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PG&E Letter DCL-12-114

U.S. Nuclear Regulatory Commission
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10 CFR 50.54(f)

Docket No. 50-275, OL-DPR-80
Docket No. 50-323, OL-DPR-82
Diablo Canyon Power Plant Units 1 and 2
Final Response to Request for Information Pursuant to 10 CFR 50.54(f) Regarding Recommendation 2.3 Flooding

References:

1. NRC Letter, "Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident," dated March 12, 2012

2. NRC Letter, Endorsement of Nuclear Energy Institute (NEI) 12-07, "Guidelines for Performing Verification Walkdowns of Plant Flood Protection Features," dated May 31, 2012

3. PG&E Letter DCL-12-059, "Pacific Gas and Electric Company's Response to NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding the Flooding Aspects of Recommendations 2.1 and 2.3 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident," dated June 7, 2012

Dear Commissioners and Staff:

On March 12, 2012, the Nuclear Regulatory Commission (NRC) issued Reference 1 to Pacific Gas and Electric Company (PG&E). Enclosure 4 of Reference 1 contains requested information, and required responses associated with Recommendation 2.3 Flooding.

In Reference 1, the NRC requested that each addressee confirm that it will use the industry-developed NRC-endorsed flooding walkdown procedures. Reference 2 documents the NRC's endorsement of Nuclear Energy Institute (NEI) 12-07, "Guidelines for Performing Verification Walkdowns of Plant Flood Protection Features. In Reference 3, PG&E confirmed that it would use NEI 12-07 as endorsed

by Reference 2 as the basis for the flooding walkdowns at Diablo Canyon Power Plant (DCPP).

Enclosure 4 of Reference 1 states that within 180 days of the NRC's endorsement of the walkdown procedure, each addressee will submit its final response for the requested information. Enclosure 4 of Reference 1 also states that the response should include a list of any areas that are unable to be inspected due to inaccessibility and a schedule for when the walkdown will be completed.

Enclosed is PG&E's final response to Recommendation 2.3 Flooding for DCPP Unit 1 and Unit 2.

There are no new or revised regulatory commitments as defined by NEI 99-04, "Guidelines for Managing NRC Commitment Changes," dated July 1999, in this report response.

If you have any questions, or require additional information, please contact Mr. Terence L. Grebel at (805) 545-4160.

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

Executed on November 27, 2012.

Sincerely,

Edward D. Halpin
Senior Vice President – Chief Nuclear Officer

dmfn/SAPN 50465913
Enclosure
cc: Diablo Distribution
cc/enc: Elmo E. Collins, NRC Region IV
Eric J. Leeds, NRC Director, Office of Nuclear Reactor Regulation
Laura H. Micewski, Acting NRC Senior Resident Inspector
Joseph M. Sebrosky, NRR Project Manager

Introduction:

On March 12, 2012, the Nuclear Regulatory Commission (NRC) issued a letter to Pacific Gas and Electric Company (PG&E) titled, "Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3 of the Near-Term Task Force Review Of Insights from the Fukushima Dai-ichi Accident" (Reference 1). Enclosure 4 of Reference 1 contains a request for information related to the results of the flooding design basis walkdowns performed in accordance with NRC Letter, Endorsement of Nuclear Energy Institute (NEI) 12-07, "Guidelines for Performing Verification Walkdowns of Plant Flood Protection Features," dated May 31, 2012 (Reference 2).

Purpose:

Reference 1 states that within 180 days of NRC's endorsement of the walkdown procedure, each addressee will submit its final response for the requested information and that the response should include a list of any areas that are unable to be inspected due to inaccessibility and a schedule for when the walkdowns will be completed. This is PG&E's final response for the requested information, which includes the results of the walkdowns performed and any further actions required. This response also includes a list of any areas that were unable to be inspected due to inaccessibility.

Background:

Due to the location and topography of the site, Diablo Canyon Power Plant (DCPP) has limited susceptibility to external flooding. As discussed in the DCPP Updated Final Safety Evaluation Report (UFSAR) Section 1.2.1.2, the DCPP site occupies a coastal terrace that ranges in elevation from 60 to 150 feet (ft) above sea level and is approximately 1000-ft wide. Plant grade is at elevation 85 ft. The seaward edge of the terrace is a near-vertical cliff.

With the exception of the intake and discharge facilities, entrance to major plant buildings is at or above elevation 85 ft. In addition, the plant site is generally sloped away from the major plant buildings and toward the ocean or Diablo Creek.

NRC Request:

a. *Describe the design basis flood hazard level(s) for all flood-causing mechanisms, including groundwater ingress.*

PG&E Response:

The design basis flood hazards are discussed below:

Streams and Rivers

As discussed in UFSAR Section 2.4.3, the only stream on the site subject to a probable maximum flood (PMF) study is Diablo Creek. Diablo Creek collects runoff from a drainage area of 5.19 square miles. The PMF was obtained by deriving an estimated probable maximum precipitation (PMP) with a duration of 24 hours over the subject drainage area. The DCPP PMP for a 24-hour duration was determined to be 16.6 inches.

The PMF study assumed the most severe antecedent condition of ground wetness favorable to high flood runoff and that during a PMF, all culverts are plugged, and water is impounded to the crest of the lowest depression of the switchyard's fill, which is along the border of Diablo Creek. The study determined that the artificial reservoir formed in this assumption is so small that the PMF could not affect the plant.

As discussed in UFSAR Section 2.4.2.2.1, the canyon confining Diablo Creek remains intact and will pass floods without hazard to safety-related equipment. In addition, channel blockage from landslides downstream of the plant, sufficient to flood the plant yard, is not possible because of the topographic arrangement of the site.

As discussed in UFSAR Section 3.4.1, Diablo Creek is adequate to handle the PMF. Thus, the depth of water at the plant location for the PMF is zero.

Local PMP

As discussed in UFSAR Section 2.4.10, roofs of safety-related buildings have a drainage system designed in accordance with the Uniform Plumbing Code for an adjusted regional PMP of 4 inches per hour. In addition, overflow scuppers are provided in parapet walls at roof level to prevent ponding of accumulated rainwater in excess of drain capacity. Yard areas around safety-related buildings are graded to provide positive slope away from buildings. Storm runoff is overland and unobstructed. It is, therefore, not possible for ponding from local PMP to flood safety-related buildings.

Storm Waves and Tsunami

As discussed in UFSAR Section 2.4.2.2.2, the licensing basis includes the combined effects of a tsunami, wind-generated storm waves, storm surge ("piling up" of water near the shore due to a storm), and tides. The combination of these effects results in a rise and fall of the ocean surface level relative to a defined datum level. The reference datum is the mean lower low water level (MLLW). At DCPP, MLLW is 2.6 ft below the mean sea level (MSL), which is used as a reference datum for plant elevation.

As discussed in UFSAR Section 2.4.5.1, hurricanes or line squalls of sufficient magnitude to generate surge flooding (storm-generated long-period sea waves) have not been recorded on the Pacific coastline. This lack of observed events in 200 years of record provides reasonable assurance that such an event will not occur during the lifetime of DCPP. However, the effects of wind-generated storm waves, storm surge, and tides are conservatively considered in the evaluation of water level and its effects on safety-related equipment and structures.

UFSAR Section 2.4.5.4 indicates that wave action behavior at DCPP was originally developed based on a statistical evaluation of historical data. PG&E conducted an extensive review of the historical data that led to the estimation of the return periods of the critical storms. A major Pacific storm in January 1981 resulted in extensive damage to the west breakwater protecting the intake basin, and led to a review of all the design waves and water levels. As a result of the damage, PG&E undertook a test program to determine critical wave behavior at the intake basin, including wave height, wave direction, wave runup, resulting forces, and the effects of wave splash on the intake structure. A three-dimensional physical model of the basin and its surroundings was constructed representing the sea floor, the intake structure, and the breakwaters in storm-induced damage conditions. The tests included the effects of: (a) wind-generated storm waves, including storm surge and tides, and (b) the effects of tsunami plus storm waves.

Waves for the scale model tests were mechanically generated. The results for the model testing indicated that the response waves within the intake basin reached a maximum height that did not increase further in response to increases in the offshore wave height. This phenomenon is due to the effects of the natural terrain and the presence of the degraded breakwater. Therefore, the maximum credible wave event is based on the maximum response of the wave height within the basin, in combination with the still water level in the basin, and was used for assessing the maximum inundating effects and wave forces at the intake structure.

As discussed in UFSAR Section 2.4.6.1.2, the combined wave runup for distantly-generated tsunamis is 30 ft and the combined wave runup for near-shore tsunamis is 34.6 ft.

As discussed in UFSAR Section 2.4.6.6, the potential effects of splash and spray of the sea waves on safety-related equipment were also evaluated. Splashing of water up to and above the top of the ventilation shaft (+52 ft MLLW) for the auxiliary salt water (ASW) pump rooms was observed during the performance of the scale model testing. The testing demonstrated that the ventilation shaft extensions remained free of the upward splashed water as they are set back from the seaward edge of the concrete vent huts at a considerable distance from the seaward edge of the intake structure, and the openings face away from the sea. Although the air intake would not be inundated by splashing of water, it could be subject to windborne spray. This spray could potentially wet the vent openings and water could enter the ASW pump rooms.

Using the model of the intake structure and intake basin, testing was performed to determine the potential for ingestion of spray water by the ASW pump room ventilation shafts. The conclusion was the combination of degraded breakwater, tsunami, high tide, severe storm, and extreme winds in the offshore direction necessary to result in enough water to render the ASW pumps inoperable was inconceivable.

As discussed above, the majority of the DCPP site is not susceptible to flooding from any sources and the PMF is essentially zero. In addition, the ASW pump rooms have been designed to mitigate any potential for flooding from tsunami, storm waves, and high tides.

NRC Request:

b. Describe protection and mitigation features that are considered in the licensing basis evaluation to protect against external ingress of water into SSCs important to safety.

PG&E Response:

Licensing Basis Plant Configurations

The following flood protection features are included in the DCPP licensing basis as summarized in the UFSAR. These include:

- Exterior flood protection barriers such as exterior walls and roof hatches
- Active flood protection features such as backflow check valves and watertight doors
- Site drains
- Tsunami warning response procedure

These features are discussed in more detail below.

Flood Duration

For these features, there is no specific flood duration evaluated in the licensing basis.

Flood Protection Features

ASW Watertight Pump Rooms

As discussed in UFSAR Section 2.4.5.7, the only safety-related system that has components within the projected tsunami and storm wave zone is the ASW system. Each ASW pump motor is housed in its own watertight room within the intake structure. These rooms are designed for a combination tsunami-storm wave activity to elevation +48 ft MLLW (+45.4 ft MSL). As discussed in UFSAR Section 9.3.3.1, the floor drainage system at DCPP is designed with consideration of the potential for back flow. As a result, a design feature of the floor drain system for each of the ASW pump rooms includes a backflow check valve to maintain the pump rooms dry.

In addition to the ASW pumps, the buried ASW piping outside of the intake structure is vulnerable to the effects of tsunami and storm waves. Erosion protection consisting of gabion mattresses, reinforced concrete pavement above this buried piping, and an armored embankment southeast of the intake structure are installed to resist the effects of tsunami and storm waves.

Tsunami Warning Response Procedure

As discussed in UFSAR Section 9.2.7.5, the watertight doors of the ASW pump rooms are alarmed and indicated in the control room. Procedurally, activities at the intake which involve opening an ASW pump room door require posting a person to close the door. In addition, there is a tsunami warning procedure which requires closure of the ASW pump room doors if they are open, and the removal of all personnel from the intake structure area. For the design of the ASW pump rooms and their ventilation structures, severe storm waves were combined with high tide and storm surge levels.

Breakwater System

DCPP has two breakwaters at the intake cove that provide protection to the intake structure from waves. They are constructed of precast concrete interlocking tri-bars with a reinforced concrete cap slab.

Diesel Fuel Oil (DFO) System

The DFO system contains two buried DFO storage tanks and a DFO transfer system, which consists of pumps and piping in underground rooms and trenches.

The design considerations to prevent water from flooding or groundwater from entering the DFO storage tanks, concrete rooms, and pipe trenches are discussed below.

Based on a discussion in UFSAR Section 2.4, the risk of surface water flooding at this site is essentially zero. No groundwater has been encountered at or below the buried tanks, pump rooms, or pipe trenches. Therefore, the source potential for water flooding the fuel oil system is negligible.

DFO Storage Tanks

The below-ground storage tanks are completely sealed with the vent line extending approximately 2 ft above ground. The room's access hatch covers are made of steel and are provided with concrete curbing to prevent water intrusion.

DFO Transfer System

The two DFO transfer pumps that transfer diesel fuel from the main storage tanks to the individual diesel engine day tanks are in separate, underground, reinforced concrete rooms with solid covers protected from surface runoff due to their location inside the west buttress and condensate polishing system structure. The room's manway hatch covers are made of steel and are provided with concrete curbing to prevent water intrusion into the rooms. These rooms are drained to the turbine building sump and are protected with backwater rooms.

Roof drains and Yard Area slope

The DCPP roof drain systems are designed to handle a maximum rate of 4 inches of rain per hour, which exceeds the PMP rate for the site. Yard areas around safety-related buildings are graded to provide positive slope away from buildings. Storm runoff is overland and unobstructed. It is, therefore, not possible for ponding to flood safety-related buildings.

NRC Request:

c. *Describe any warning systems to detect the presence of water in rooms important to safety.*

PG&E Response:

There are no DCPP warning systems or alarms in rooms to detect the presence of water due to external flooding.

NRC Request:

d. Discuss the effectiveness of flood protection systems and exterior, incorporated, and temporary flood barriers. Discuss how these systems and barriers were evaluated using the acceptance criteria developed as part of Requested Information Item 1.h.

PG&E Response:

PG&E used the general acceptance criteria from NEI 12-07, Section 6 (Reference 2). Item 1.h of the 50.54(f) letter (Reference 1) further clarifies the definition of a deficiency:

> Flood protection features are considered acceptable if no conditions adverse to quality were identified during walkdowns, verification activities, or program reviews as determined by the licensee's Corrective Action Program (CAP). Conditions adverse to quality are those that prevent the flood protection feature from performing its credited function during a design basis external flooding event and are "deficiencies." Deficiencies must be reported to the NRC in the response to the 50.54(f) letter.

PG&E walked down recent design modifications to ensure that they did not adversely affect the site flood protection features from performing their intended function. No deficiencies were identified in accordance with NEI 12-07.

Flood protection features were visually inspected as part of the walkdowns. The CAP process was used to determine which of the walkdown observations were deficiencies and actions required to address them. The CAP process also addressed the current functionality of the feature and whether immediate action was required for protection of the plant. The walkdown process also evaluated the existing maintenance procedures and identified enhancements that were entered in the CAP.

The ASW pump room watertight doors are normally in a closed position. Any activities at the intake that involve opening an individual ASW pump room door require posting a person to close the door. As discussed in the response to NRC request b, the tsunami warning procedure requires the control room personnel, upon receipt of a tsunami warning, to notify the door attendant to close the ASW watertight door, if open, and order personnel to evacuate the intake structure. A team of engineering and operations personnel performed a procedure walkthrough that verified the procedure can be executed as written.

Based on this criteria, there were no deficiencies (conditions adverse to quality) identified that would prevent the flood protection features from performing their flood

protection functions. Observations made during the walkdowns were entered into and evaluated in the CAP.

NRC Request:

e. Present information related to the implementation of the walkdown process (e.g., details of selection of the walkdown team and procedures,) using the documentation template discussed in Requested Information Item 1.j, including actions taken in response to the peer review.

PG&E Response:

Site-specific procedures were created to implement flood protection feature evaluations and walkdowns in accordance with NEI 12-07.

A dedicated walkdown team was formed that consisted of an experienced DCPP civil engineering team lead knowledgeable of the DCPP current licensing basis and a minimum of two other civil engineers to perform walkdown inspections. These personnel had specific knowledge necessary to inspect a flood protection feature/procedure and the capability to determine if the condition of the feature/procedure needed to be entered into the CAP. Training for all personnel on the team consisted of a site-specific training package given by the team lead, and included the NEI recommended Nuclear Academy for Nuclear Training e-Learning training for training personnel in inspection methodology.

The peer review looked at the development of the features list and the walkdown methodology and results. Peer review recommendations were added to the features list for evaluation and walkdown.

NRC Request:

f. Results of the walkdown including key findings and identified degraded, non-conforming, or unanalyzed conditions. Include a detailed description of the actions taken or planned to address these conditions using the guidance in Regulatory Issues Summary 2005-20, Rev 1, Revision to NRC Inspection Manual Part 9900 Technical Guidance, "Operability Conditions Adverse to Quality or Safety," including entering the condition in the corrective action program.

PG&E Response:

Observations from the walkdowns were entered into the CAP and evaluated in accordance with DCPP processes. As described in response to NRC request d, there were no deficiencies identified that would prevent the flood protection features from performing their flood protection functions.

NEI 12-07 defines restricted access and inaccessible features. Restricted access areas are those normally not accessible for direct visual inspection. NEI 12-07 states it is expected that flood protection features in restricted access areas will be inspected when conditions allow. Inaccessible features are those that cannot be visually inspected. NEI 12-07 also states that any items classified as inaccessible shall be identified, evaluated, and justification shall be provided that there is reasonable assurance that safety related equipment will be adequately protected from external flooding.

Based on an evaluation of external flood protection features, no features were found to meet the definition of restricted access features. Table 1 provides a list of features that were identified to be inaccessible. The table includes a discussion regarding why each feature is considered inaccessible and a justification for reasonable assurance that these features remain functional, or an assessment of the impact of non-performance of the function.

Table 1: Flood Protection Features Found to be Inaccessible

Flood Protection Feature	**Reason for Inaccessibility**	**Justification for Ability to Perform Flood Protection Function**
Gabion Mattress	The gabion mattress is a buried feature over the ASW bypass piping and is unable to be walked down.	The gabion mattress was installed in the late 1990s as a protective measure for erosion of the soil support for the ASW bypass piping in a tsunami event. A review of the construction records shows that the gabion mattress was adequately installed and inspected to all required criteria. A monitoring program of the fill material over the gabion mattress has indicated no major erosion or settlement in the area since the original construction of the gabion mattress. Therefore, there is reasonable assurance that the gabion mattress will perform its external flood protection function.
ASW Room Internal Conduit Seals	These are internal conduit seals and cannot be accessed without significant disassembly.	The internal conduit seals into the ASW pump rooms were replaced in the late 1990s. A review of the construction records shows that these seals were adequately installed and inspected to all required criteria. Therefore, there is reasonable assurance that these items will perform their external flood protection function for the full flood duration.

Flood Protection Feature	Reason for Inaccessibility	Justification for Ability to Perform Flood Protection Function
DFO Pump Rooms Internal Conduit Seals	These are internal conduit seals and cannot be accessed without significant disassembly.	For the internal conduit seals in the DFO pump rooms, the potential impact of the loss of function of these seals was evaluated. Assuming these seals are not present, a potential water path could exist from the conduit outside the rooms. All conduit paths outside the rooms start at locations that are either above a point where water could enter (i.e. above elevation 85 ft), or start at a location where water entry is protected by another flood feature (i.e. the raised berm around the DFO tank manways). Therefore, the function of the DFO transfer system would not be impacted by the non-performance of these internal conduit seals.

NRC Request:

g. *Document any cliff-edge effects identified and the associated basis. Indicate those that were entered into the corrective action program. Also include a detailed description of the actions taken or planned to address these effects.*

PG&E Response:

Per NEI 12-07, the cliff-edge effects were defined by the NRC's Near-Term Task Force (NTTF) Report, which noted that "the safety consequences of a flooding event may increase sharply with a small increase in the flooding level" (Reference 2, pages 29, 36, and 37).

While the NRC used the same term as the NTTF Report in its 50.54(f) information request related to Flooding Recommendation 2.3, the information that the NRC expects utilities to obtain during the Recommendation 2.3 walkdowns is different. To clarify, the NRC is now differentiating between cliff-edge effects (which are dealt with in Recommendation 2.1) and a new term, available physical margin (APM). APM information was collected during the walkdowns, but will not be reported in the response to Enclosure 4 of Reference 1.

The term APM describes the flood margin available for applicable flood protection features at a site (not all flood protection features have APMs). The APM for each applicable flood protection feature is the difference between licensing basis flood height and the flood height at which water could affect a structure, system, or component important to safety.

All APMs have been collected and documented in the walkdown record forms and will be available for review onsite. This information will be used in the flood hazard reevaluations performed in response to Item 2.1: Flooding in Reference 1.

NRC Request:

h. Describe any other planned or newly installed flood protection systems or flood mitigation measures including flood barriers that further enhance the flood protection. Identify results and any subsequent actions taken in response to the peer review.

PG&E Response:

During, and as a result of, the flood walkdowns no vulnerabilities were identified to external flooding at DCPP and no design changes or further actions were determined to be required. There were no actions identified in the peer review that resulted in any subsequent actions.

References:

1. NRC letter dated March 12, 2012, "Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3 of the Near Term Task Force Review of Insights from the Fukushima Dai-ichi Accident"

2. Nuclear Energy Institute (NEI) letter dated May 21, 2012, "Submittal of NEI 12-07, Revision 0, Guidelines for Performing Verification Walkdowns of Plant Flood Protection Features"

3. NRC letter dated May 31, 2012, Endorsement of Nuclear Energy Institute (NEI) 12-07, "Guidelines for Performing Verification Walkdowns of Plant Flood Protection Features"