemical effects document outlines the proposed approach for the BWROG, the NRC staff's comments are focused on general approach or higher level feedback. More in-depth staff comments will be provided after the BWROG submits the more detailed material dissolution test plan.

1. Since the NRC staff will be providing more detailed feedback in the future concerning the BWROG test plans to evaluate potential chemical effects, the staff is interested in obtaining a summary of BWR plant materials showing the quantities of various materials in each plant and whether the plant would inject sodium pentaborate from the standby liquid control system following a LOCA. It would be acceptable to the staff if this information is provided with individual plants designated by letter or number rather than by name.

2. Overall, the NRC staff agrees with a phased testing approach since it is important that results from initial testing help inform the direction and extent of subsequent tests. The staff also agrees that it is prudent to use smaller scale, relatively inexpensive testing to explore the range of potential environments and understand the sensitivities of various environmental parameters before performing larger scale experiments.

3. Based on the strategy plan, it is not clear to the staff how the BWROG is considering international test experience that may be applicable to the BWROG post-LOCA environment. For example, testing performed in Germany (ADAMS Accession No.

ML083510156) has indicated that water falling over galvanized steel grating produced zinc-based corrosion products that resulted in significant head loss across a fibrous debris bed. In addition, some of the Japan Nuclear Safety Organization's corrosion testing results available on the following web page: http://www.nrc.gov/reactors/operating/ops-experience/pwr-sump-performance/tech-references.html may be applicable. The NRC staff suggests the BWROG include a discussion of potentially relevant international test experience that either demonstrates that the results are considered in the strategy test plan or justifies why some results are not applicable to the BWROG post-accident environment.

4. As discussed in Section 1.2, "PWR [pressurized water reactor] Experience" (page 6 of the strategy plan) integrated chemical effects testing, along with bench testing, formed part of the technical basis for understanding and evaluating potential chemical effects in PWRs. While the BWROG test strategy document indicates that mixed material tests will be conducted to measure possible interactions between materials, it is not clear to the staff that the dissolution testing includes fully integrated testing. Previous integrated testing was an important supplement to single effects testing since it provided confidence that an unanticipated interaction of materials was not overlooked. The staff is interested in understanding the extent of integrated testing proposed by the BWROG.

5. Phase 1 of the proposed BWROG test strategy involves material corrosion, dissolution, and precipitation. According to Sections 3.1(b)(ii) and 3.1(b)(iii) of the strategy plan, "*the fluid at the end of each test will be added to a settling cone, and allowed to cool, and any precipitate will be collected via filtration. Quantitative, qualitative and elemental evaluation of precipitates will be used to characterize precipitates and gather additional insight into the materials' dissolution behavior and reactivity*." One of the lessons learned from the PWR chemical effects testing was the difficulty in accurately characterizing precipitates and subsequently generating surrogate precipitates with equivalent behavior in head loss testing. Therefore, the BWROG should consider as part of the Phase I dissolution and precipitation test methods some type of head loss screening. Even a smaller-scale, semi-quantitative method capable of reliably differentiating head loss behavior differences between crystalline type precipitates and small amounts of amorphous, hydrated precipitates would provide valuable information to inform future decisions that could involve larger scale testing.

6. Additional information is needed to help the staff evaluate and provide feedback on the Phase I dissolution tests that will be provided to the NRC as stated in Section 5.1.5 of the Strategy Plan. In particular, the NRC staff is interested in how the materials and environment will be determined for the Phase 1 tests. Defining the chemical environment may not be straightforward due to: (1) variability in whether

sodium pentaborate is injected, (2) pH transients resulting from the types and quantities of insulation materials that may dissolve, (3) differences in environment or flow conditions in locations where debris could collect, and (4) the potential for formation of acids following a LOCA. Therefore, the staff is interested in understanding the assumptions and other supporting information that will be used to determine the dissolution test matrix.

7. It is not clear to the NRC staff how the small scale dissolution tests would screen for precipitates that may form at higher temperatures due to retrograde solubility. For example, Pressurized Water Reactor Owners' Group sponsored testing supporting WCAP-16530-NP included tests at 265 ^{o}F to evaluate higher temperature phenomena. The staff is interested in how the BWROG will evaluate the high temperature range of post accident conditions.

8. Following the Phase 1 dissolution testing, vertical loop head loss tests are proposed to facilitate development of a time dependent chemical effects factor calculated by a ratio of head loss from a test with dissolved materials to head loss from a baseline test that does not have a chemical contribution representing dissolved plant materials. The chemical effects factor for each category of plants is intended to be applied to the design basis head loss as a function of time. The NRC staff questions the feasibility of applying a chemical effects multiplier since for cases other than when the chemical effects factor equals one, the magnitude of the chemical effects factor will be influenced by the debris bed characteristics and composition. This approach is conceptually similar to one that was pursued by some PWR licensees for a time before being dropped due to difficulty responding to technical issues raised by the NRC staff. Furthermore, the staff has questions concerning the test procedures and empirical correlations that were used to determine existing design basis head loss values. The staff also notes that previous vertical head loss tests that provided part of the chemical effects evaluation technical basis in PWRs supported short-term solubility credit for aluminum based precipitates.

9. If initial testing indicates that significant head loss could occur due to chemical effects in the post-LOCA BWROG environment, the BWROG should consider resolving interconnected issues (e.g., break zone of influence, debris transport) either prior to or concurrently with the resolution of chemical effects since other issues may influence the test approach used to evaluate the overall head loss.

10. The staff is interested in the details concerning the BWR chemical effects resolution screening tool since items such as determining how the plant groups will be established, the criteria for evaluating whether a plant fits into any group, and how release rates for different groups are determined are important steps in the resolution process.

11. The NRC staff has a number of questions related to the issue of high temperature water pooling. For example, the staff questions how the potential for differences in species concentrations and/or pH between the water in the drywell pools and the suppression pool will be addressed in the chemical evaluations. The staff notes that the BWROG letter dated January 5, 2011 (ADAMS Accession No. ML110070025) states that the details and potential impacts of the active and inactive volumes on chemical effects will be evaluated and documented in the BWR Material Dissolution Test Plan.

12. The NRC staff has additional comments that are more detail oriented compared to the more general methodology comments provided in this letter. The NRC staff suggests a telephone call with the BWROG to help clarify any questions the BWROG may have based on these staff comments and to discuss the staff's lower priority comments.

If you have any questions regarding this matter, please contact Joe Golla at 301-415-1002 or at Joe.Golla@nrc.gov.

Sincerely,

/RA/

John R. Jolicoeur, Chief
Licensing Processes Branch
Division of Policy and Rulemaking
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Project No. 691

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