DCISC

DIABLO CANYON INDEPENDENT SAFETY COMMITTEE

COMMITTEE MEMBERS

WEBSITE - WWW.DCISC.ORG

ROBERT J. BUDNITZ
PETER LAM
PER F. PETERSON

By Email to:
comments@waterboards.ca.gov

October 30, 2014

Ms. Jeanine Townsend
Clerk to the Board
State Water Resources Control Board
1001 I Street, 24th Floor
Sacramento, California 95814

Re: Comment Letter – Once-Through Cooling Policy Special Studies.

Dear Ms. Townsend:

The Diablo Canyon Independent Safety Committee (DCISC) was established in 1988 by a settlement agreement approved by the California Public Utilities Commission (CPUC) to review operations at PG&E's Diablo Canyon Power Plant (DCPP) for the purpose of assessing the safety of operations and suggesting any recommendations for its safe operation. The DCISC consists of three members, one each appointed by the Governor, the Attorney General and the Chairperson of the California Energy Commission.

To assist the State Water Resources Control Board (Board) and its Review Committee for Nuclear Fueled Power Plants (Review Committee) in evaluating the special studies conducted by the Bechtel Power Corporation (Bechtel) regarding the scientific, technical and environmental issues related to a closed-cycle cooling retrofit and the ability, alternatives and costs for DCPP to meet policy requirements on the use of coastal and estuarine waters for power plant cooling, the DCISC conducted two evaluations of the issues and the impacts on safety at DCPP from the elimination of once-through cooling and its replacement by closed-cycle cooling. The major issue that the DCISC considered in both evaluations was that of nuclear safety.

On October 14, 2014, the DCISC approved its Preliminary Evaluation of Safety Issues for Bechtel's "Addendum to the Independent Third-Party Final Technologies Assessment for the Alternative Cooling Technologies or Modifications to the Existing Once-Through Cooling System for the Diablo Canyon Power Plant Addressing the Installation of Saltwater Cooling Towers in the South Parking Lot." The DCISC's Preliminary Evaluation is provided herein as Attachment 1 for the Board's consideration at its meeting on November 18, 2014.

Previously, on September 5, 2013, the DCISC provided to the Board its Evaluation of Bechtel's "Independent Third-Party Final Technologies Assessment for the Alternative Cooling Technologies or Modifications to the Existing Once-Through Cooling System for Diablo Canyon Power Plant." The DCISC's September 5, 2013, Evaluation is provided as Attachment 2 herein for the Board's consideration on November 18, 2014.

Because the DCISC will continue to study the safety implications of alternatives to once-through cooling, and because additional information concerning these issues may be developed by Bechtel or others, and further design and analysis work may be developed in the future either by Bechtel or by PG&E, it is possible that the DCISC may modify either or both evaluations.

In continuing to fulfill its charge from the CPUC to review operations at DCPP for purposes of assessing the safety of operations and suggesting any recommendations for safe operations, the DCISC commits to perform additional study and to be alert to any new information that might lead the DCISC to modify its conclusions about safety as set forth in Attachments 1 and 2. Please provide acknowledgment of your receipt of this letter together with the attachments by reply email and keep us informed concerning the Board's plans for continuing the process of evaluating alternative cooling methods for DCPP.

On behalf of myself and the other members of the Diablo Canyon Independent Safety Committee, please convey our thanks to the Board for the opportunity to review the Bechtel reports and to contribute to the Board's assessment of these important issues and their potential to affect the future safety of the DCPP. Should the Board Members have any questions or concerns about the substance or nature of the DCISC's evaluations or the conclusions or recommendation therein, please do not hesitate to communicate with us.

Very truly yours,

Per F. Peterson
Chair

Attachments 1 and 2

cc (w/att.):
Hon. Edmund G. Brown, Jr., Governor, State of California
    c/o Mr. Ken Alex, Senior Policy Advisor/Director of Planning & Research
Hon. Kamala Harris, Attorney General, State of California
    c/o Ms. Megan Hey, Deputy Attorney General
Hon. Robert B. Weisenmiller, Chair, California Energy Commission
Mr. Kevin Barker, Advisor to the Chair, California Energy Commission
Ms. Danielle Osborn Mills, Senior Nuclear Policy Advisor, California Energy Commission
Hon. Michael R. Peevey, President, California Public Utilities Commission
Mr. Thomas Hipschman, DCPP Senior Resident Inspector, U.S. Nuclear Regulatory Commission.
Mr. Ed Halpin, Senior Vice President and Chief Nuclear Officer, PG&E
Mr. Barry Allen, Site Vice President, PG&E, Diablo Canyon
Mr. Mark Krausse, Director, State Agency Relations, PG&E, Sacramento
Ms. Maureen Zawalick, Corporate Support Manager PG&E, DCPP
Mr. Douglas E. Dismukes, Bechtel Power Corporation
Mr. Jonathan Bishop, Chief Deputy Director, SWRCB
Ms. Marleigh Wood, Senior Staff Counsel, California State Water Resources Control Board (SWRCB)
Ms. Victoria Whitney, Director of Water Quality, SWRCB
Mr. Rik Rasmussen, Surface Water Assistant Deputy Director, SWRCB
Mr. Paul Hann, Watershed Ocean and Wetlands Section Chief, SWRCB
Dr. Maria de la Paz Carpio-Obeso, Ocean Unit Chief, Div. of Water Quality, SWRCB
Ms. Shuka Rastegarpour, Environmental Scientist, Ocean Stnds.Unit, Div. of Water Quality, SWRCB

Attachment 1

Diablo Canyon Independent Safety Committee's Preliminary Evaluation of Safety Issues for "Addendum to the Independent Third Party Final Technologies Assessment for the Alternative Cooling Technologies or Modifications to the Existing Once-Through Cooling System for the Diablo Canyon Power Plant"

17 OCTOBER 2014

Concurred in by the Three Members of the DCISC at the DCISC Public Meeting on 14 October 2014

Robert J. Budnitz
Peter Lam
Per F. Peterson

I. Background: Addendum to the Bechtel Report Reviewed by the DCISC

In early 2011, the California State Water Resources Control Board appointed a special committee, a "Review Committee to Oversee Special Studies for the Nuclear-Fueled Power Plants Using Once-through Cooling" (the "Review Committee") to assist it in evaluating various technical options that might be used to replace or reduce the environmental impacts of once-through cooling (OTC) at the two nuclear power plants then operating along California's Pacific coast, Diablo Canyon Power Plant (DCPP) and San Onofre Nuclear Generating Station.

Bechtel Power Corporation was selected as the contractor to perform technical evaluation of options. In August 2013, Bechtel published a technical study of seven options (Reference 1). During its meeting on 13 August 2013 in Sacramento, the Review Committee requested that the Diablo Canyon Independent Safety Committee (DCISC) provide a technical evaluation of the nuclear-reactor-safety issues associated with these seven alternative cooling technologies for modifications to the existing once-through cooling system for DCPP.

The DCISC's charter is to review and make recommendations concerning the safety of operations at Diablo Canyon Power Plant.

On September 5, 2013, the DCISC issued a report reviewing safety issues associated with the seven potential technologies to modify cooling of the DCPP (Reference 2). The DCISC established a "safety criterion" in that prior report, which is repeated below and which also applies to our current review reported here [See the box below].

The DCISC's Safety Criterion

As background, we first reiterate something we noted above, which is that the current OTC approach for providing the normal cooling function at Diablo Canyon meets all applicable NRC requirements. The DCISC is acutely cognizant of the US NRC's nuclear-reactor-safety criteria for this function, and would not provide a positive evaluation for any technology that did not meet those criteria. However, we have approached our safety evaluation using a different set of criteria. Our position is that, although replacement cooling technology could meet all NRC regulations, it could still represent an unacceptable degradation of the overall nuclear-reactor-safety performance at Diablo Canyon when compared to the current configuration. For this reason, the DCISC criterion can be stated as follows:

> *Having concluded that the current OTC approach for performing the normal plant cooling function at Diablo Canyon has adequate safety, the DCISC's safety criterion is that any alternative proposed as a replacement should provide at least approximately the same level of overall nuclear-reactor safety.*

In the DCISC's view, this mainly (but not entirely) comes down to asking the following question of any technology that might be proposed to replace once-through cooling to perform the normal cooling function at Diablo Canyon, after stipulating that the technology must also meet all applicable NRC regulations:

> *As analyzed in the plant PRA, will the contribution of accident sequences involving loss of cooling remain as only a modest contributor to the total residual risk at Diablo Canyon?* *

The DCISC cannot answer this question today, because the analysis has not been performed. In our review of the first seven options, the DCISC offered the following assessment: Based on our review of the technical information in front of us, meaning the information in the two Bechtel reports (supplemented by our knowledge of how various cooling technologies perform at other nuclear power plants around the world), we judge it likely that none of the [seven technology options studied initially by Bechtel] would pose a significant safety problem at Diablo Canyon, if they do not degrade significantly the plant's reliability and increase the frequency of plant trips. However, this was not a strong conclusion based on evidence, but merely a judgment based on what we know so far. Crucially, more analysis is needed. Any new technology must be designed, installed, and operated to high reliability standards, and the first step would be the design step, where details must be developed that will lead to an acceptable design solution.

The DCISC received a copy of Bechtel's draft Addendum on the use of salt water cooling towers south of the plant on July 3, 2014 and published the Bechtel report and a draft evaluation of it developed by Per F. Peterson (then DCISC Chair) and R. Ferman Wardell (a DCISC Consultant) on the DCISC website on August 6, 2014. On August 8, 2014, the DCISC held a public meeting in San Luis Obispo to discuss a draft version of this report. Public comment received before and during this public meeting strongly encouraged the DCISC not to finalize the report at that meeting because there was insufficient time for public review and comment. Recognizing the importance of public comment, and the value of waiting for the final Bechtel Addendum Report to be issued, at tat August 8 Public Meeting the DCISC decided to defer any approval of this report and announced a public comment period for its evaluation. Immediately after that public meeting, the DCISC draft report was placed on the DCISC website (www.dcisc.org) and forwarded in draft form to Bechtel and to the SWRCB. Bechtel issued its Final Addendum on September 19, 2014. The DCISC comment period, and its extension, ended on September 26, 2014. Comments were received from the Friends of the Earth (FOE) and the San Luis Obispo Mothers for Peace (SLOMFP), and were posted to the DCISC web site. These comments, and any others, will be discussed at the DCISC October 14-15, 2014 Public Meeting in Avila Beach CA as described on the DCISC website.

As discussed in more detail below, in its preliminary review of the Bechtel Addendum Study, which was issued in final form on September 19, 2014 (Reference 3), we find that the use of salt water evaporative cooling, and the impacts of southern siting of cooling towers on operations and site emergency access both should be studied more to determine if there are overall safety impacts such that the design might not meet the DCISC's safety criterion.

We did not review the Bechtel cooling tower designs with respect to their optimization or economics. We note that the FOE review suggests that design options are available that could reduce the cost of such towers, in particular, to locate the towers at higher elevations than by Bechtel in their evaluation in order to reduce excavation costs and reduce the number of buildings that would need to be demolished.

The FOE review also notes that closed cooling would eliminate the risk of plant trips caused by entrainment of kelp and salp (a type of jellyfish) into the existing circulating water system at the plant intake cove, which has resulted in periodic plant trips in the past. DCPP has reduced this risk by curtailing power during winter storms and by monitoring for sea life entering the intake cove and maintaining a bubble curtain system to prevent salp from becoming entrained. This has been successful in reducing the frequency of plant trips due to kelp and salp entrainment. The DCISC believes that insufficient information exists to evaluate whether the rate of circulating water trips that might occur during the start up or normal operation of new cooling towers would be lower than, or greater than, the rate that would occur with the existing once-through cooling system, and that further study is warranted.

II. <u>Scope of the Addendum Study</u>

The additional study the Review Committee directed Bechtel to perform evaluated a modified cooling tower system implementing the following changes from the initial study:

1. *Southern siting:* Relocation of the cooling towers from the north side of the plant to the south side, to reduce excavation requirements,

2. *Seawater evaporative cooling:* Use of seawater in the cooling towers to eliminate the requirement for a desalination plant as part of the overall system, and

3. *Increased coolant temperature:* An evaluation of options with higher cooling water temperature, which would increase the operating pressure of the DCPP condensers and reduce plant efficiency, but also reduce the size and cost of the cooling towers.

In our earlier review (Reference 2), the DCISC disagreed with the Bechtel conclusion that none of the cooling options studied would be likely to require a License Amendment Request (LAR) to the U.S. Nuclear Regulatory Commission (NRC). In the final Addendum Report, Bechtel states (Reference 3, pg. 5),

> "Although we believe that the 10 CFR 50.59 process required to make any plant modification would not result in the need for a licensing amendment, it is likely that the U.S. Nuclear Regulatory Commission (USNRC) would be involved in reviewing this change, which may result in a detailed regulatory review process. It is assumed that any USNRC review would be conducted in parallel with the various state permit reviews."

Ultimately, only the NRC can make the decision about whether an LAR would be required. Under NRC regulations, an LAR would be required if the change to the plant was an unreviewed (by NRC) safety question of the NRC-approved Final Safety Analysis Report (FASR) or Technical Specifications (TS). Our review concludes that the use of cooling towers creates a new flooding risk affecting safety-related emergency diesel generators and switchgear located in the 85-foot level of the turbine building, and that both southern siting and seawater evaporative cooling would impact the operability and performance of several additional safety-related systems, and thus the DCISC concludes that an NRC LAR would almost certainly be required if closed cooling were used, as discussed in the following sections of this report.

FOE (Reference 12) challenged this conclusion at the October 14, 2014 DCISC Public Meeting by citing NRC statements from the 2007 California Energy Commission's workshop on nuclear safety issues. The NRC statements were that the NRC would defer to the states the decision on whether to require cooling towers or once-through-cooling. The DCISC understands this to be for the concept of cooling for primarily new plant designs, not the effect on safety systems and safety analyses for back-fitting cooling towers. Further, for cooling water backfits, the DCISC's interpretation is that the NRC would still defer that choice to California but would still perform its own safety review of the safety effects of the change.

FOE stated that, "It is unknown what practical experience DCISC committee members have to challenge Bechtel on this [whether an NRC LAR is required]. As explained in the October 14, 2014 DCISC Public Meeting Dr. Peter Lam served as a Federal Administrative Law Judge for 18 years sitting on the NRC Atomic and Safety Licensing Board panel adjudicating NRC licensing matters. Mr. Wardell has extensive experience in NRC licensing and compliance. Dr. Budnitz was once Director of Research at NRC.

To perform our review of the Bechtel Addendum Report, we used information from several sources. These include information requested from DCPP during the DCISC

May 21-22, 2014 Fact Finding meeting, documented in the resulting DCISC Fact Finding Report (Reference 4); a November 2013 report commissioned by the Friends of the Earth (Reference 5); a detailed report on performance and effects of saltwater cooling towers performed by the California Energy Commission's Public Interest Energy Research Program (Reference 6); the User Manual for the F400 ClearSky® cooling tower (Reference 7); and information from the Palo Verde Nuclear Generating Station near Phoenix Arizona, which uses cooling towers that operate with relatively high-salinity water (Reference 8), and review comments of the earlier draft report provided by the FOE (Reference 9) and SLOMFP (Reference 10).

III. The Baseline Bechtel Cooling Tower Designs

The initial Bechtel report (Reference 1) evaluated seven cooling technologies, including five closed cycle cooling systems:

- Inshore mechanical (active) intake fine mesh screening systems

- Offshore modular wedge wire systems

- Closed-cycle cooling systems (5 different approaches):
  - Passive draft dry/air cooling
  - Mechanical (forced) draft dry/air cooling
  - Wet natural draft cooling
  - Wet mechanical (forced) draft cooling
  - Hybrid wet/dry cooling

In evaluating the closed cooling options, the 2013 Bechtel study concluded,

> "*All [closed] cooling technologies are considered viable from a tsunami, seismic, and structural perspective. However, from an efficient design and construction perspective, the wet mechanical (forced) draft cooling is considered most attractive for DCPP (since there is no sufficient space at DCPP site for the mechanical (forced) draft dry/air cooling option). The hybrid wet/dry cooling tower option is also considered to be an efficient option, and warrants further consideration when making the final selection.*" (Reference 1, pg. 121).

The Bechtel cooling tower designs were located on the northern side of the plant, in an area where little existing infrastructure exists, and the wet-cooling designs used fresh water for cooling provided by a combination of reclaimed water and water produced using a new desalination plant. Also, the wet cooling towers were sized to be capable of providing condenser cooling water at a temperature that would allow the cooling towers to also provide service water* cooling, by installing larger service water heat exchangers to accommodate the higher temperature of the cooling water.

Subsequently, the Review Committee received comments from the Friends of the Earth (Reference 5) suggesting that the capital cost of the closed cooling system could be reduced using a combination of southern siting, to reduce excavation costs; seawater evaporative cooling, to eliminate the need for a desalination plant; and allowing

* The plant service water system provides cooling to non-safety-related equipment in the plant.

somewhat higher turbine back pressure to reduce the cooling tower size. The Review Committee then directed Bechtel to develop and evaluate a new closed cooling system design based upon these changes. Bechtel's new work to share this assignment has resulted in their Addendum (Ref. 3).

In this report, the DCISC evaluates the potential additional plant operational safety impacts that would result from these proposed design changes.

FOE submitted additional comments (Reference 12) on this evaluation at the October 14, 2014 DCISC Public Meeting in Avila Beach CA. These comments dealt primarily with conclusions the DCISC had drawn about the effects of salt deposition on DCPP equipment. The DCISC has revised its evaluation to incorporate those comments. Other FOE comments are addressed herein.

IV. Safety Impacts of Southern Siting

Figure 1 presents a plant arrangement drawing developed by Bechtel (Reference 3) showing southern siting of saltwater cooling towers. Bechtel evaluated two design options using ClearSky® cooling towers as a case-study example, Case 1 being a configuration sized to have a visible plume only 5% of the time, and Case 1B being smaller and sized to have a visible plume 55% of the time.

Because the primary access to the plant site is from the south and most of the plant support infrastructure, including parking, security, training, and support buildings are on the south side of the plant, southern siting of cooling towers has the potential to generate more negative impacts on plant operations, emergency response, and safety related systems than northern siting, not only during construction, but also during long-term operation.

To reduce lost electricity revenues, Bechtel proposes that the majority of construction work would occur during a 6.3 to 6.5 year period during which plant operation would continue (Reference 3, Table 5.1-1). The final connection of the new cooling towers would then occur during simultaneous outages of both units lasting 2.3 years.

Because the plant training facility and security facility are required to be available continuously during the construction period (even during the dual unit outage), the Bechtel design leaves these facilities in place. But the plan requires demolition and reconstruction of most other plant infrastructure buildings, access roads, and underground services in the southern area of the plant. Under the Bechtel design, twenty-two buildings would be removed and reconstructed, including the fire department building and fire operations garage (Reference 3, pg. 26). FOE (Reference 9) has stated that fewer buildings would require demolition, and less excavation would be required, if the cooling towers were located at a higher elevation than the locations proposed by Bechtel for its 34 cell design. We have not reviewed how higher elevations would affect building demolition, but note that because circulating water pipe routing would be similar, construction impacts on plant operations would likely be comparable (except those associated with reduced excavation requirements). Because the smaller footprint available to the south of the plant requires that the cooling tower size be reduced, the Bechtel design concludes that it would be impractical to modify the service water cooling system, and thus a new system to provide once-through cooling for service water is included in the design.

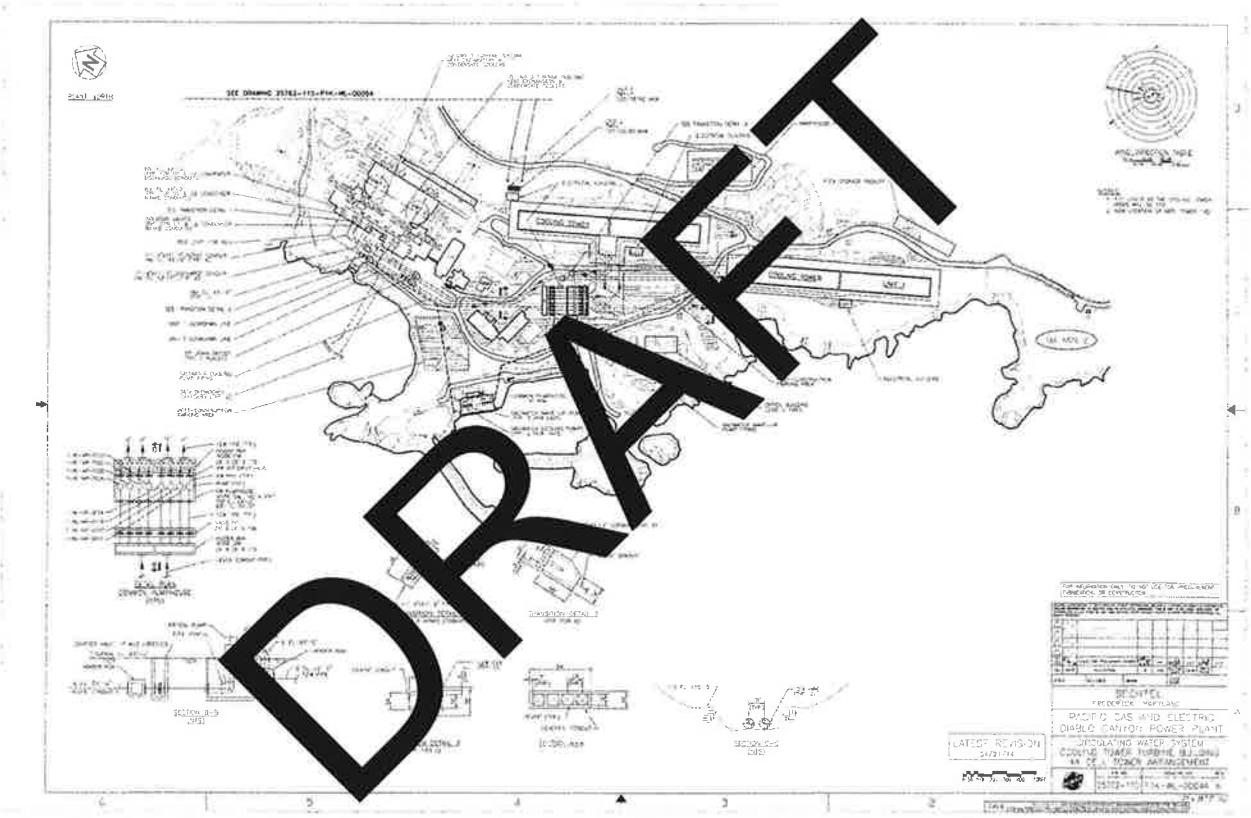


Fig. 1: Bechtel arrangement for a 44-cell southern cooling tower system.

The most relevant experience with major construction projects that has affected plant access, that the DCISC has reviewed in detail to assess potential safety impacts, involved major post 9/11 security upgrades at DCPP. All of these plant security modifications were assessed for their safety impacts, and where the modifications would affect plant access for operation, temporary barriers were erected to gain experience with how these modifications would affect operations and maintenance. In an April, 2005 Fact Finding report, the DCISC described the review process that was required to assess safety impacts of these security upgrades (Reference 11):

> *"The DCISC reviewed the provisions made for normal and emergency plant access in the new security design modifications. Prior to finalizing and implementing any security upgrade designs, Security involved affected stakeholders in a design review. (This is actually a standard practice in the DCPP Design Change Process). Likewise, Security reviews non-security draft plant design changes for security requirements and effects. The DCISC reviewed an Action Request which documented these reviews by*
>
> - *California Division of Forestry (for fire truck access)*
> - *Operations*
> - *Radiation Protection*
> - *Outage Coordinators*
> - *Industrial Safety*
> - *Maintenance*

- *Emergency Preparedness*
- *Fire Protection*
- *Security (for effects on other parts of the Security Plan)"*

The scale of plant modifications required to implement closed cooling with southern siting, and impacts on site access during construction, would be significantly larger than what was required to implement the post-9/11 security changes or for the northern site. It is not clear to the DCISC that the Bechtel construction schedule provides sufficient time to complete rigorous safety reviews, at the level that was performed for earlier security modifications.

DCISC Conclusion 1: The logistics for maintaining effective plant access for normal operations and emergency response, as well as meeting requirements for physical security during the six-year cooling tower construction period prior to the dual-unit outage, will be substantially more complex for the southern siting option.

DCISC Recommendation 1: An evaluation should be performed to understand the impact of southern-sited cooling towers on plant security and emergency response capabilities.

Two major safety-related systems are impacted substantially by the southern siting option. Auxiliary Salt Water (ASW) supply, which provides safety-related heat removal from reactors, spent fuel pools, and other safety-related equipment, must be temporarily rerouted and then replaced by a new underground piping system. This system is the last, or ultimate, cooling water supply for the plant. During a beyond design basis accident the plant has the capability to cope temporarily without ASW by injecting water into the steam generators and venting steam and by allowing the spent fuel pools to boil, but ASW's long-term operation is essential to providing cooling to the fuel in the reactor and the spent fuel pools. Likewise, the two 50,000 gallon underground fuel tanks for the plant Emergency Diesel Generators (EDGs) must be removed and replaced. The EDGs provide the last supply of electricity to the plant, in a similar fashion to the ASW system for cooling water. Both systems are essential for maintaining long-term safe plant shutdown.

The draft Bechtel report states that "[e]mergency backup power required during the outage would be provided by temporary diesel generators." The DCISC concludes that the design of these proposed temporary generators will require very careful review to assure that safety can be maintained. The draft Bechtel report also states that "[e]xcavation and demolition of existing [circulating water system] duct west of the turbine building within the footprint of the new concrete ducts, [will occur] while supporting the five existing ASW lines." The DCISC concludes that it is unlikely that the existing ASW lines, which are integrated into the existing circulating water system underground concrete duct structure, could be maintained. Instead, temporary rerouting of ASW lines to maintain spent fuel pool cooling, followed by replacement, will be needed. This would continue to maintain safety system cooling but would add some adverse risk to plant operational safety.

Bechtel proposes that the construction activities to modify the AWS supply and the EDG fuel storage tanks, along with other construction inside the plant protected area, would occur during the 2.3-year long dual unit outage.

FOE challenged the DCISC concern (Reference 12), stating that "There can be no operational plant risk when the plant is offline, only need to assure cooling water to spent fuel storage pools." The Bechtel design approach calls for a cooling tower construction period is approximately six years while DCPP is operating, and the cooling tower piping and electrical tie-ins would then occur during another 2.3 year dual unit outage. The DCISC concern for southern construction on safety is primarily for the six year tie-in period when the plant would be fully operational.

DCISC Conclusion 2: Installation of cooling water ducts in the protected area will impact operability and require design changes to the emergency diesel generator fuel tanks and the auxiliary saltwater system, and require analysis for new flooding risks for safety-related equipment (emergency diesel generators and switch gear) located in the 85-foot elevation of the turbine building. Southern siting would also require redesign and replacement of the underground Auxiliary Saltwater System piping, which, when modified by DCPP in the past, has required a NRC License Amendment Request (LAR). Combined with other safety related impacts related to emergency response, fire protection, and security, implementation of closed cooling with southern siting will require NRC review and appears likely to trigger a requirement for a NRC LAR, which would lead to a potentially lengthy NRC review.

DCISC Recommendation 2: Additional review/analysis should be performed to provide an estimate of how extensive an NRC review might be necessary concerning the cooling tower options. Such an effort should incorporate NRC staff inputs.

DCISC Conclusion 3: The design of the proposed temporary emergency diesel generators will require very careful review to assure that safety can be maintained.

DCISC Conclusion 4: It is unlikely that the existing ASW lines, which are integrated into the existing circulating water system underground concrete duct structure, could be maintained. Instead, temporary rerouting of ASW lines to maintain spent fuel pool cooling, followed by replacement, will be needed. This would continue to maintain safety system cooling but would add some adverse risk to plant operational safety.

DCISC Recommendation 3: A probabilistic risk assessment analysis should be made to quantify the impact of cooling towers on the risk of transients and accidents and any change to the margins of safety.

V. Safety Impacts of Seawater Evaporative Cooling

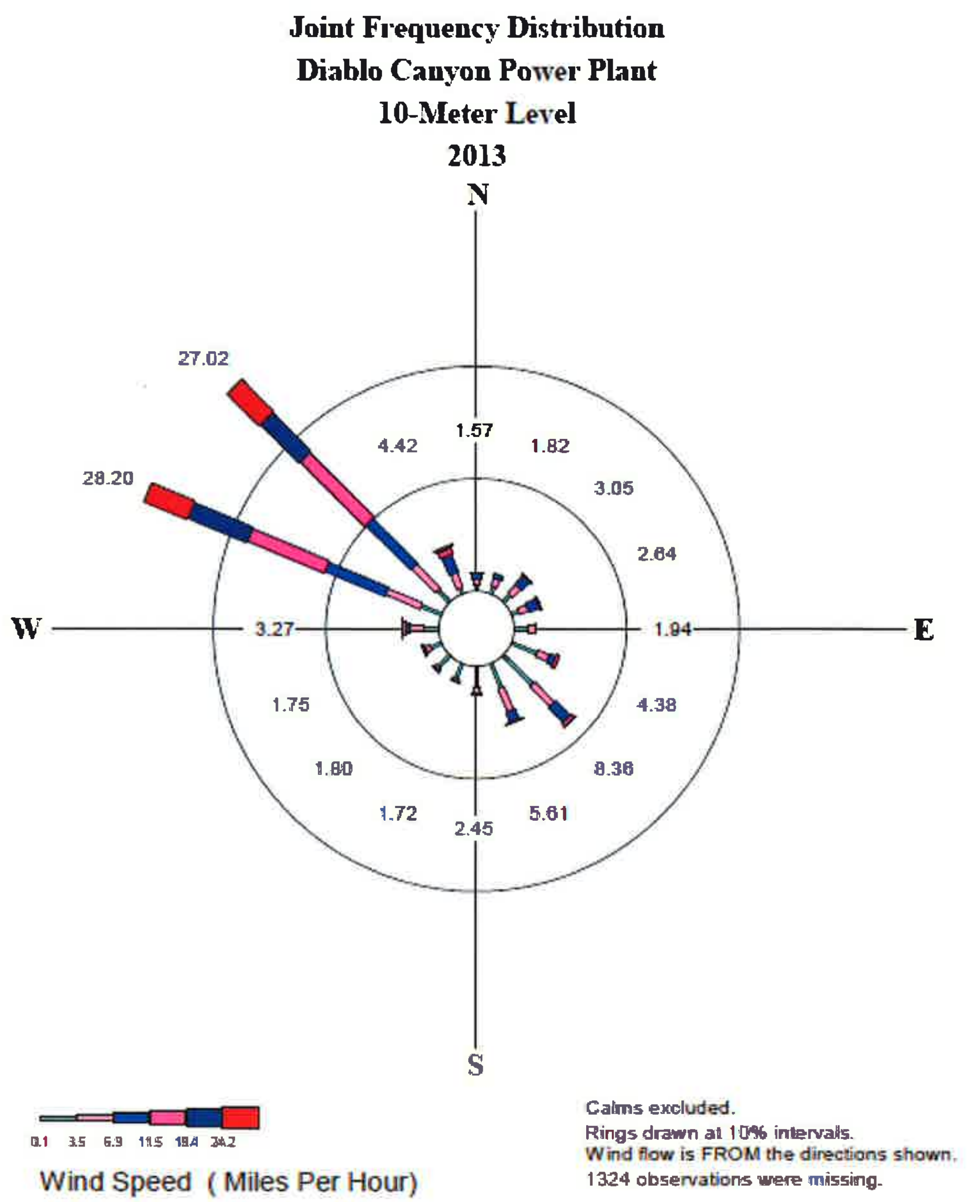
The consumption of fresh water (including reclaimed and desalinated water) can be reduced in cooling towers by using brackish water (water with sufficient dissolved solids to be non potable) or seawater for makeup (Reference 6). The primary safety-related impacts of using seawater in cooling towers at DCPP will involve increased rates of salt deposition on plant equipment and structures, "*Nearly all plants with high□salinity cooling towers, both natural and mechanical draft, have encountered accelerated corrosion on unprotected metal surfaces on buildings and equipment at the plant site near the towers.*" (Reference 6, pg. 28)

FOE advised at the October 14, 2014 DCISC Public Meeting (Reference 12) that most conclusions from the above-cited report (Reference 6) were about the successful operation of plants with saltwater cooling towers. Conflicting information exists about the salinity levels in the cooling water for the Hope Creek nuclear plant cited in the FOE comments. The DCISC notes that U.S. nuclear plants that currently use brackish or saltwater were designed from the start for saltwater cooling towers, whereas DCPP is being considered for back-fitting saltwater cooling towers, and they likewise operate in areas that have different wind and humidity conditions. The observations provide additional motivation for further study.

Wet cooling towers operate by drawing external air upward in counter flow with cooling water, which runs down over structures designed to provide high contact surface area between the water and the air. Cooling of the water occurs due to a combination of sensible heating of the air (raising the air temperature), as well as evaporation of the water (raising the air humidity). The evaporated water does not contain salt, but inevitably droplets of water, referred to as "drift", that do contain salt become entrained in the air flow. For the ClearSky® cooling tower selected for review in the Bechtel report, approximately 0.02% of the circulating water flow becomes entrained in the air flow as droplets (Reference 7, Pg. 13). The ClearSky® cooling towers then pass the air flow through a heat exchanger that cools the air and condenses some of the water vapor, using dry ambient air, and then mixes these streams together, to reduce the generation of visible plumes above the cooling towers. The ClearSky® cooling tower also has drift eliminators, which remove most of the entrained water droplets, so the total release of water droplets is reduced to 0.0005% of the circulating water flow.

The total cooling tower flow for the Bechtel design is 2 x 868,300 gallons per minute (gpm) or 1,736,600 gpm. For the design performance of the drift eliminators of 0.0005% (Reference 3, pg. 15), the drift release is 8.7 gpm. The design cycle concentration is 1.5, such that water in the cooling system and drift has 1.5 times the salt content of the makeup seawater. With the dissolved solids in seawater being 35,000 parts per million (ppm), the concentration in the circulating water is then 52,000 ppm. For operation with a 90% capacity factor, the annual release of dissolved salt is then (0.90)(8.7 gpm)(0.052)(8.56 lb/gal)(525,000 min/yr)/(2200 lb/t) = 830 metric tons/yr.

The fraction of the salt contained in this drift flow, that would deposit onto equipment around the plant, depends upon the wind speed, droplet size distribution, and droplet settling velocities. Figure 2 shows a wind direction table (wind rose) for the DCPP site in 2013, which is representative of data for earlier years also (Appendix A). The prevailing winds greater than 3.5 miles per hour (mph) from the west-northwest, northwest and north-northwest would carry droplets away from the plant approximately 55.4% of the time. Approximately 23.3% of the year wind speeds are under 3.5 miles per hour (mph), and approximately 10.1% of the time wind comes from the east-southeast, southeast, or south-southeast at speeds above 3.5 mph, during which times a larger fraction of droplets can be expected to deposit on plant equipment.



PERCENT OCCURRENCE: Wind Speed (Miles Per Hour)
LOWER BOUND OF CATEGORY

DIR	0.1	3.5	6.9	11.5	18.4	24.2
N	0.52	0.63	0.36	0.05	0.00	0.00
NNE	0.69	0.75	0.38	0.00	0.00	0.00
NE	0.87	1.06	0.97	0.15	0.00	0.00
ENE	0.69	0.83	0.94	0.17	0.00	0.00
E	1.28	0.52	0.12	0.01	0.00	0.00
ESE	2.39	1.12	0.55	0.32	0.00	0.00
SE	3.64	2.50	1.75	0.43	0.04	0.00
SSE	2.33	2.23	0.86	0.09	0.07	0.03

TOTAL OBS = 7436 MISSING OBS = 1324

PERCENT OCCURRENCE: Wind Speed (Miles Per Hour)
LOWER BOUND OF CATEGORY

DIR	0.1	3.5	6.9	11.5	18.4	24.2
S	1.75	0.62	0.08	0.00	0.00	0.00
SSW	1.39	0.24	0.09	0.00	0.00	0.00
SW	1.40	0.28	0.11	0.01	0.00	0.00
WSW	1.05	0.44	0.20	0.05	0.00	0.00
W	1.32	1.30	0.34	0.23	0.05	0.03
WNW	1.99	3.29	5.73	7.42	5.66	4.10
NW	1.48	3.04	5.62	8.08	4.83	3.97
NNW	0.54	1.44	1.67	0.59	0.13	0.05

CALM OBS = 0

Fig. 2: Wind direction table for the DCPP site in 2013.

As a result of insights from recent high-voltage flashover events, discussed later, DCPP recently initiated a program to measure the rate of salt deposition on transformers by collecting salt samples on coupons placed near the Unit 1 and Unit 2 transformers (Reference 4). This is the first time that salt deposition rates have been measured since the plant initial measurements were performed in 1969. The collection coupons are replaced on a monthly basis, so that seasonal variability in salt deposition rates can be measured. These measurements have revealed that the Unit 2 main transformer area experiences higher rates of salt deposition than for Unit 1, approximately double, which is ascribed to added salt spray from the plant cooling water outfall, that tends to be carried by prevailing winds through the gap between the Turbine Building and the Administration Building and thus to deposit salt on the Unit 2 transformers, whereas the Unit 1 transformers experience salt deposition primarily from natural sources of spray. This higher rate of salt deposition, caused by carryover from the plant outfall, helps explain why the major problems with high-voltage flashover events at DCPP have involved the Unit 2 high-voltage equipment.

The measured rate of deposition of salt in the area of the Unit 2 transformers, on 16 samples exposed over a 30-day period and collected on April 3, 2014, ranged from 0.0368 to 0.2062 mg/cm^2, with an average of 0.1015 mg/cm^2. Conversely, for 16 samples collected in similar locations near Unit 1, deposition ranged from 0.0289 to 0.1243 mg/cm^2, with an average of 0.0520 mg/cm^2. These values are consistent with studies performed at the site in 1969, which recommended use of a value of 0.011 mg/cm^2/week (or 0.047 mg/cm^2 in 30 days), as an appropriate deposition rate to assume in the design of high voltage insulators.

A key question for salt-water cooling towers is how rapidly salt might deposit onto equipment, particularly during periods of adverse weather when salt water drift would move slowly and deposit primarily onto the plant area, compared to the current deposition rates. Considering the plant area inside the vehicle exclusion barrier, which is approximately 2400 ft (730 m) long and 1200 ft (366 m) wide, at a nominal deposition rate of 0.052 mg/cm^2 per 30 days, total salt deposition is approximately (0.052 mg/cm^2)(730 m)(366 m)(10^4 cm^2/m^2)(365 days/yr)/(30 d)(10^9 mg/ton) = 1.7 tons/yr. This existing rate of salt deposition is very small compared to the rate at which salt would be released from the cooling towers, around 830 tons/yr as calculated above.

Safety-related equipment that could be negatively impacted by increased salt deposition are the Emergency Diesel Generators (which draw in large volumes of external air during test and operation), the Auxiliary Building, Control Room, and Fuel Handling Building Ventilation Systems which also draw in large volumes of external air (Reference 4), and the dry cask storage canisters and overpacks in the plant Independent Spent Fuel Storage Installation (ISFSI), although deposition on the storage casks is likely to have less effect than on the plant itself and its equipment, which is closer to the ocean. In addition, the reliability of high voltage equipment located outdoors could be reduced, including high voltage insulators in transformers and in switchyards. A key area of risk that will require evaluation will be potential for increased frequency of loss of offsite power (LOOP) due to potential simultaneous electrical failures in the 230 kV and 500 kV switchyards.

DCPP has already experienced problems with high-voltage flashover events caused by current rates of salt deposition. The most recent cases involved an event in October 2012, when during a light rain arcing occurred on the Unit 2 A and B Phase Main Bank Transformers (MBT) and shortly afterward the 500 kV insulator flashed to ground, causing Unit 2 to trip. A similar Unit 2 trip occurred in July 2013 during a periodic hot washing of the 500 kV insulators for Unit 2, which is conducted every 6 weeks, when overspray induced an external arc around the lighting arrester insulation and flashover. A third event occurred in February 2014, after about an hour and a half of light rain, again on the Unit 2 Main Bank Transformer "B" Phase Lightning Arrester (Reference 4).

Relevant experience with the effects of salt releases from cooling towers on nuclear plant safety is provided by the Palo Verde Station in Arizona (Reference 6). Because the Palo Verde Station has a zero discharge design, it runs with a high dissolved solids concentration in its cooling water of around 24,000 ppm, with a total cooling water flow rate for 3 reactor units of 1,863,000 gpm (Reference 6). These cooling towers operate with a drift of under 0.001% (Reference 8). These values can be compared to the 52,000 ppm and 1,736,600 gpm for seawater cooling towers for DCPP, suggesting that total salt releases for the DCPP cooling towers would be approximately double those for Palo Verde. Salt deposition would be different at DCPP than at Palo Verde due to differences in prevailing winds and in average air humidity. Likewise, the corrosive effects of salt deposits are higher in humid environments, and thus would be larger under the more humid conditions at DCPP than experienced in the less humid conditions at Palo Verde.

FOE advised at the October 14, 2014 DCISC Public Meeting (Reference 12) that the Hope Creek Nuclear Plant in New Jersey has been operating well for 28 years with saltwater cooling towers. Hope Creek is reported to be operating with cooling towers using brackish water (Reference 13) withdrawn from the Delaware River Estuary and thus with lower salinity levels than ocean water. The question about the actual salinity levels at Hope Creek, its design features to accommodate brackish water in its cooling towers, and specific wind and humidity conditions at this site suggests more study is warranted.

The Bechtel report states, "The actual level of additional effort necessary to mitigate the effects of the saltwater drift will have to be determined based on operating experience after the saltwater towers are placed in service." The DCISC does not agree with this approach. Because the increase in salt deposition rates is likely to be large, the impact of this change on plant safety related systems should be studied in detail before any plant modification is performed. As noted in the Bechtel report, modeling tools such as the Electric Power Research Institute Seasonal/Annual Cooling Tower Impact Model can simulate drift deposition and can provide a quantitative estimate for the increased rate of deposition. The DCISC also anticipates that the NRC would require such studies before it would approve any LAR implementing salt-water cooling towers.

FOE suggested (Reference 12), and the DCISC agrees, that for salt deposition studies the salt source from the existing DCPP outfall (circulating water discharge) be removed because the outfall would be eliminated if cooling towers were to be installed. The DCISC also notes that the areas impacted by drift from the current discharge (outfall) are limited, while drift from saltwater cooling towers has the potential to deposit on a wider range of structures and equipment, again suggesting the need for further study.

As discussed earlier, the use of cooling towers would also change, and potentially improve, the reliability of the circulating water system compared to the current once-through system which can become plugged by entrained kelp or salp. Because plant trips due to loss of circulating water place significant stress on the plant, it would be highly desirable to have a better quantitative understanding of the relative reliability, and potential reduction in the rate of trips, that cooling towers could provide. This understanding can be developed as part of the PRA analysis we recommend elsewhere in this report.

<u>DCISC Conclusion 5</u>: The use of salt water cooling towers could result in an increase in the rate of deposition of salt on DCPP plant equipment during the 10.1% of the year that wind blows from the east-south-east and the 23.3% of the year when wind speeds are very low, compared to the rate currently experienced. Higher salt deposition rates have the potential to create negative impacts on some safety-related systems, in particular Emergency Diesel Generators, and ventilation systems for the Auxiliary Building, Control Room, and Fuel Handling Building. Higher salt deposition rates may also reduce the reliability of outdoor high voltage systems that play a major role in plant safety, and increase the frequency of loss of off-site power (LOOP) events. These higher salt deposition rates could also produce negative impacts on the long-term safety of the spent fuel casks in the ISFSI, although these effects should be much less because of the longer distance from the ocean to the ISFSI.

DCISC Recommendation 4: Simulation of rates of salt deposition from salt-water cooling towers, using available modeling tools, should be performed to assess the increase in salt deposition rates that would occur if salt water, rather than fresh water, were used in cooling towers at the site, and these simulations should be used to assess potential impacts on plant safety systems and plant reliability, to inform the decision on whether fresh water or salt water should be used.

VI. Safety Impacts of Increased Coolant Temperature

To reduce the size of the cooling towers to allow them to fit within the smaller footprint available to the south of the plant, and to reduce the cost of the cooling towers, the new cooling towers are sized by Bechtel to operate with higher circulating water temperature than the earlier northern Bechtel design. This results in a somewhat higher condenser back pressure, and somewhat lower power output from the plant turbines. Because the cooling water temperature is higher, the service cooling water system that provides cooling to non-safety related equipment in the plant would continue to use once-through cooling using two new, 10,200 gpm saltwater pumps, to avoid requirements for redesign of service-water system components. The DCPP turbine vendor, Alstom, has indicated that these low pressure turbines can operate reliably at higher condenser pressure.

<u>DCISC Conclusion 6</u>: Operation of the DCPP condensers at a higher pressure of 4 to 5 inches Hg, and the use of a separate once-through cooling system for service water, are unlikely to affect plant safety significantly.

VII. Summary of DCISC Conclusions and Recommendations

Our earlier assessment of closed cooling options, based upon northern siting of the cooling towers and the use of reclaimed and desalinated water, reached the following four conclusions (quoted verbatim from Reference 2):

- "We find that the nuclear safety impacts of the alternative cooling options, if and when they are appropriately designed, manufactured, and installed, would likely be sufficiently small that NRC approval could be obtained. However, the DCISC has an additional criterion for judging the safety impact of an alternative plant cooling technology at Diablo Canyon. That is because, in our view, meeting NRC's safety regulations is necessary to support a decision to proceed, but not sufficient.

- "Based on our review of the technical information in front of us, we judge it probable that none of the proposed new technologies, if and when they are developed and implemented in accordance with established safety practices, would pose a sufficient safety problem to preclude NRC licensing of the modified design. However, this is not a strong conclusion based on evidence, but merely a judgment based on what we know so far.

- "One of our primary concerns with any of the proposed alternative cooling methods involves the potential impact on plant reliability, in particular whether the modified configuration might be more prone to generating plant trips and forced outages, with a potential impact on plant safety, in particular a potential impact on ASW/UHS [Auxiliary Saltwater System/Ultimate Heat Sink].

- **"The DCISC recommends that additional analysis be performed and more design detail be provided by Bechtel or by PG&E in order to assess the likely effects of the alternative cooling methods on plant reliability and to determine whether the DCISC safety criterion will be met.**" [The **bold** text is in the original.]

These four earlier conclusions still apply to our assessment of the seven cooling options studied earlier by Bechtel, including closed cooling systems located to the north of the plant and using reclaimed and desalinated water. However, we conclude that the impacts of southern siting of cooling towers on plant access during construction, and the impacts of increased salt deposition on plant equipment from use of salt-water cooling, would both have the potential for substantially more negative safety impacts than would northern siting and use of reclaimed and desalinated water. Conversely, operating with higher cooling temperatures would have minimal safety impact.

VIII. Conclusions

The DCISC concludes that the impacts of southern siting of cooling towers on plant access during construction, and the impacts of increased salt deposition on plant equipment from use of salt-water cooling, would both have the potential for more negative safety impacts than would northern siting and use of reclaimed and desalinated water. Conversely, operating with higher cooling temperatures would have minimal safety impact.

Additional conclusions:

1. *The logistics for maintaining effective plant access for normal operations and emergency response, as well as meeting requirements for physical security during the*

six-year cooling tower construction period prior to the dual-unit outage, will be substantially more complex for the southern siting option.

2. Installation of cooling water ducts in the protected area will impact operability and require design changes to the emergency diesel generator fuel tanks and the auxiliary saltwater system, and require analysis for new flooding risks for safety-related equipment (emergency diesel generators and switchgear) located in the 85-foot elevation of the turbine building. Combined with other safety related impacts related to emergency response, fire protection, and security, implementation of closed cooling with southern siting appears likely to trigger a requirement for an NRC License Amendment Request, which would lead to a potentially lengthy NRC review.

3. The design of the proposed temporary emergency diesel generators will require very careful review to assure that safety can be maintained.

4. It is unlikely that the existing ASW lines, which are integrated into the existing circulating water system underground concrete duct structure, could be maintained. Instead, temporary rerouting of ASW lines to maintain spent fuel pool cooling, followed by replacement, will be needed. This would continue to maintain safety system cooling but would add some adverse risk to plant operational safety.

5. The use of salt water cooling towers could result in an increase in the rate of deposition of salt on DCPP plant equipment during the 10.1% of the year that wind blows from the east-south-east and the 23.3% of the year when wind speeds are very low, compared to the rate currently experienced. Higher salt deposition rates have the potential to create negative impacts on some safety-related systems, in particular Emergency Diesel Generators, and ventilation systems for the Auxiliary Building, Control Room, and Fuel Handling Building. Higher salt deposition rates may also reduce the reliability of outdoor high voltage systems that play a major role in plant safety, and increase the frequency of loss of off-site power (LOOP) events. These higher salt deposition rates could also produce negative impacts on the long-term safety of the spent fuel casks in the ISFSI, although these effects should be much less because of the longer distance from the ocean to the ISFSI.

6. Operation of the DCPP condensers at a higher pressure of 5 inches Hg, which allows the use of smaller cooling towers, is unlikely to affect plant safety significantly.

IX. Recommendations

1. **An evaluation should be performed to understand the impact of southern-sited cooling towers on plant security and emergency response capabilities.**

2. **Additional review/analysis should be performed to provide an estimate of how extensive an NRC review might be necessary concerning the cooling tower options. Such an effort should incorporate NRC staff inputs.**

3. **A probabilistic risk assessment analysis should be made to quantify the impact of cooling towers on the risk of transients and accidents and any change to the margins of safety.**

4. **Simulation of rates of salt deposition from salt-water cooling towers, using available modeling tools, should be performed to assess the increase in salt deposition rates that would occur if salt water, rather than fresh water, were used in cooling towers at the site, and these simulations should be used to assess potential impacts on plant safety systems and plant reliability, to inform the decision on whether fresh water or salt water should be used.**

X. References

1. Bechtel Power Corporation, "Alternative Cooling Technologies or Modifications to the Existing Once-Through Cooling System for the Diablo Canyon Power Plant," Report No. 25762-000-30R-G01G-00010 (August 2013)

2. Diablo Canyon Independent Safety Committee's Evaluation of Safety Issues for "Independent Third Party Final Technologies Assessment for the Alternative Cooling Technologies or Modifications to the Existing Once-Through Cooling System for the Diablo Canyon Power Plant," September 5, 2013.

3. Bechtel Power Corporation, "Addendum to the Independent Third-Party Final Technologies Assessment of Alternative Cooling Technologies or Modifications to the Existing Once-Through Cooling System for the Diablo Canyon Power Plant Addressing the Installation of Salt Water Cooling Towers in the South Parking Lot," Report No. 25762-000-30H-G01G-00001 (September 17, 2014).

4. Diablo Canyon Independent Safety Committee Report on Fact-finding Meeting at DCPP on May 21-22, 2014, Section 3.5, "Cooling Tower Study," Approved June 11, 2014.

5. P. Hendersen, R. Seaby, and R. Powers, "Comments on September 2013 Bechtel Phase 2 Final Technologies Assessment for Alternative Cooling Technologies at Diablo Canyon Power Plant," Friends of the Earth, November 19, 2013. (http://www.waterboards.ca.gov/water_issues/programs/ocean/cwa316/rcnfpp/docs/foe_cmmnts_to_bechtel.PDF)

6. J.S. Maulbetsch, M.N. DiFilippo, "Performance, Cost, and Environmental Effects of Saltwater Cooling Towers," California Energy Commission, Report CEC-500-2008-043, January 2010.

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8. "Water resources, utilization experiences at Palo Verde Nuclear Generating Stations," Topical Issues on Infrastructure Development, International Atomic Energy Agency, January 24-27, 2012.

(http://www.iaea.org/NuclearPower/Downloadable/Meetings/2012/2012-01-TM-WS-Vienna/Day-4/3.Mortazavi-PVNGS.pdf)

9. Bill Powers, "Powers Engineering Comments on August 11, 2014 Diablo Canyon Independent Safety Committee's (DCISC) Draft Evaluation of Safety Issues," Commissioned by Friends of the Earth, September 22, 2014

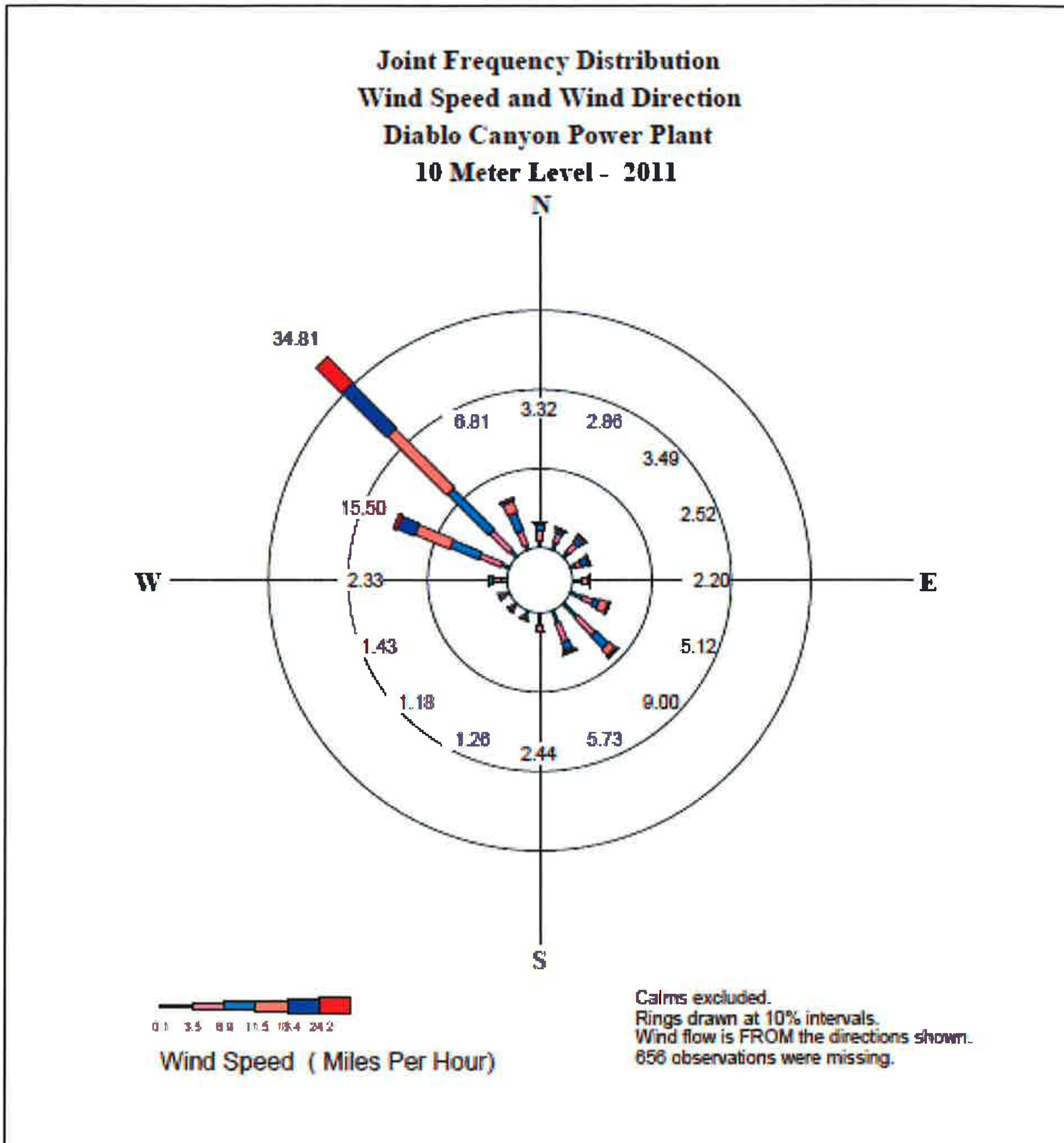
10. San Luis Obispo Mothers for Peace, Email communication to DCISC, September 26, 2014.

11. Diablo Canyon Independent Safety Committee Report on Fact-finding Meeting at DCPP on April 16-17, 2014, Section 3.7, "Flashover Events," Approved June 11, 2014.

12. Bill Powers, "Powers Engineering Comments on October 7, 2014 Diablo Canyon Independent Safety Committee's Evaluation of Safety Issues for "Addendum to the Independent Third Party Final Technologies Assessment for the Alternative Cooling Technologies or Modifications to the Existing OnceThrough Cooling System for the Diablo Canyon Power Plant," October 14, 2014.

13. NOAA's National Marine Fisheries Service Greater Atlantic Regional Fisheries Office, "Endangered Species Act Section 7 Consultation Biological Opinion: Continued Operation of Salem and Hope Creek Nuclear Generating Stations," NER-2010-6581, July 17, 2014, Pg. 8, (http://www.greateratlantic.fisheries.noaa.gov/protected/section7/bo/actbiops/salemhcnmfsfinalbiopjuly172014.pdf)

APPENDIX A: Wind Rose for DCPP site for 2011 and 2012



PERCENT OCCURRENCE: Wind Speed (Miles Per Hour)
LOWER BOUND OF CATEGORY

DIR	0.1	3.5	6.9	11.5	18.4	24.2
N	0.75	1.38	0.84	0.31	0.04	0.00
NNE	1.01	1.20	0.46	0.17	0.02	0.00
NE	0.88	1.37	0.77	0.42	0.06	0.00
ENE	0.64	0.79	0.74	0.32	0.02	0.00
E	1.11	0.84	0.15	0.06	0.04	0.00
ESE	1.58	1.43	0.77	1.11	0.23	0.00
SE	2.31	3.11	2.13	1.04	0.36	0.05
SSE	1.62	2.62	0.99	0.23	0.20	0.07

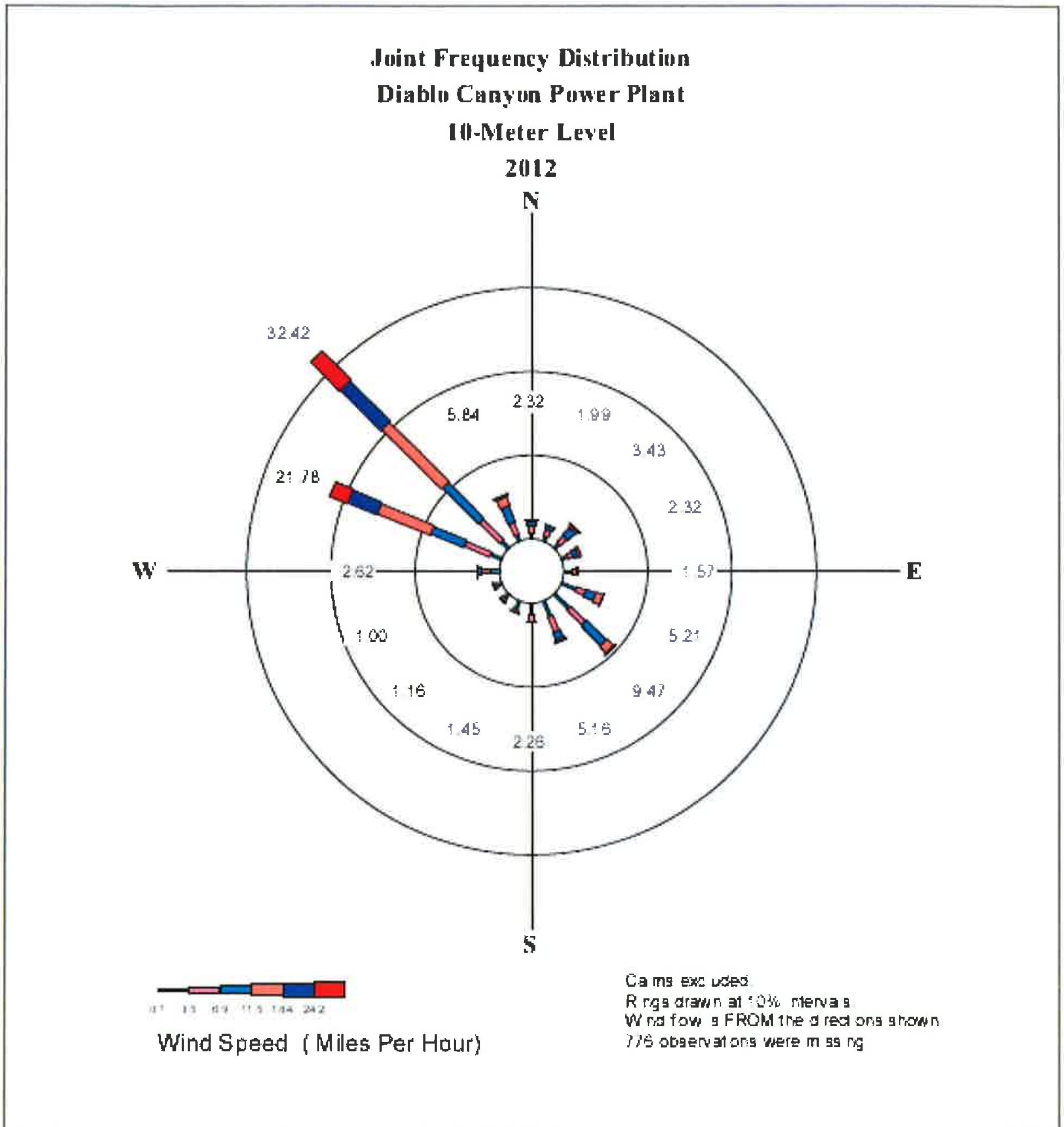
TOTAL OBS = 8104 MISSING OBS = 656

PERCENT OCCURRENCE: Wind Speed (Miles Per Hour)
LOWER BOUND OF CATEGORY

DIR	0.1	3.5	6.9	11.5	18.4	24.2
S	1.53	0.72	0.19	0.01	0.00	0.00
SSW	0.77	0.36	0.10	0.04	0.00	0.00
SW	0.72	0.37	0.09	0.01	0.00	0.00
WSW	0.79	0.53	0.12	0.00	0.00	0.00
W	0.72	1.05	0.41	0.16	0.00	0.00
WNW	1.11	2.94	3.94	4.73	2.31	0.48
NW	1.11	3.42	7.34	10.50	7.91	4.53
NNW	0.62	1.91	2.39	1.49	0.35	0.05

CALM OBS = 0

Fig. A-1: Wind direction table for the DCPP site in 2011.



PERCENT OCCURRENCE: Wind Speed (Miles Per Hour)
LOWER BOUND OF CATEGORY

DIR	0.1	3.5	6.9	11.5	18.4	24.2
N	0.72	0.91	0.49	0.17	0.03	0.00
NNE	0.60	0.86	0.47	0.04	0.01	0.00
NE	0.71	1.11	1.21	0.55	0.03	0.03
ENE	0.76	0.61	0.61	0.54	0.00	0.00
E	0.86	0.47	0.22	0.01	0.00	0.00
ESE	1.82	1.17	1.26	0.87	0.07	0.00
SE	2.42	2.50	5.32	1.05	0.14	0.04
SSE	1.95	1.97	0.80	0.29	0.06	0.00

TOTAL OBS 8008 MISSING OBS 776

PERCENT OCCURRENCE: Wind Speed (Miles Per Hour)
LOWER BOUND OF CATEGORY

DIR	0.1	3.5	6.9	11.5	18.4	24.2
S	1.42	0.72	0.11	0.00	0.00	0.00
SSW	1.00	0.59	0.04	0.05	0.00	0.00
SW	0.65	0.59	0.11	0.01	0.00	0.00
WSW	0.60	0.54	0.15	0.01	0.00	0.00
W	1.01	1.04	0.44	0.11	0.03	0.00
WNW	1.45	3.30	4.25	6.78	3.76	2.26
NW	1.17	4.46	5.07	10.04	6.82	4.86
NNW	0.81	1.64	2.04	1.10	0.17	0.00

CALM OBS 0

Fig. A-2: Wind direction table for the DCPP site in 2012.

Attachment 2
Diablo Canyon Independent Safety Committee's Evaluation of Safety Issues for "Independent Third Party Final Technologies Assessment for the Alternative Cooling Technologies or Modifications to the Existing Once-Through Cooling System for the Diablo Canyon Power Plant"

5 SEPTEMBER 2013

Concurred in by the Three Members of the DCISC at the DCISC Public Meeting on 4 September 2013

Robert J. Budnitz
Peter Lam
Per F. Peterson

Background: The request from the SWRCB "Review Committee"

In early 2011, the California State Water Resources Control Board appointed a special committee, a "Review Committee to Oversee Special Studies for the Nuclear-Fueled Power Plants Using Once-through Cooling" (the "Review Committee") to assist it in evaluating various technical options that might be used to replace or reduce the environmental impacts of once-through cooling (OTC) at the two nuclear power plants along California's Pacific coast, Diablo Canyon and San Onofre. To discharge its charter, the Review Committee requested the two companies then operating those nuclear power plants, Pacific Gas and Electric Company and Southern California Edison Company, to contract for a technical evaluation.

Bechtel Power Corporation was selected as the contractor, and its technical work is the subject of the evaluation here. Specifically, Bechtel published a preliminary study in November 2012 (Reference 1), and then in August 2013 published a follow-up technical study (Reference 2) that extends their earlier work in more detail. The current study remains at the conceptual level but contains sufficient details to reach some high-level conclusions on the nuclear-reactor-safety issues. The level of design detail remains insufficient to assess the impact of the potential design changes on the plant reliability and frequency of trips and forced outages, and to assess potential safety impacts that could occur during or after construction of the modified cooling systems.

The original scope for Bechtel was to provide information and analysis related to both Diablo Canyon and San Onofre. However, in summer 2013 Southern California Edison announced that San Onofre would be permanently closed, after which Bechtel's work has concentrated only on Diablo Canyon. The scope of the DCISC's evaluation here is also related only to the Diablo Canyon Power Plant (DCPP).

During its meeting on 13 August 2013 in Sacramento, the Review Committee made a request of the DCISC. The specific request was that the DCISC provide a technical evaluation of the nuclear-reactor-safety issues associated with seven alternative cooling technologies or modifications to the existing once-through cooling system for DCPP.

The request asked if the DCISC could provide its evaluation by 5 September 2013, which represented a very tight schedule. One of the DCISC's three members (Dr. Budnitz) attended the 13 August meeting, at which he agreed that the DCISC could and would do such an evaluation and would try to meet this schedule. The DCISC's evaluation has concentrated on Bechtel's second report (Reference 2), but has also relied in part on Bechtel's earlier work in Reference 1 as a source of important technical information.

Additional information related to the evaluation

1) Light water power reactors, like the two units at Diablo Canyon, produce large amounts of "waste heat" that must be discharged to the environment. During normal operation, the waste heat is discharged to the Pacific Ocean from the Condenser via the Condenser Circulating Water System. During off-normal or emergency conditions or when one or both reactors are shut down, residual decay heat can be ultimately discharged to the Pacific Ocean via a separate safety-related Auxiliary Saltwater (ASW) System termed the "ultimate heat sink" (UHS), and we will use that term here.

2) Today, Diablo Canyon's normal heat discharge to the adjacent Pacific Ocean uses the specific technology called once-through cooling (OTC), in which cool ocean water is pumped into the plant, warmed up about 20 degrees Fahrenheit, and returned to the ocean. The current OTC approach inevitably produces environmental impacts on the nearby ocean, and the motivation for the current review of OTC is a desire to decrease these impacts by a change in cooling technology. While each of the seven alternatives being evaluated by Bechtel has a different mix of environmental impacts, and although the waste heat must go "somewhere in the environment," this set of environmental-impact issues is beyond the scope of DCISC's evaluation here.

3) The SWRCB is currently considering a new regulatory position that would require Diablo Canyon to replace its current OTC system with a system that would produce smaller environmental impacts on certain aspects of the ocean environment.

4) A paraphrasing of Bechtel's initial scope is that Bechtel was asked to identify a very large range of technically feasible cooling alternatives that might be deployed at Diablo Canyon. It discharged that assignment in its first report (November 2012, Reference 1).

5) The SWRCB Review Committee reviewed Bechtel's report, and based on criteria that are beyond our scope here, the Review Committee directed Bechtel to narrow the options to seven that were to be evaluated further. In the next phase of Bechtel's work (Phase 2), more detailed conceptual designs and engineering analyses were completed for each of these seven options, and Bechtel also performed a review of the relevant nuclear-reactor-safety issues for each. A cost study is also part of Bechtel's Phase 2 work, but evaluating it is outside of the DCISC's scope.

The seven technologies are as follows:

- Inshore mechanical (active) intake fine mesh screening systems
- Offshore modular wedge wire systems

- Closed-cycle cooling systems (5 different approaches):
  - Passive draft dry/air cooling
  - Mechanical (forced) draft dry/air cooling
  - Wet natural draft cooling
  - Wet mechanical (forced) draft cooling
  - Hybrid wet/dry cooling

6) Providing reliable and effective cooling is an important aspect of the overall safety of a nuclear power plant's design, and, as noted above, the DCISC's concern here is to evaluate the implications of a change in cooling technology on the overall nuclear-reactor safety at Diablo Canyon.

Bechtel's safety assessment and conclusions

As noted above, in Bechtel's recent report (Reference 2) the Bechtel team has performed an assessment of the nuclear-reactor safety of each of the seven alternative cooling options that might replace OTC at Diablo Canyon. Bechtel based its assessment on a set of criteria specified by the Review Committee. This set of criteria, called in the Bechtel report "Criterion 10," covers eight "*areas of NRC interest,*" against each of which the assessment was performed. The NRC regulation 10 CFR 50.59 (Reference. 3) is a major basis for these criteria. Diablo Canyon's Final Safety Analysis Report Update (Reference. 4) is cited by Bechtel as one of the major regulatory documents used by the NRC and the plant to document the plant's safety analyses.

The eight areas are:

- Seismic issues
- Operability
- Transient analyses
- Nuclear fuel (accident analyses)
- Single failures
- Hydraulic design
- Probabilistic risk assessment
- Instrumentation controls and alarms

The Bechtel report states, "*Criterion 10 is a feasibility assessment based on regulatory requirements established by 10 CFR 50.59 to determine whether NRC approval of the alternative technology is required.*"

For each of the seven alternative UHS options, Bechtel has concluded as follows (Reference. 2, Section 1.5, "Conclusions"):

"*Based on the results of the feasibility assessment and when more detailed engineering information becomes available, the anticipated responses to the following eight 10 CFR 50.59 criteria questions for each of the proposed modifications would be NO:*"

1. Result in more than a minimal increase in the frequency of occurrence of an accident previously evaluated in the FSARU [Final Safety Analysis Report Update]?

2. Result in more than a minimal increase in the likelihood of occurrence of a malfunction of an SSC [structure, system, or component] important to safety previously evaluated in the FSARU?

3. Result in more than a minimal increase in the consequences of an accident previously evaluated in the FSARU?

4. Result in more than a minimal increase in the consequences of a malfunction of an SSC important to safety previously evaluated in the FSARU?

5. Create the possibility of an accident of a type different from any previously evaluated in the FSARU?

6. Create the possibility of a malfunction of an SSC important to safety with a result different from any previously evaluated in the FSARU?

7. Result in a design basis limit for a fission product barrier as described in the FSARU being exceeded or altered?

8. Result in a departure from a method of evaluation described in the FSARU used in establishing the design bases or in the safety analyses?

The Bechtel report continues: *"Consequently, subject to the limitations of the Phase 2 assessment information, implementation of the closed cooling technology, the inshore dual-flow fine mesh screens, or the offshore modular wedge wire screening system design alternatives is believed to not require a License Amendment Request (LAR) in accordance with 10 CFR 50.59."*

Among the crucial words in these two quotes are the "conditional words," as follows: *"the anticipated responses . . . would be NO"* [first sentence in the above quote], and *"subject to the limitations of the Phase 2 assessment information, implementation [of any of the options] is believed not to require a License Amendment Request"* [final sentence in the above quote.]

Bechtel's conclusion concerning safety and DCISC's evaluation of it

We understand Bechtel's conclusion to mean the following: Although more information would be needed to support a definitive conclusion, Bechtel, applying its expert judgment and based on the information at hand, concludes that any of the proposed cooling options can be implemented in a way that will meet NRC requirements vis-à-vis nuclear-reactor-safety. In fact, Bechtel's conclusion is stronger than that. Bechtel's judgment is that it is likely that for any of the seven cooling options under consideration, the nuclear-reactor-safety impact on the plant would be modest enough that PG&E would not even need to request a NRC license amendment request (LAR) before it could proceed with installing that option at Diablo Canyon. (All of this is subject to

Bechtel's appropriate *caveat* that more detailed information will ultimately be needed, as the specific design details are developed, before a sufficient basis will be available for a firmer judgment.)

The DCISC has reviewed Bechtel's conclusion and the basis for it. We believe that not enough information is available now to conclude definitively that any of the seven options will meet NRC's nuclear-reactor-safety regulations. That will need to await specific design details that are not available now.

We conclude that the Bechtel assessment that no LAR is required might be correct for the inshore fine-mesh screening system option, because this option involves the least extensive modifications to the plant; however, this assessment is questionable for the off-shore, modular wedge-wire system, because this option requires the installation of a new, safety-related stop-log system in the plant intake cove. The addition of a new, safety-related system will certainly require a NRC LAR.

We conclude that the Bechtel assessment is likely to be incorrect for the various closed-cycle cooling options. All of these options involve very extensive modifications to the plant, including modifications to the plant intake structure that also houses the ASW system, protected area boundary, turbine building (which houses safety-related emergency diesel generators and electrical switchgear), and rerouting of the plant's 230-kV alternate offsite power transmission system. These major modifications have the potential to affect the operability of safety-related systems both during and following construction, and potential undesirable interactions will require detailed design review by the NRC to identify and mitigate.

While we conclude that most of the proposed cooling system modifications would require a NRC license amendment request, Bechtel's conceptual design study has sufficient detail to allow a preliminary conclusion that NRC approval of the license amendment could likely be obtained. The most important bases for this, in our view, are two:

1. First, Bechtel has performed a set of nuclear-reactor-safety evaluations against each of the various 10 CFR 50.59 criteria for each of the seven alternative cooling technologies.

2. Second, around the world there are a wide variety of cooling designs deployed today at the few hundred operating nuclear power plants. The seven options under consideration here are each represented (broadly, although not in technical detail) elsewhere, and at large numbers of plants for the closed-cycle options. Less experience exists with intake fine screening and offshore modular wedge-wire systems under conditions relevant to the Diablo Canyon site, and we therefore believe that a testing program should be conducted or actual experience elsewhere reviewed to verify performance of either system before it should be selected. Furthermore, for any of the seven proposed alternatives, there is the potential for a significant reduction in the plant's reliability and for an increase in the frequency of trips and forced outages. Much additional work would be needed before assurances could be had that the overall safety impact of these potential issues is manageable. However, because these cooling technologies exist, can be and have been designed and operated safely

elsewhere, we judge that it is probably feasible to deploy any of these seven options at Diablo Canyon in a manner that will meet NRC safety regulations.

However, this finding on our part is not sufficient for us. That is, the DCISC has developed a different criterion for judging the safety of an alternative cooling technology at Diablo Canyon. The next section will explain why we have a different criterion, after which we will present our safety criterion and our evaluation based on it.

The ultimate heat sink

The preceding discussion covered the normal non-safety-related plant cooling system, which discharges waste heat from the condenser to the Pacific Ocean via a Once-Through Cooling System. A totally separate system, the nuclear-safety-related Auxiliary Saltwater System, discharges plant decay heat to the Pacific Ocean in certain shutdown, off-normal, and emergency conditions. This arrangement is called the Ultimate Heat Sink (UHS) because it is the final or ultimate opportunity to keep the plant cool and safe if all other methods are unavailable or have failed.

With two exceptions the seven cooling alternatives proposed by Bechtel would be independent and separate from the UHS, and thus should normally have no adverse impact on nuclear-reactor safety from the UHS standpoint. The two exceptions are the following options:

- Inshore mechanical (active) intake fine mesh screening systems
- Offshore modular wedge wire systems

We are also concerned about a third issue:

- Effects of construction/installation on AWS/UHS

The first two alternative cooling options both utilize the current OTC intake cove and intake structure, which also house the ASW System, part of the UHS. At this stage it appears that these two options would affect the UHS, but final design and analysis would be necessary to permit a determination of the significance. The third item, construction/installation, could adversely impact ASW/UHS, which concerns the DCISC at this conceptual stage. We believe that compensatory measures would likely be taken; however, we reserve final judgment until more is known about this impact.

The DCISC has been studying this issue since December 2010, and in its most recent 2010 – 2011 Annual Report (Reference 11), it concluded the following:

"A range of adverse nuclear safety impacts is known qualitatively at this time and is of concern to the DCISC. The DCISC will continue to take seriously the charge to review the safety impacts of the elimination of Once Through Cooling (OTC) at DCPP and provide analysis and input to the process."

Bechtel concluded the following:

"*The safety-related ASW system is not affected by this modification. The CWS* (Circulating Water System) *and the SCW* (Service Cooling Water) *system do not provide cooling to any component required for safe shutdown. The CW* (Circulating Water) *pumps are not required for the safety of the units. A complete shutdown of the SCW system would not affect safe shutdown of the reactor. The replacement of the once-through cooling with closed cycle cooling would result in an increase in circulating water temperature. This increase is not expected to adversely affect FSARU accident analyses since these systems serve no safety related functions.*"

The DCISC agrees that the alternative cooling systems would not adversely affect the FSARU accident analyses provided that the ASW/UHS is not affected by the proposed alternative cooling system, which appears to be the case based on Bechtel's conceptual studies performed to date, but the reliability of this non-safety related equipment may affect the frequency of plant trips and equipment failures that require safety-related equipment to function in order to prevent or mitigate accidents. Insufficient information is available to answer the question of whether the alternative cooling systems might affect the frequency of accident initiating events.

Effects of plant modifications on plant reliability

One of DCISC's principal concerns with the proposed alternative cooling options is their potential impact on the plant's reliability, and the potential to increase the frequency of plant trips and forced outages that stress plant safety systems (e.g., ASW/UHS) and can provide initiators for accidents. Much of the improvement in nuclear plant safety around the world in the last three decades has come from improved operational methods that have greatly reduced the frequency of plant trips and forced outages.

While the DCISC assesses that the proposed alternative cooling methods could be successfully licensed by the NRC, the level of design detail and information is insufficient to assess the likely affects of the design changes on plant reliability. For example, the closed-cycle options all involve a substantial increase in the operating pressure of the circulating water system, and the potential for increased flooding risk can only be assessed following detailed design. Likewise, the wet closed cycle options include a water storage capacity of only two hours (Reference 2, Section 4.3.4.1) so any outage of the water supply system exceeding this will result in a plant trip. For all systems, there will be a learning curve associated with the transition to alternative cooling that will result in increased risk of plant trips during the learning period.

The importance of the ultimate heat sink in reactor safety, and how an understanding of this importance is developed

Before describing the nuclear-reactor-safety criterion that the DCISC has used in this evaluation, we need to explain something about nuclear-power-plant risk, and about how it is understood by the community of nuclear-power-plant safety analysts.

Every operating US nuclear power reactor, including the two units at Diablo Canyon, meets all applicable NRC regulations. (Otherwise, it would not be operating.) However, this does not mean that any of these reactors presents zero risk to the public. While the NRC has judged the risks acceptably low, the possibility of a release of radioactivity that might affect the public does exist. We will call the ensemble of these risks of a radioactive release the "residual risk," the word "residual" meaning to imply that these are the risks that remain after all of the hard work has been done to reduce the risks to low levels that are acceptable to the NRC and to the DCISC.

Reactor safety analysts study these risks using many different approaches. The approach that provides the most realistic understanding is embodied in an analysis technology known as "probabilistic risk assessment" (PRA), which delineates every important "accident sequence" that might arise at a given reactor. In the PRA, each such accident sequence begins with a specified "initiating event" (such as an equipment failure, a human error, an electrical fire, or an event external to the plant like an earthquake), proceeds through a series of other failures (either equipment failures or operator errors), and ends up with an end-state other than a "safe, stable" end state. (A PRA sequence that ends up at a "safe, stable" end-state is not an "accident.") For those sequences that do not end "safe and stable," the PRA evaluates the overall annual probability of occurrence, the sequence of events that would take place, and the consequences were the sequence to occur. The consequences are analyzed and described quantitatively in terms of damage to the reactor core, the potential for releases of radioactivity from the core to the building, the physical, chemical, and radiological character of those releases, and ultimately the possible release of radioactivity to the environment outside the plant.

It is important to note that the initiating events that can lead to accidents do not necessarily involve safety related systems. Instead, as the reactor-safety community knows from both analysis and operating experience, sometimes these accident sequences may initially involve failures of non-safety related equipment, which then require that safety-related systems function in order to prevent or mitigate an accident. Thus data for the reliability of non-safety-related equipment and systems is a key input to PRA assessments, in addition to that for safety-related systems.

The Diablo Canyon station has performed a PRA of good quality (Reference 5), which is used essentially every day to help understand various issues at the plant as they arise. This PRA is currently being updated in important ways, a process that goes on periodically at Diablo Canyon as elsewhere around the country, because new PRA methodologies are continually being developed, data bases for equipment failures and the like are continually being revised with new information, and there is now a methodology standard for PRA (Reference 6) that is used throughout the U.S. to which the Diablo Canyon PRA is being compared.

The DCISC has reviewed the Diablo Canyon PRA, and also studied several later reviews of it by others (References 7, 8, and 9). We judge that the residual risk as described in the PRA is acceptably small, and have used that judgment as one basis for our conclusion that the plant's two reactors are now being operated safely.

As noted, many different types of accident sequences can occur at Diablo Canyon, and the PRA analyzes them. Among these accident sequences are some that involve prolonged loss of the function of discharging the waste heat to the environment. Prolonged loss of this function can lead to a serious accident, which is why great care is taken at every nuclear plant in the design and operation of the equipment and structures that carry out this function. There are potential sequences in which loss of this function is the initiating event, and others in which this function is lost as a consequence of another initiating event, such as an equipment failure elsewhere in the plant.

The DCISC has reached two important conclusions about Diablo Canyon that need to be understood before we can explain our evaluation here. First, the DCISC judges (as noted above and based in part on the PRA) that the current level of safety achieved at Diablo Canyon is acceptable. Second, the PRA, which the DCISC judges to be technically sound, finds that none of the major contributors to the residual risk from accident sequences at Diablo Canyon involve prolonged loss of the normal function of discharging the waste heat to the environment.

While prolonged loss of circulating water system (CWS) function is not an important contributor to risk at DCPP with today's configuration, abrupt loss of CWS results in one of the more severe types of transients the plant can experience. The risk arises from the coupling between different pieces of equipment during the transient, which can affect equipment reliability in ways not fully captured by the normal reliability data. In the case of abrupt failure of CWS, a normal turbine and reactor trip occur, but the capability to dump excess steam to control the primary system pressure and temperature is reduced because the capacity of the turbine condenser to accept steam is lost. Thus abrupt CWS failures result in a larger temperature and pressure transient to the primary system than during normal plant trips. While these temperatures and pressures remain within the design capability of the primary system, the greater stresses increase the probability of failures of safety-related components. For this reason, the DCISC recommends that special attention be paid to assure that any cooling system modifications do not result in a significant reduction in the reliability of the CWS function.

Another consideration is important to mention here. As a result of insights from the Fukushima nuclear-plant accident in Japan in March 2011, the NRC has ordered all US operating reactors to perform certain studies and based on them to carry out certain safety improvements; other safety improvements may be required by the NRC in the future based on technical studies now under way. In parallel, the US nuclear-power-reactor industry as a whole has undertaken other studies, and has taken the initiative to propose a set of safety improvements that it believes are required and beneficial. Among these latter is an industry initiative, known as "FLEX" (Reference 10), that among other benefits will provide each nuclear plant with a more robust capability to respond in the unlikely event of a prolonged loss of ultimate heat sink. We note that the specifics of these FLEX improvements have not yet been finalized, either at Diablo Canyon or anywhere else, but they are surely going to be installed in one form or another, and they will provide Diablo Canyon with an even stronger basis for the safety performance of its current UHS.

The DCISC's safety criterion

As background, we first reiterate something we noted above, which is that the current OTC approach for providing the normal cooling function at Diablo Canyon meets all applicable NRC requirements. The DCISC is acutely cognizant of the US NRC's nuclear-reactor-safety criteria for this function, and would not provide a positive evaluation for any technology that did not meet those criteria. However, we have approached our safety evaluation using a different set of criteria. Our position is that, although replacement cooling technology could meet all NRC regulations, it could still represent an unacceptable degradation of the overall nuclear-reactor-safety performance at Diablo Canyon when compared to the current configuration. For this reason, the DCISC criterion can be stated as follows:

> *Having concluded that the current OTC approach for performing the normal plant cooling function at Diablo Canyon has adequate safety, the DCISC's safety criterion is that any alternative proposed as a replacement should provide at least approximately the same level of overall nuclear-reactor safety.*

In the DCISC's view, this mainly (but not entirely) comes down to asking the following question of any technology that might be proposed to replace once-through cooling to perform the normal cooling function at Diablo Canyon, after stipulating that the technology must also meet all applicable NRC regulations:

> *As analyzed in the plant PRA, will the contribution of accident sequences involving loss of cooling remain as only a modest contributor to the total residual risk at Diablo Canyon?* *

The DCISC cannot answer this question today, because the analysis has not been performed. However, the DCISC is willing to offer the following assessment: Based on our review of the technical information in front of us, meaning the information in the two Bechtel reports (supplemented by our knowledge of how various cooling technologies perform at other nuclear power plants around the world), we judge it likely that none of the proposed new technologies would pose a significant safety problem at Diablo Canyon, if they do not degrade significantly the plant's reliability and increase the frequency of plant trips. However, this is not a strong conclusion based on evidence, but merely a judgment based on what we know so far. Crucially, more analysis is needed. Any new technology must be designed, installed, and operated to high reliability standards, and the first step would be the design step, where details must be developed that will lead to an acceptable design solution.

To summarize: While the DCISC has a technical basis for optimism, we cannot determine from the available conceptual information whether any of the proposed alternative technologies will contribute more to the overall plant risk profile at Diablo Canyon than the modest contribution made today by the current cooling technology

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* The comparison between the current cooling configuration and any proposed new one should, in our view, account for the safety benefits to be realized when the new FLEX equipment is installed, because that equipment will surely be available long before any proposed change in the cooling configuration at Diablo Canyon would occur.

(using once-through cooling) -- and we believe that nobody else can fully determine this yet either.

Summary of DCISC findings, conclusions and recommendation

o Bechtel's assessment (as we have paraphrased it) is that if any of the seven alternative options under consideration were to be selected to replace OTC at Diablo Canyon, the nuclear-reactor-safety impact on the plant would not be significant enough that PG&E would even need to ask for an NRC license amendment before it could proceed with installing that option at Diablo Canyon. The DCISC has reviewed Bechtel's conclusion and the basis for it. We find that this conclusion is questionable for the offshore wedge-wire system, because this system requires that a new safety-related system be designed and installed in the plant intake structure. We also find that it is unlikely, given how extensive the plant modifications are, that the installation of any of the five closed cooling options could be performed without a license amendment request.

o We find that the nuclear safety impacts of the alternative cooling options, if and when they are appropriately designed, manufactured, and installed, would likely be sufficiently small that NRC approval could be obtained. However, the DCISC has an additional criterion for judging the safety impact of an alternative plant cooling technology at Diablo Canyon. That is because, in our view, meeting NRC's safety regulations is necessary to support a decision to proceed, but not sufficient.

o Based on our review of the technical information in front of us, we judge it probable that none of the proposed new technologies, if and when they are developed and implemented in accordance with established safety practices, would pose a sufficient safety problem to preclude NRC licensing of the modified design. However, this is not a strong conclusion based on evidence, but merely a judgment based on what we know so far.

o One of our primary concerns with any of the proposed alternative cooling methods involves the potential impact on plant reliability, in particular whether the modified configuration might be more prone to generating plant trips and forced outages, with a potential impact on plant safety, in particular a potential impact on ASW/UHS.

o **The DCISC recommends that additional analysis be performed and more design detail be provided by Bechtel or by PG&E in order to assess the likely effects of the alternative cooling methods on plant reliability and to determine whether the DCISC safety criterion will be met.**

DCISC follow-on activities

These are all interim DCISC findings and conclusions, in the sense that as new information is developed (and it will be) any of them is subject to updated evaluation. In particular, as a follow-on to the work done so far on this set of issues, we will undertake the following:

- We (the DCISC) will continue to review the latest technical information developed by both Bechtel and PG&E; will follow and review any other new information as it comes to our attention; and will also review any NRC evaluations if the NRC becomes involved.

- We will review any new information about these issues that may emerge in the engineering community more broadly for possible relevance to Diablo Canyon, quite apart from whether it is associated with the current proposals.

All of the above would be a part of our normal DCISC scope to review operational safety at Diablo Canyon, but because of the special inquiry made by the California SWRCB, we will be especially alert about these issues.

References

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10. Nuclear Energy Institute, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Report No. NEI 12-06, Washington DC (August 2012)

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