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PG&E Letter DCL-06-124

U.S. Nuclear Regulatory Commission
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Washington, D.C. 20555-0001

Docket No. 50-323, OL-DPR-82
Diablo Canyon Unit 2
Request for Extension to Completion Date for Unit 2 for Corrective Actions Required by Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors"

References: 1. NRC Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors," dated September 13, 2004

2. PG&E Letter DCL-05-099, "Response to Requested Information Part 2 of NRC Generic Letter 2004-02, 'Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors,'" dated September 1, 2005

NRC Generic Letter (GL) 2004-02 (Reference 1) requested that licensees provide information regarding the potential impact of debris blockage on emergency recirculation during design basis accidents. In Reference 2, Pacific Gas and Electric Company (PG&E) provided its response to GL 2004-02 stating that Diablo Canyon Power Plant (DCPP) Units 1 and 2 would be in compliance with the regulatory requirements listed in the Applicable Regulatory Requirements section of GL 2004-02 by December 31, 2007.

PG&E has placed orders for new screens for both units. Head loss testing, fabrication, and delivery of a new screen for Unit 2 has been scheduled to support installation during the next refueling outage, which is scheduled to begin in February 2008.

This submittal requests an extension to the GL 2004-02 December 31, 2007, completion date for DCPP Unit 2. Specifically, PG&E requests that the DCPP Unit 2 GL 2004-02 completion date be extended to the Unit 2 Fourteenth Refueling Outage currently scheduled to start February 4, 2008. Enclosure 1 presents the bases

supporting PG&E's conclusions that it is acceptable to extend the Unit 2 completion date by approximately five weeks.

If you have any questions or require additional information, please contact Stan Ketelsen at 805-545-4720.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on November 9, 2006.

Sincerely,

Donna Jacobs
Vice President - Nuclear Services

jer1/3664
Enclosures
cc: Edgar Bailey, DHS
Terry W. Jackson
Bruce S. Mallett
Diablo Distribution
cc/enc: Alan B. Wang

Request for Extension to Completion Date for Unit 2 for Corrective Actions Required by Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors"

Background

Generic Letter (GL) 2004-02 (Reference 1) required that addressees provide by September 1, 2005, a description of and implementation schedule for all corrective actions, including any plant modifications, that are identified while responding to the GL. All actions are to be completed by December 31, 2007. Pacific Gas and Electric Company (PG&E) provided its response to GL 2004-02 in Reference 2 stating that Diablo Canyon Power Plant (DCPP) Units 1 and 2 would be in compliance with the regulatory requirements listed in the Applicable Regulatory Requirements section of GL 2004-02 by December 31, 2007.

Recent industry and plant-specific analysis and testing results have been evaluated and indicate that both the units containment sump screens will require replacement. Screen replacement will render the screens inoperable while the work is performed, requiring installation to be performed during an outage of sufficient duration. The next Unit 2 refueling outage is the Unit 2 Fourteenth Refueling Outage (2R14) scheduled to start on February 4, 2008, approximately 5 weeks beyond the GL 2004-02 completion date.

SECY-06-0078 (Reference 3) specifies two criteria for short duration (less than several months) GL 2004-02 extensions. These criteria and PG&E's response are provided below.

SECY-06-0078 Criterion No.1:

The licensee has a plant-specific technical/experimental plan with milestones and schedule to address outstanding technical issues with enough margin to account for uncertainties.

PG&E Response

In Reference 2, PG&E submitted a detailed listing of actions it is taking to address GL 2004-02, and updated the status of those actions in Reference 4.

The NRC requested additional information concerning GL 2004-02 responses in Reference 5. PG&E will provide the requested information by separate correspondence in accordance with Reference 6.

In Reference 2, PG&E stated it was pursuing parallel paths of testing and designing modifications to support continued use of its existing recirculation sump screens, and was also evaluating replacement of the existing screens with new screens.

The DCPP sump screens were already replaced with larger screens in 2000 (Unit 1 Tenth Refueling Outage), and 2001 (Unit 2 Tenth Refueling Outage). The screens were replaced with a new design consisting of a series of 3.5 foot by 4 foot perforated plates welded into a series of channels to provide approximately 700 square feet of surface area for Unit 1, and 760 square feet for Unit 2. These screens were significantly larger than screens in place at most pressurized water reactor plants at the time GL 2004-02 was issued. In response to GL 2004-02, PG&E performed tests on its screen design using the guidance of NEI 04-07 (Reference 7), including use of NEI 04-07 Section 6, "Alternate Evaluation." NEI 04-07 Section 6 alternate break size methodology allows postulating a limited break size that reduces the magnitude of debris generation. Test results in July-August 2005 appeared favorable. However, in late 2005 and early 2006, uncertainties arose within the industry concerning the magnitude of chemical effects, and the potential effect of fiber bypassing screens and blocking flow at the reactor core.

Based on the uncertainties with chemical effects, PG&E has placed orders for replacement screens for both units. The replacement screens will be approximately 4000 square feet in area and are expected to be of sufficient size to accommodate DCPP plant-specific debris and chemical loadings.

The Unit 2 screen will be designed based on testing scheduled for the Unit 1 screen (i.e., the lead screen). Head loss testing, including fiber bypass, fuel bottom nozzle head loss testing and chemical effects testing, is scheduled to be performed in November and December 2006.

In addition, PG&E has contracted performance of jet impact testing on several modifications planned for 2R14 to encapsulate debris sources. These modifications are needed to support debris reduction inside containment. This testing will be performed during October and November 2006.

SECY-06-0078 Criterion No.2:

The licensee identifies mitigative measures to be put in place prior to December 31, 2007, and adequately describes how these mitigative measures will minimize the risk of degraded ECCS [emergency core cooling system] and CSS [containment spray system] functions during the extension period.

PG&E Response

Mitigative Measures

The following mitigative measures have already been implemented to minimize the risk of degraded ECCS and CSS functions during the extension period.

Containment Spray System Design

The DCPP Final Safety Analysis Report Update (FSARU) safety analyses assume the CSS is available only during the injection mode following a loss-of-coolant accident (LOCA). Once switchover to the recirculation mode is made, at approximately 30 minutes after the initiation of the LOCA, the function of the CSS is complete.

The CSS utilizes sodium hydroxide as its spray additive. The containments have calcium silicate and fiberglass insulation as the predominant interacting debris source. The industry and NRC sponsored Integrated Chemical Effects Testing (ICET), Test No. 4, most closely relates to the DCPP conditions. ICET results show that the chemical effects of Test No. 4 are the least detrimental of the four ICET tests.

Containment Floor Design

The floor of containment slopes away from the recirculation sump. As a result, heavy debris particles are inhibited from reaching the recirculation sump. This design feature will be retained when the new sump screens are installed.

Leak Before Break

DCPP has approval to credit leak-before-break (LBB) for its largest primary coolant piping.

DCPP FSARU Section 3.6.2.1.1.1, "Reactor Coolant System Main Loop Piping (Leak-Before-Break)" states in part:

> *In November 1984, the NRC issued NUREG-1061 assessing the applicability of leak-before-break analysis to nuclear power plant piping systems. Effective May 1986, the NRC revised 1971 General Design Criterion 4 to allow the use of leak-before-break methodology for excluding the dynamic effects of postulated ruptures in reactor coolant loop piping in PWRs from the design basis. A draft revision to Standard Review Plan 3.6.3 was subsequently issued outlining the scope of the plant specific evaluation required to obtain NRC acceptance of the use of leak-before-break exclusion. Westinghouse performed the required*

evaluation for the DCPP main reactor coolant loops [Reference 11], and PG&E submitted the evaluation to the NRC on March 16, 1992, requesting elimination of the dynamic effects of postulated ruptures in the main reactor coolant loop piping from the DCPP design basis. On March 2, 1993, the NRC accepted the analysis and granted permission to eliminate the dynamic effects of those breaks from the DCPP design basis [Reference 12]. The scope of application of the DCPP leak-before-break exemption is limited in nature. It applies to the dynamic effects of breaks in the main reactor coolant loop piping only, and can be used only for purposes of exempting consideration of the dynamic loads resulting from such breaks in the equipment and structural design bases, and for exempting consideration of the dynamic effects of those breaks in the protection of equipment.

While LBB is not acceptable for demonstrating compliance with 10 CFR 50.46, it does demonstrate that LBB-qualified piping is of sufficient toughness that it will most likely leak (even under safe shutdown earthquake conditions) rather than rupture. Therefore, rupture of the main reactor coolant piping is extremely unlikely.

NRC Staff Justification for Continued Operation

The NRC staff provided a justification for continued operation (JCO) in Reference 8 that justifies continued operation of pressurized-water reactors through December 31, 2007. The elements of the JCO applicable to DCPP include:

1. The DCPP containments are compartmentalized making transport of debris to the sump difficult.
2. DCPP does not require switchover to recirculation from the sump during a LOCA until 20 to 30 minutes after the accident initiation allowing time for much of the debris to settle in other places within the containment.
3. The probability of the initiating event (i.e., large break LOCA) is extremely low.
4. LBB-qualified piping is of sufficient toughness that it will most likely leak (even under safe shutdown earthquake conditions) rather than rupture.
5. ECCS pumps would be able to continue operating for some period of time under cavitation conditions. This may prevent complete loss of ECCS recirculation flow or increase the time available for operator action (e.g., refilling the refueling water storage tank (RWST)) prior to loss of flow.

These elements will remain valid during the extension period requested by this submittal.

Risk Assessment

A probabilistic risk assessment (PRA) was performed by PG&E (Reference 13) that specifically assessed the impact of extending the time for implementing the sump strainer modification at DCPP Unit 2 until February 4, 2008 (approximate five week delay assumed). Sump performance will be adequate for break sizes up to the 14 inch diameter alternate break size in reactor coolant system (RCS) piping, which includes the 14 inch diameter pressurizer surge line.

The PRA conservatively assumes that sump blockage would occur for all breaks larger than six inches in diameter (DCPP PRA model lower bound for large LOCA). The potential for sump failure based on the need for recirculation exists for smaller breaks, those in the range of three to six inches, which can occur at a wide variety of locations in containment. However, these smaller break sizes have a smaller zone of influence and therefore, much less potential for sufficient debris generation required for sump blockage This analysis did not take credit for the actions taken in response to NRC Bulletin 2003-01 that could mitigate sump blockage. This assessment demonstrated that the core damage risk increase due to a five week extension of the containment sump strainer modification schedule is 4.82E-7 per year, which is less than the 1E-06 per year acceptance limit. The large early release frequency risk increase is 1.00E-8 per year, which is less than the 1E-07 per year acceptance limit. Both calculated risk metric values are within acceptable limits per Regulatory Guide 1.174 (Reference 14). Therefore, the five week extension is not risk significant.

Compensatory Measures

In Reference 9, PG&E stated it had already implemented, or would implement the following compensatory measures (all of the items have been implemented):

1. The RWST level is maintained higher than required by Technical Specifications (TS). Surveillance Test Procedure (STP) R-20, "Boric Acid Inventory," requires maintaining RWST level at 90 percent level or greater. The minimum TS limit is 81.5 percent level (400,000 gallons as required by TS Surveillance Requirement 3.5.4.2) or 84 percent including instrument error. Maintaining the level at 90 percent or greater increases RWST inventory by 27,500 gallons, taking into account instrument error. This added inventory, when injected into containment, will increase the water level at the sump screen by approximately 4 inches, which equates to an additional 75 square feet of screen area.

2. Material exclusion procedures exist to verify that no loose debris is left following any activity performed in containment once containment integrity has been established. STP M-45B, "Containment Inspection When Containment Integrity is Established," is implemented for at-power entries and requires that a visual inspection be performed and any debris found during the inspection be removed from containment. This procedure also requires that all tools, equipment, and material used in a work activity be removed from containment.

3. An aggressive, ongoing containment cleaning program has been developed and implemented. This program has evolved over several years and includes:

   a. General Employee Training has been augmented to include a segment on the importance of maintaining the containment free of debris.

   b. Routine work orders for cleaning containment prior to Mode 4 have been revised to include a detailed list of areas for cleaning and inspection.

   c. Containment cleanup activities and inspections are now scheduled later in the outage. Containment inspections are performed by management personnel, radiation protection personnel, a senior licensed operator, and personnel knowledgeable of the containment environment. These improvements allow the efficient use of manpower and assure that the containment is cleaned prior to entering Mode 4.

   d. A containment cleanliness program has been established and a program owner has been assigned. The program owner has the overall responsibility for containment cleanliness and establishes procedures and necessary work orders to maintain clean containments.

4. More aggressive containment cleanup activities have been implemented to remove dirt and dust, including vacuuming of accessible cable trays and other accessible surfaces.

5. PG&E has inspection procedures to assure the containment recirculation sump screens are free of adverse gaps and breaches. STP M-45A, "Containment Inspection Prior to Establishing Containment Integrity," verifies by inspection that the fine screening surfaces are free of holes and that there are no gaps greater than the acceptable gap size. The acceptable gap size and fine screen openings protect the minimum flow

clearances in systems served by the pumps performing the recirculation function. This inspection is performed at the completion of each refueling outage.

6. Classroom and simulator training on indications of and responses to sump clogging have been included in operator initial and requalification training.

7. Training has been provided to engineering personnel to raise their awareness of the more aggressive containment cleanliness requirements, the potential for sump blockage, and actions being taken to address sump blockage concerns.

8. Training has been conducted for Emergency Response Organization decision makers and evaluators in the Technical Support Center on indications of sump blockage and compensatory actions.

9. To ensure that alternative water sources are available to refill the RWST, Emergency Operating Procedure (EOP) ECA-1.1, "Loss of Emergency Core Cooling," provides two methods to refill the RWST; (1) refill from the boric acid blender and (2) refill from the spent fuel pool (SFP) via the SFP pumps. ECA-1.1 also provides guidance for injecting into the reactor coolant system using the boric acid blender flow path and into containment using either the boric acid blender or the SFP flow path via the RWST to the CSS.

10. In Reference 10, PG&E stated that the following EOP changes have been implemented:

    <u>EOP E-1.3, "Transfer to Cold Leg Recirculation"</u>

    Three steps were added to this procedure to address the potential for sump blockage.

    Step 11, "Reduce RHR [residual heat removal] flow as RCS conditions permit: [followed by instructions for performing this action]," was added as a continuous action to reduce RHR flow and transport velocities to the containment sump after the recirculation alignment has been established. The step ensures that spray flow from RHR is secured if it is no longer needed. Then RHR flow control valves are throttled to approximately 400 gpm per train while maintaining core water level and thermocouple temperatures within satisfactory limits. The recirculation alignment is not changed (i.e., high head pumps receiving suction flow from the RHR pumps remain operating at full capacity).

Step 12, "Implement Appendix M, RWST Makeup," was added to begin refilling the RWST in accordance with the instructions of new Appendix M, "RWST Makeup."

Step 13, "Monitor for Containment Recirc Sump Blockage: [followed by instructions for performing this action]," was added as a continuous action to monitor sump level, pump flows and motor amps for signs of loss of suction or cavitation. Action is directed to shut down pumps (high head pumps first) as necessary to prevent damage.

EOP E-1, "Loss of Reactor or Secondary Coolant"

EOP E-1 is reentered after completion of the transfer to cold leg recirculation. Actions pertinent to sump blockage must be continued. The following two steps were added:

Step 15, "Reduce RHR Flow as RCS Conditions Permit: [followed by instructions for performing this action]," was added to reduce RHR flow consistent with maintaining acceptable core level and temperature conditions. If RCS pressure is high enough to preclude significant RHR injection, then the step is bypassed.

Step 16, "Monitor for Containment Recirc Sump Blockage: [followed by instructions for performing this action]," was added to continue monitoring for signs of sump blockage.

11. WCAP-16204, "Evaluation of Potential ERG [Emergency Response Guideline] and EPG [Emergency Procedure Guideline] Changes to Address NRC Bulletin 2003-01 Recommendations," was prepared by Westinghouse as an account of work sponsored by the Westinghouse Owners Group (WOG). It provides a generic evaluation of potential changes to the Westinghouse ERGs and Combustion Engineering EPGs to address NRC Bulletin 2003-01. PG&E has developed a new EOP (ECA-1.3) based on the WOG guidance.

Additional Considerations

In addition to the above responses, the following information is relevant to justifying an extension for Unit 2.

Previous Plant Modifications

As reported in Reference 9, two areas in the units were identified where flow paths to the sump were susceptible to blockage due to debris accumulation. These are the refueling cavity drain (at elevation 99 feet 6 inches) and the three doors installed in the biological shield wall (at elevation 91 feet 0 inches). The following actions have been taken to ensure containment drainage paths are unblocked:

a. The 8-inch diameter refueling cavity drain is installed in a small depression in the cavity floor (approximately 6 inches deep and 24 square inches in area) and was covered with grating that was flush with the floor. During a design basis LOCA, water from the CSS had the potential to collect in the refueling cavity. If the refueling cavity drain became blocked by debris, the water would not drain onto the containment floor and reach the recirculation sump. This configuration, with the grating flush with the floor, lent itself to becoming a chokepoint where the drain could be blocked due to the accumulation of debris. PG&E modified this drain to replace the floor grating screen with a raised drain screen. The raised drain screen provides more screen area and significantly reduces the likelihood of this drain path becoming blocked.

b. Three doors installed in the biological shield wall on the 91 foot elevation vary in width from approximately 37 to 52 inches. These doors were fabricated from standard floor grating and were installed to prohibit personnel from entering high radiation areas at power. The doors lead from the containment annulus area to the steam generator (SG) compartments. During a LOCA, these doors allow break flow from the SG compartments into the containment annulus area and to the sump. The use of grating for these doors made them susceptible to blockage due to transport and accumulation of floating debris. The licensing and design bases credited the doors' bottom frames as debris curbs to preventing sliding transport of nonbuoyant reflective metal and calcium-silicate insulation from reaching the sump.

   To assure that this drainage path will not become blocked by floating debris, PG&E replaced the grating material with bars that are less restrictive and allow most of the floating debris through without blocking the flow path. The doors' 4-inch high bottom frames continue to function as debris curbs.

Plant Modifications for 2R14

In addition to plant modifications previously implemented for GL 2004-02, design changes are being developed for 2R14 that include removal or encapsulation of selected debris sources, installation of debris interceptors, and replacement of the existing sump screen.

Conclusion

A five week extension to the completion date for DCPP Unit 2 to meet the criteria of GL 2004-02 is acceptable because:

- PG&E has a plan that will result in the installation of modifications that provide acceptable strainer function with adequate margin for uncertainties.
- PG&E currently has or will implement mitigation measures to adequately reduce risk for the requested extension period.
- PG&E has already replaced its recirculation sump screens with much larger screens that provide acceptable performance using plant specific debris except for the unresolved areas of chemical effects and fuel blockage effects.

References

1. NRC Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors," dated September 13, 2004

2. PG&E Letter DCL-05-099, "Response to Requested Information Part 2 of NRC Generic Letter 2004-02, 'Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors,'" dated September 1, 2005

3. SECY-06-0078, from L. A. Reyes, NRC Executive Director for Operations, to NRC Commissioners, "Status of Resolution of GSI-191, 'Assessment of [Effect of] Debris Accumulation on PWR [pressurized water reactor] Sump Performance,'" dated March 31, 2006

4. PG&E Letter DCL-06-107, "Supplemental Response to Requested Information Part 2 of NRC Generic Letter 2004-02, 'Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors,'" dated September 1, 2006

5. NRC Letter dated February 9, 2006, "Diablo Canyon Power Plant, Units 1 and 2, Request for Additional Information Re: Response to Generic Letter

2004-02, 'Potential Impact of Debris Blockage on Emergency Recirculation During Design-Basis Accidents at Pressurized-Water Reactor (TAC No. MC4682 and MC4683)'"

6. NRC Letter dated March 28, 2006, "Alternative Approach for Responding to the Nuclear Regulatory Commission Request for Additional Information Letter Re: Generic Letter 2004-02"

7. Nuclear Energy Institute 04-07, Volume 1, "Pressurized Water Reactor Sump Performance Methodology," and NEI 04-07, Volume 2, "Safety Evaluation by the Office of Nuclear Reactor Regulation Related to NRC Generic Letter 2004-02," Revision 0, dated December 2004

8. Summary of July 26-27, 2001, Meeting with Nuclear Energy Institute and Industry on ECCS Strainer Blockage in PWRs, dated August 14, 2001

9. PG&E Letter DCL-03-097, "Response to NRC Bulletin 2003-01, 'Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors,'" dated August 8, 2003

10. PG&E Letter DCL-04-152, "Response to NRC Request for Additional Information Regarding NRC Bulletin 2003-1, 'Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors,'" dated November 9, 2004

11. WCAP-13039, Technical Justification for Eliminating Large Primary Loop Pipe Rupture as the Structural Design Basis for DCPP Units 1 and 2, Westinghouse Electric Corporation, November 1991

12. NRC Letter, "Leak-Before-Break Evaluation of Reactor Coolant System Piping for DCPP Units 1 and 2," (Docket Nos. 50-275 and 50-323), from Sheri R. Peterson of the NRC to Gregory M. Rueger of PG&E, dated March 2, 1993

13. PG&E Probabilistic Risk Assessment Calculation File No. PRA-06-08, Revision 1

14. Regulatory Guide 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," dated July, 1998

LIST OF REGULATORY COMMITMENTS

The following table identifies PG&E's commitment made in this document. Any other statements in this letter are provided for information purposes and are not considered to be regulatory commitments. Please direct questions regarding these commitments to Stan Ketelsen at 805-545-4720.

Regulatory Commitment	*Due Date*
1. Unit 2 will be in compliance with the regulatory requirements listed in the Applicable Regulatory Requirements section of GL 2004-02.	On completion of the Unit 2 Fourteenth Refueling Outage currently scheduled to start February 4, 2008.