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OTC Public Hearing (9/16/09)
SB Hearing
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Once Through Cooling
Deadline: 9/30/09 by 12 noon

Powers Engineering comments – Sept. 16, 2009 SWRCB Public Hearing

The OTC water withdrawals from the two nuclear plants, at 2.5 billion gallons per day of seawater each, dominate power plant water withdrawals along California's coast. These two plants, 2,160 MW Diablo Canyon and 2,200 MW San Onofre Nuclear Generating Station (SONGS), account for approximately two-thirds of the once-through cooling water utilized by the state's combined population of coastal nuclear and natural gas-fired steam boiler plants.

Retrofitting nuclear plants with cooling towers is technically straightforward. The entire cooling tower and piping construction process can take place while reactors continue to operate using once-through cooling. A shutdown is only required to allow final tie-in of the cooling tower piping to the existing surface condensers at each reactor. The April 2008 ICF Jones & Stokes reliability report prepared for the State Board states that properly scheduled conversion shutdowns, including those for nuclear plant conversions, should have no effect on overall grid reliability in the state.

Retrofitting the nuclear plants with cooling towers will not jeopardize nuclear safety in any way. Retrofitting to a wet tower is fundamentally simple - the pipes going to and from the ocean are rerouted to a cooling tower. No modification is required to the core components of the nuclear plant. Many U.S. nuclear plants already use wet cooling towers, and a number of these plants are equipped to switch between wet cooling towers and once-through cooling. One US nuclear plant, 800 MW Palisades Nuclear in Michigan, has already been retrofit to closed-cycle cooling. NRC participants in the CEC's June 2007 workshop on California nuclear plants identified no nuclear safety requirements that would preclude retrofitting California's nuclear plants to cooling towers when questioned on this topic by CEC commissioners.

Retrofitting the nuclear plants with cooling towers is cost-effective and would have very little impact on the cost of power generated by these plants, on the order of a 2 percent increase. I am a consultant on a proposed nuclear plant cooling tower retrofit in Connecticut. The retrofit cost estimate prepared by the plant owner, Dominion Nuclear, is similar to the public interest cost estimate. Dominion's 2001 estimate for a conventional cooling tower on 1,130 MW Unit 3 at Millstone was $126 million. This is equivalent to approximately $160 million in mid-2009. Millstone Unit 3 is slightly bigger than the reactors at Diablo Canyon and SONGS.

This cost is consistent with the cooling tower cost estimated for the reactors at Diablo Canyon and SONGS in June 2009 by the nation's largest power plant cooling tower manufacturer, SPX Cooling Technologies. SPX estimated a cost of approximately $155 million for a conventional cooling tower for each reactor and $230 million for a plume-abated tower that minimizes visible vapor plumes. PG&E's public comments that a cooling tower retrofit at Diablo Canyon would cost $4 to 4.5 billion is unsupported and contradicts available industry cost estimates.

Diablo Canyon generates more than $2 billion per year in revenue for PG&E. The annualized cost of a cooling tower retrofit, assuming a plume-abated tower, would be on the order of $40 million per year. That is approximately 2 percent of the annual revenue generated by the plant.

Retrofitting cooling towers to the nuclear plants will not result in long plant outages.
One US nuclear plant and several US coal-fired plants have been retrofit to cooling towers. The hook-up of the new cooling system has generally been carried-out: 1) in four weeks or less with little or no downtime beyond the typical outage period, and/or 2) in non-summer months when power demands is low. In the case of Diablo Canyon and SONGS, each reactor is shut down for 30-40 days every two years or so for refueling. Longer outages of 100 days or more occur every 3-5 years. There are regular opportunities to plan the cooling tower tie-in with scheduled outages at Diablo Canyon and SONGS.

Far more invasive and expensive retrofits are currently taking place at both Diablo Canyon and SONGS. Reactor steam boiler replacements have just been completed at Diablo Canyon and are underway at SONGS. The CPUC-approved cost of the boiler replacements is approximately $350 million per reactor. The four steam generators at Diablo Canyon Unit 2 were replaced in 2008 with a total outage time of 69 days. The work was done concurrently with a planned refueling outage. Since the containment building and original installation of the steam generators was not intended to provide for boiler replacement, a completely customized system was needed to remove them. In contrast, the connection of cooling tower piping is far simpler technically and is the only phase of the cooling tower retrofit that would require shutdown of the reactor.

The difference in cost estimates for cooling tower retrofits at Diablo Canyon and SONGS is driven by faulty assumptions on the need to demolish existing onsite structures, outage duration, and contingency costs. The Ocean Protection Council's contractor, TetraTech, estimated approximately the same cost as SPX, $150 million per reactor, for conventional cooling towers at Diablo Canyon in its February 2008 report on the cost and feasibility of cooling tower retrofits. However, in the case of Diablo Canyon, the TetraTech cost estimate also includes $300 million per reactor for demolition of existing onsite structures, undefined indirect costs, and 30% contingency. In addition, TetraTech assumes an 8-month outage for the cooling tower tie-in, at an estimated lost revenue cost of over $350 million per reactor.

All of these additional costs are avoidable if better locations are chosen for the cooling towers and a realistic tie-in outage time is assumed. For example, TetraTech assumes a 4-week tie-in outage for the 700 MW units at Moss Landing. This is a reasonable assumption. An 8-month outage at Diablo Canyon for the same type of tie-in is not reasonable.

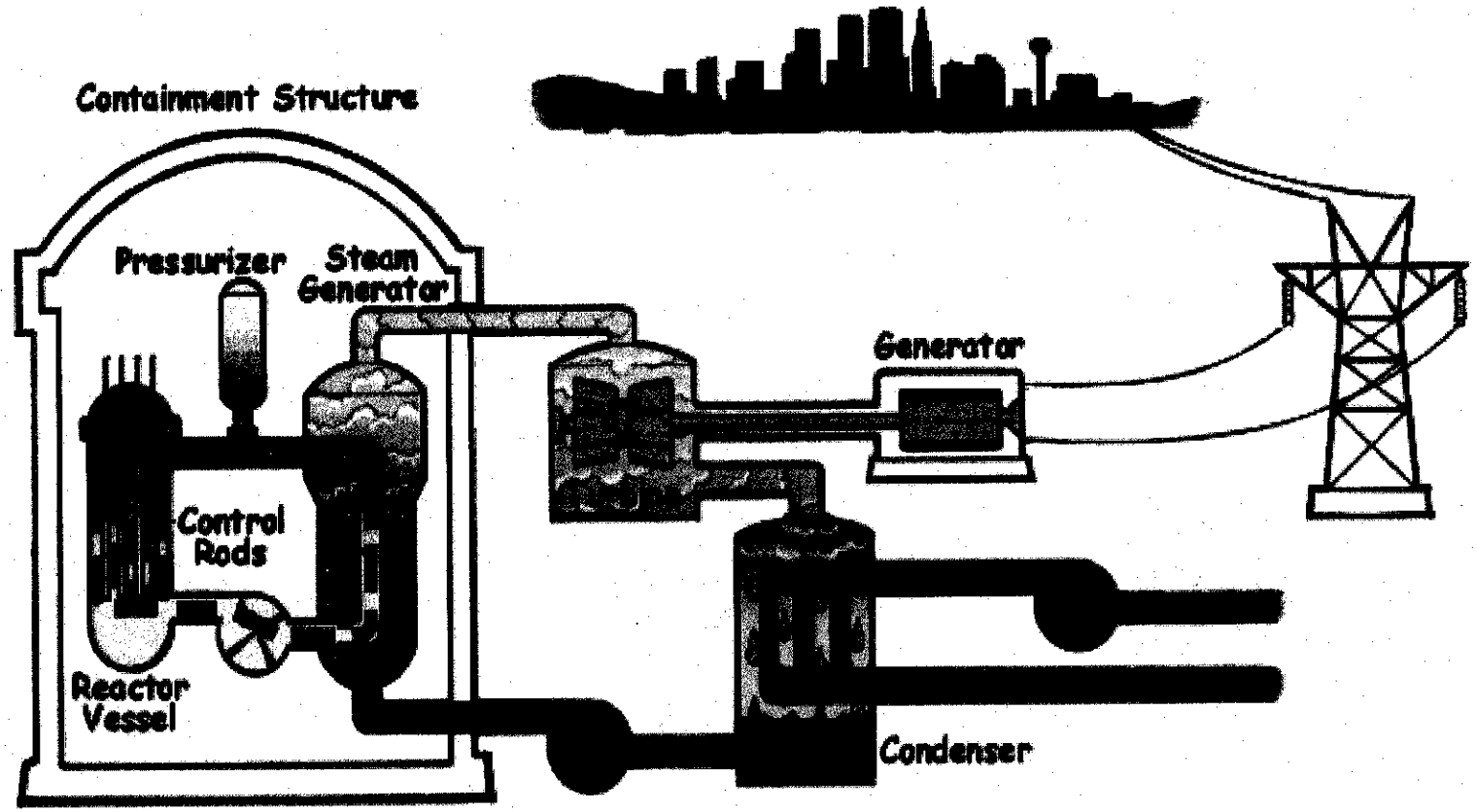
The TetraTech cost estimate for SONGS, at approximately $230 million per reactor for a plume-abated cooling tower (without the 30% contingency), is the same as the SPX estimate. However, again without supporting justification, TetraTech assumes a 6-month outage to tie-in each cooling tower which results in $300 million in lost power generation revenues per reactor.

The conversion to cooling towers will have little impact on the efficiency of the nuclear plants. The overall energy penalty of a nuclear plant wet cooling tower retrofit is approximately 1 to 2%. EPA cites a range of 1.2 to 1.5% total energy penalty depending on where the nuclear plant is located in the country. These estimates are thoroughly substantiated with technical support documentation developed for the 316(b) regulatory process.

Particulate emissions from the cooling towers will have little or no impact on local air quality. Some solids are contained in the small amount of circulating water that is emitted from the cooling towers as fine mist, and has the potential to become airborne particulate. In San Luis Obispo County, where Diablo Canyon is located, these emissions can be offset by paving dirt roads. In San Diego County, where SONGS is located, cooling towers are exempt from air quality permit requirements. Use of reclaimed wastewater as cooling water, which is an option in the case of SONGS, would reduce particulate emissions due to the lower solids content of reclaimed water compared to seawater.

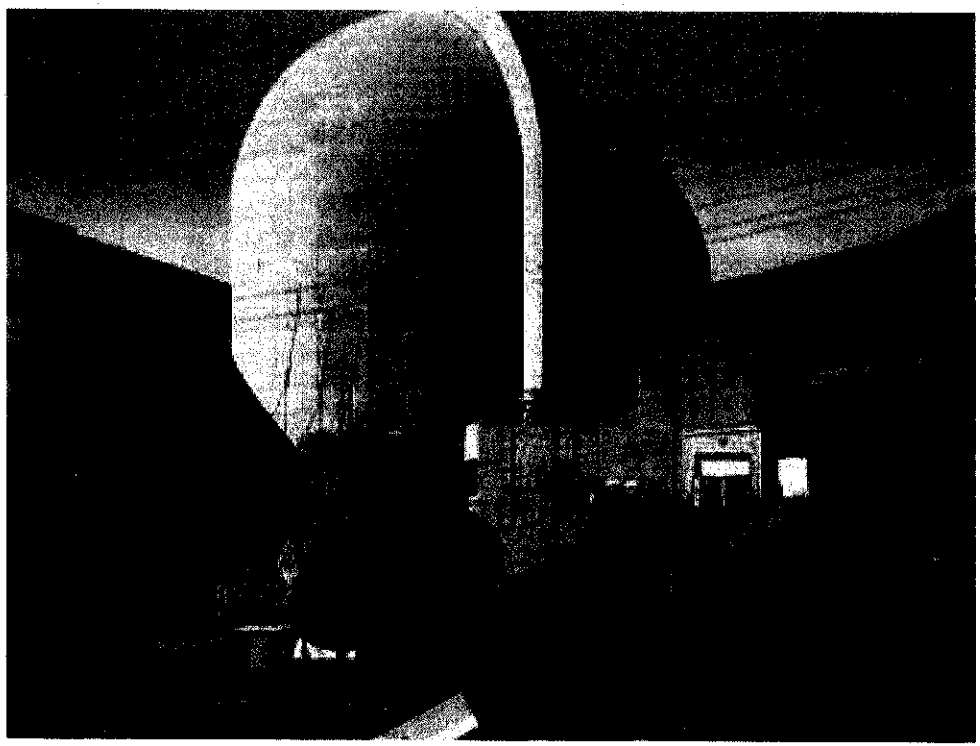
Recommendation: 1) The proposed study of nuclear plant retrofits should be independent of the utilities and TetraTech. Both have stated indefensibly high costs for nuclear plant cooling tower retrofits. 2) It is not advisable to have the affected parties conduct a "wholly disproportionate" analysis. These parties are on record as opposed to cooling tower retrofits. There is sufficient public domain information, much of it paid for by the state, for review, identification of data gaps, and decisionmaking.

Pressurized water reactor basics



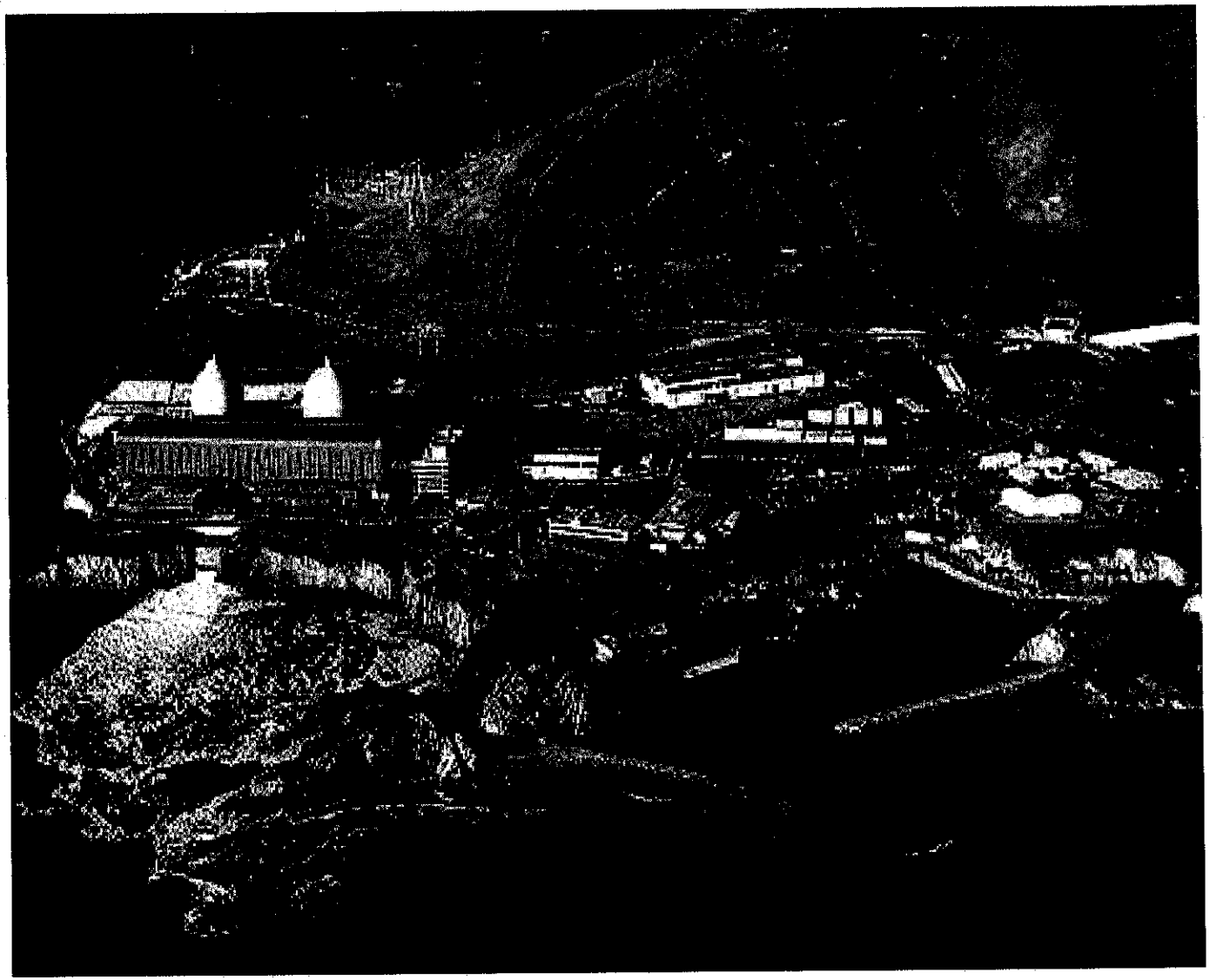
Removal of steam generator from Diablo Canyon Unit 1 containment dome

source of photos: Power Engineering, Diablo Canyon Unit 1 Steam Generator Replacement Project, Sept 2009

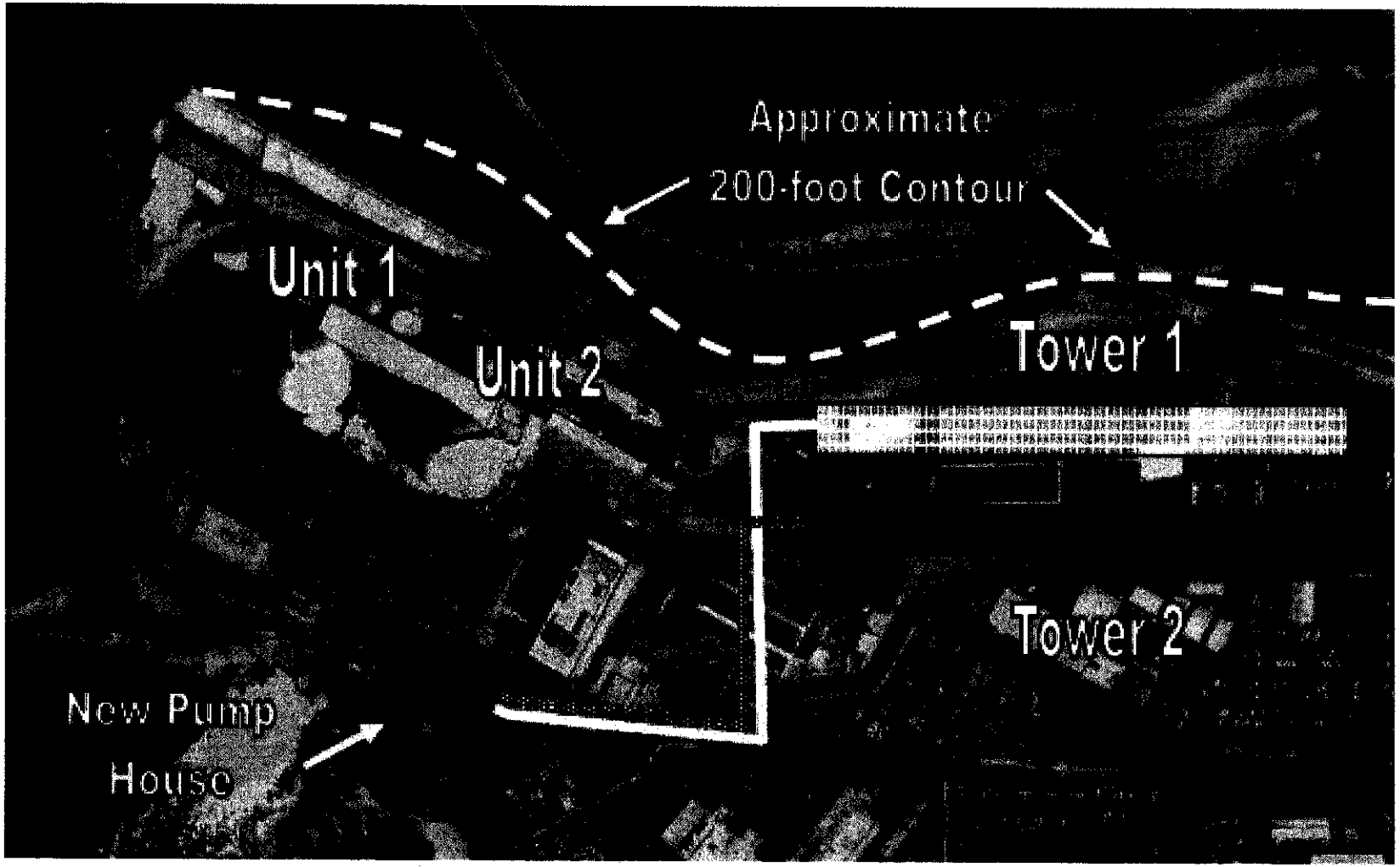


Diablo Canyon Nuclear Plant

source of all photos: TetraTech, California's Coastal Power Plants: Alternative Cooling System Analysis, February 2008

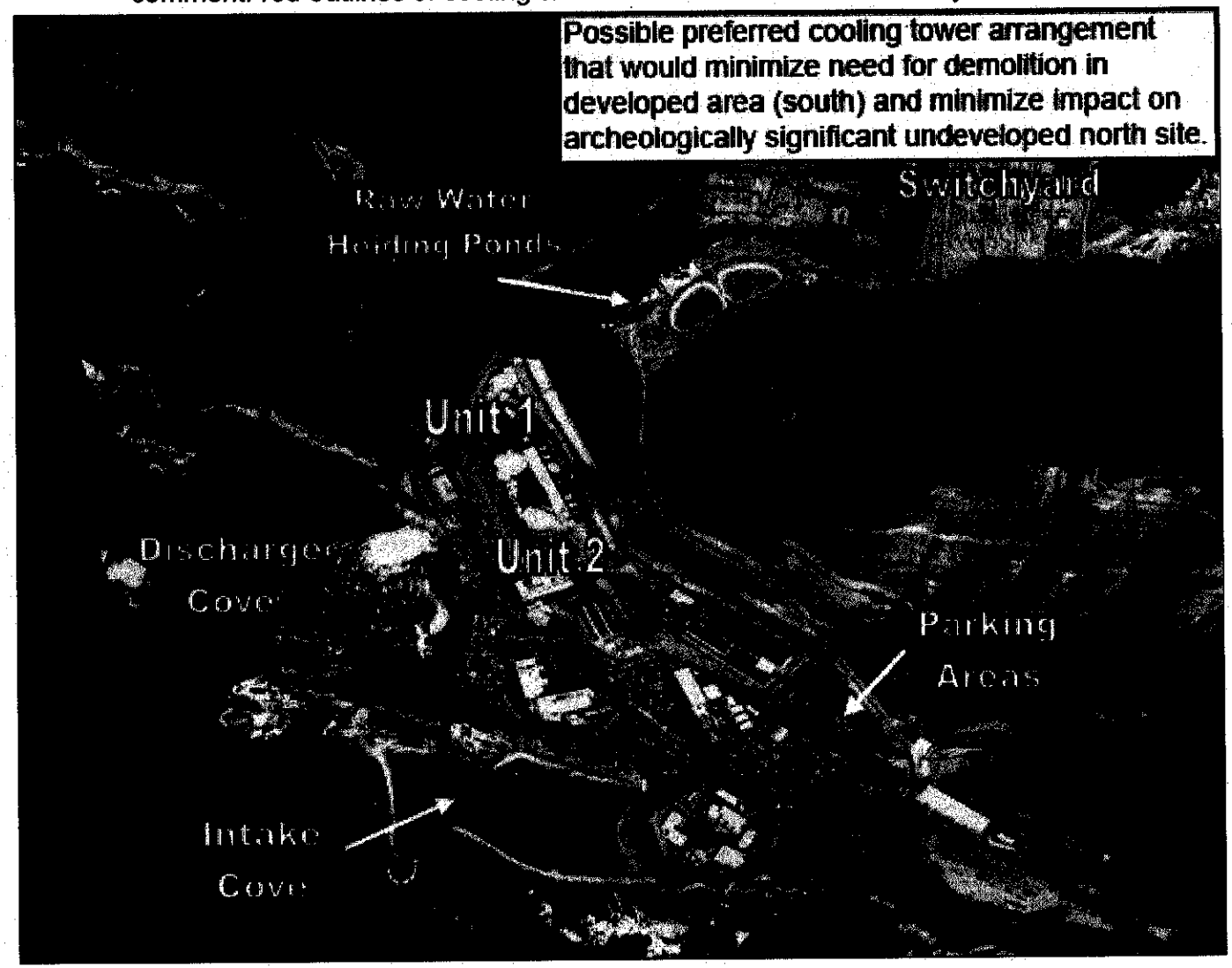


Diablo Canyon –location of cooling towers assumed by TetraTech

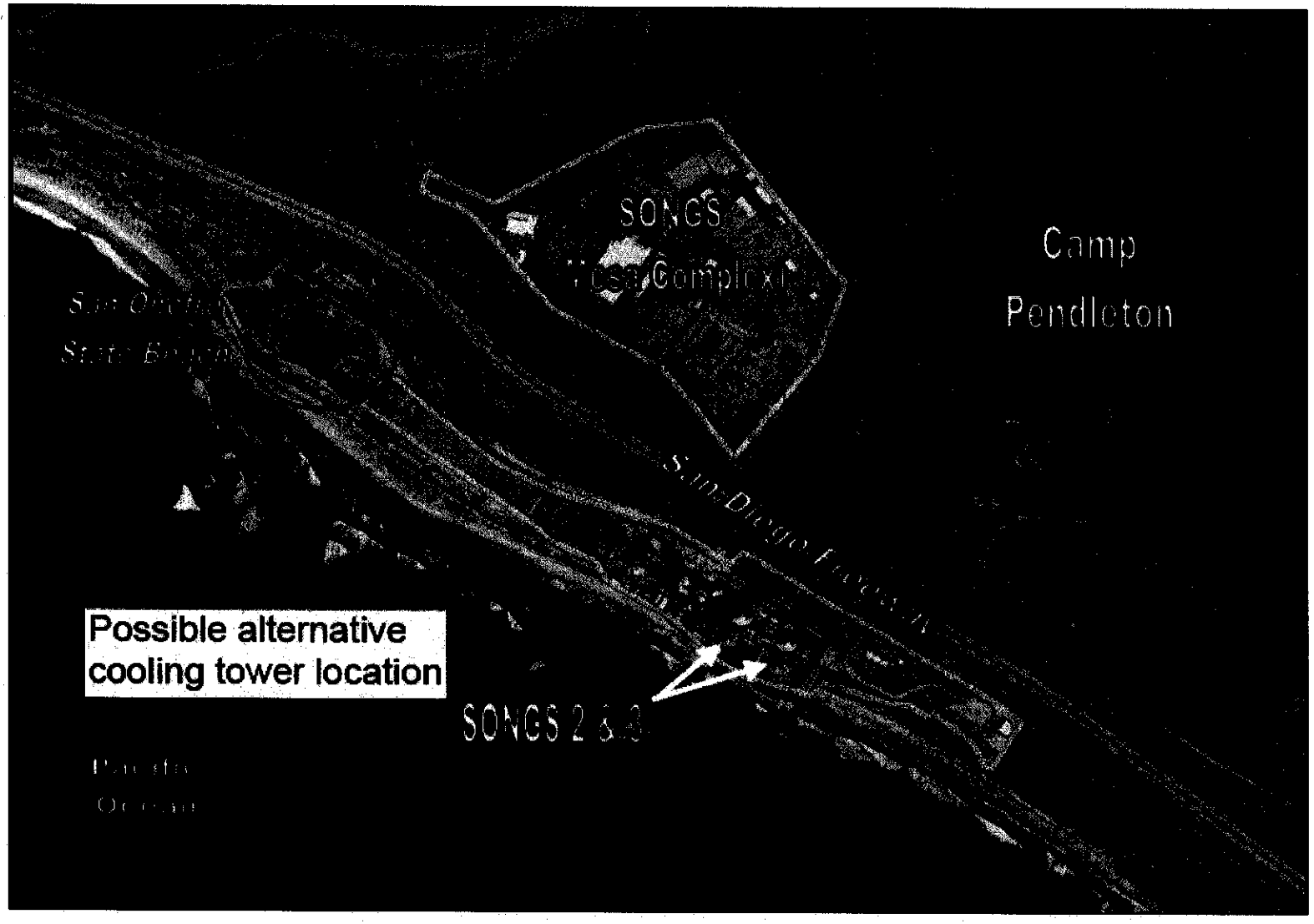


Diablo Canyon – cooling tower locations that avoid existing structures

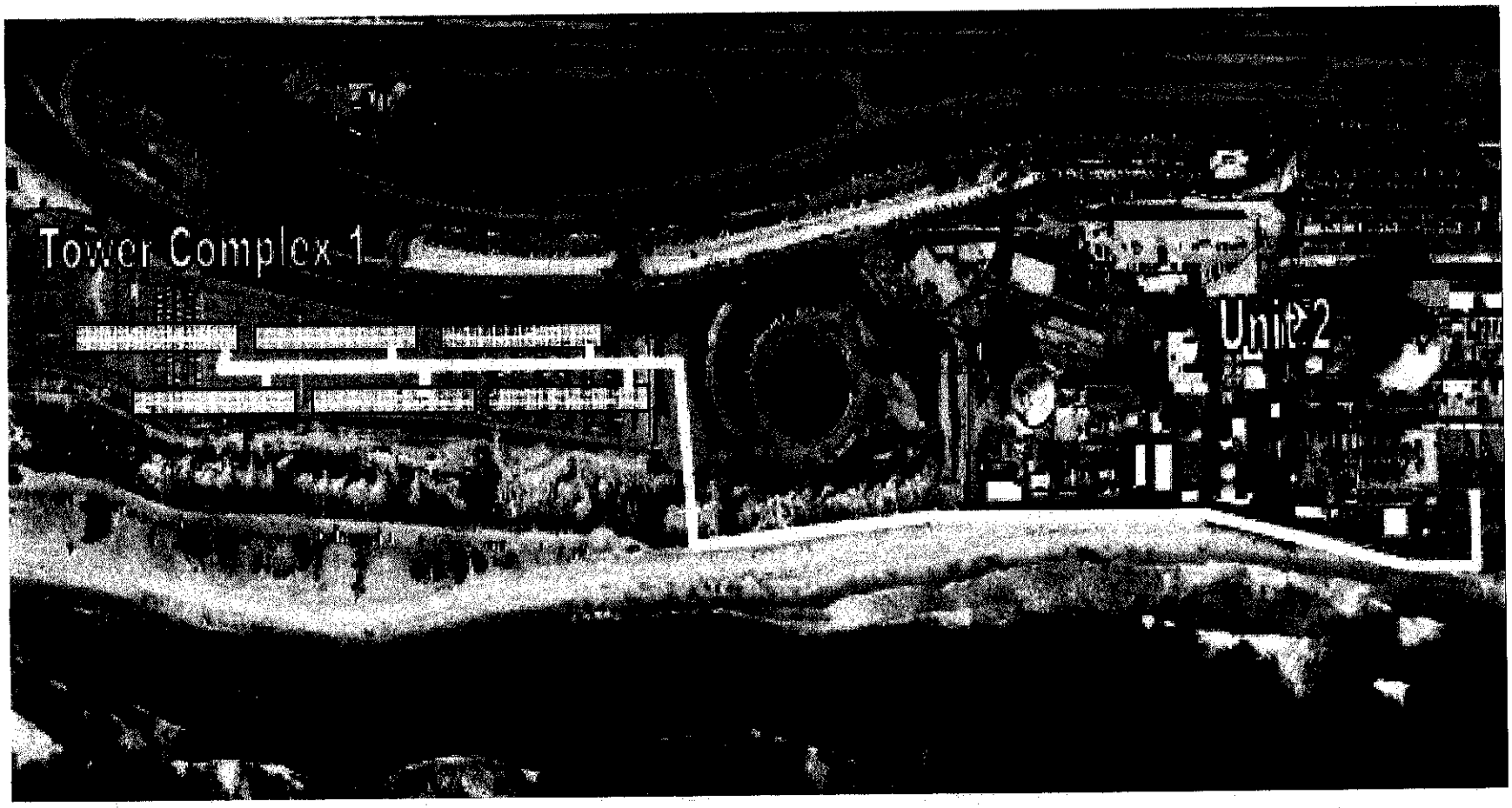
comment: red outlines of cooling tower locations and note added by B. Powers



San Onofre Nuclear Generating Station



Tetratech – assumed location of SONGS Unit 2 cooling tower



Tetratech – assumed location of SONGS Unit 3 cooling tower