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Prepared for

PG&E

and the
State Water Resources Control Board
Nuclear Review Committee

Alternative Cooling Technologies or Modifications to the Existing Once-Through Cooling System for the Diablo Canyon Power Plant (Draft)

Prepared by
Bechtel Power Corporation
Report No. 25762-000-30R-G01G-00010

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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 (Draft)

Report No.
25762-000-30R-G01G-00010
Prepared by
Bechtel Power Corporation

Revision	Date	Affected Sections
A	9/20/13	Draft for Review

PACIFIC GAS AND ELECTRIC COMPANY (PG&E)
DIABLO CANYON POWER PLANT
ONCE THROUGH COOLING SYSTEM
ALTERNATIVE OPTIONS REPORT
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List of Acronyms and Abbreviations

Term	Definition
°C	degrees Celsius
°F	degrees Fahrenheit
ac	alternating current
ASW	auxiliary saltwater
ATC	regional pollution control district permit to construct
Caltrans	California Department of Transportation
CAMP	Construction Activity Management Plan
CARB	California Air Resources Board
CBOE	California Board of Equalization
CCC	California Coastal Commission
CCR	California Code of Regulations
CCRWQCB	Central Coast Regional Water Quality Control Board
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
CFR	(U.S.) Code of Federal Regulations
CPUC	California Public Utilities Commission
CSLC	California State Lands Commission
CT	cooling tower
CW	circulating water
CWS	CW system
dc	direct current
DCPP	Diablo Canyon Power Plant
DCS	distributed control system
desal	desalination
e.g.	for example
EA	Environmental Assessment
EIR	Environmental Impact Report
EPP	environmental protection plan
EWS	engineering workstation
FAA	(U.S.) Federal Aviation Administration
FAQ	frequently asked questions
fpm	feet per minute
fps	feet per second
FRP	fiber-reinforced polymer
FSARU	Final Safety Analysis Report Updated
ft	feet/foot
GDC	general design criteria
GO	General Order
gpm	gallons per minute
HMI	human-machine interface
hp	horsepower
hr	hour
I/O	input/output
ID	identification
JUOTC	Joint Utility Once-Through Cooling (Study)
kV	kilovolt(s)
LAR	License Amendment Request
LSA	Lake and Streambed Alteration
MCC	motor control center
mg/l	milligrams per liter
mgd	million gallons per day

Term	Definition
MLLW	mean lower-low water
mm	millimeter
MV	medium voltage
MVA	megavolt ampere
MWh	megawatt hour
NESC	National Electrical Safety Code
NMFS	National Marine Fisheries Service
NOx	oxides of nitrogen
NPDES	National Pollutant Discharge Elimination System
NTP	Notice to Proceed
OHP	(California) Office of Historic Preservation
OWS	operator workstation
P&I	piping and instrumentation
PLC	programmable logic controller
PM	particulate matter
PM-10	PM less than 10 microns in diameter
PTC	regional control district permit to operate
RCRA	Resource Conservation and Recovery Act
ROG	reactive organic gas
SACTI	Seasonal/Annual Cooling Tower Impact (Electric Power Research Institute model)
SCW	service cooling water
SLO	San Luis Obispo (County)
SLO-APCD	SLO Air Pollution Control District
SLO-DPB	SLO Department of Planning and Building
SLO-DPW	SLO Department of Public Works
SLO-EHS	SLO Environmental Health Services
SPCC	spill prevention, control, and countermeasure
SSC	structure, system, or component
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	(California) State Water Resources Control Board
TBM	tunnel-boring machine
TDS	total dissolved solids
TOPO	topological
tpy	tons per year
TS	technical specification
UPS	uninterruptible power supply
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USNRC	U.S. Nuclear Regulatory Commission
V	volt(s)
VI	Vendor Information
WWTF	Waste Water Treatment Facility

1 Executive Summary

This final report describes the findings of the second phase of an assessment of the viability of the technologies noted in the Scope of Work Report prepared for the Diablo Canyon Power Plant (DCPP) by the Nuclear Review Committee to Oversee Special Studies for the Nuclear-Fueled Power Plants Using Once-through Cooling and dated November 7, 2011. The report is in support of the Nuclear Review Committee's initiative to identify strategies to implement the California *Policy on the Use of Coastal and Estuarine Waters for Power Plant Cooling*. This strategy would comply with the *California Once-Through-Cooling Policy*. The Phase 1 report, "Independent Third-Party Interim Technical Assessment for the Alternative Cooling Technologies to the Existing Once-Through Cooling System for Diablo Canyon Power Plant," was issued on November 5, 2012.

The Phase 1 report evaluates the following technologies for feasibility:

- Closed-cycle cooling systems
- Deepwater offshore intake
- Initial intake relocation
- Onshore mechanical (active) intake fine mesh screening systems
- Offshore modular wedge wire systems
- Operational strategies to reduce impingement and entrainment
- Source water substrate filtering/collection systems
- Variable-speed cooling water pumping systems

The first-phase evaluation process reviewed each of the technologies without regard for cost against the Nuclear Review Committee evaluation criteria mandated by the Scope of Work document:

- First-of-a-kind to scale
- External approval and permitting (nonnuclear licensing)
- Operability general site conditions
- Impingement/entrainment design
- Offsetting environmental impacts
- Seismic and tsunami issues
- Structural
- Construction
- Maintenance

A detailed review of each of the technologies against each of the DCPP criteria has been completed. The evaluation is documented in detail in the Phase 1 final report. Figure 1-1 presents a work flow diagram of the approach used to complete the Phase 1 work.

All of the technologies were reviewed against each of the Phase 1 review criterion, and the Phase 1 final report addressed the feasibility of each of the technologies evaluated for DCPP.

The Phase 1 study concluded that the following technologies were feasible for DCPP subject to the completion of the Phase 2 study:

- Closed-cycle cooling systems (except for wet cooling using seawater for makeup)
- Onshore mechanical (active) intake fine mesh screening systems
- Offshore modular wedge wire systems

In general, the technologies that were found to be not feasible were rejected due to their inability to substantially improve the impingement and/or entrainment characteristics of the intake or, in the case of the closed cooling water technology using saltwater makeup, their inability to permit the technology due to the lack of available PM-10 (particulate matter particles with a diameter of 10 micrometers or less) offsets (salt-related emissions from drift) that would be necessary for an air emissions permit to be granted.

The evaluations examined only the technical feasibility of each technology's application at DCPP, without consideration of costs, in accordance with the report requirements defined by the State Water Resources Control Board (SWRCB) and PG&E. A more detailed evaluation of which technology/variation is optimum for DCPP, including estimated costs, is performed in Phase 2 of this study.

For technologies that were found to be feasible, the overall finding is that several significant technical and operational challenges are associated with each of the technologies. Those key challenges center on determining the optimum screen and slot sizes to gain the optimum effectiveness in reducing fish egg and larvae entrainment for the once-through cooling; identifying the supply source(s) for makeup water and optimizing the land usage for the closed cooling water options; and managing a permitting process that will be lengthy, complex, and challenging. These issues have been addressed in detail in Phase 2. The overall conclusions of the Phase 1 report are provided in Table 1-1.

Phase 2 includes completing the nuclear-specific assessment, Criterion 10 (licensing nuclear-specific assessment), and, based on the results of the Criterion 10 assessment, proceeding with the cost and schedule (Criterion 11) assessment for each technology that passes the Criterion 10 evaluation. Figures 1-2 and 1-3 present a work flow diagram of the approach used to complete the Phase 2 work.

The first step of the Phase 2 effort is to complete the Criterion 10 evaluation for each of the technologies to be considered. Criterion 10 is the criteria specified by the Nuclear Review Committee to Oversee Special Studies for the Nuclear-fueled Power Plants Using Once-through Cooling for evaluating the feasibility of alternative technologies to reduce the impingement and entrainment of aquatic organisms in the cooling water. Criterion 10 describes eight areas of U.S. Nuclear Regulatory Commission (USNRC) interest to be assessed:

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

Criterion 10 is a feasibility assessment based on regulatory requirements established by Title 10 of the U.S. Code of Federal Regulations, Part 50, Section 59 (10 CFR 50.59), to determine whether USNRC approval of the alternative technology is required.

The Criterion 10 assessment for the three technologies was completed, and all three selected technologies from Phase 1 passed through the Criterion 10 assessment to Criterion 11.

The Criterion 11 effort included the completion of preliminary designs, development of a Level 2 schedule for each technology, and an additional permitting review focused on the schedule and cost aspects of the required permits identified in Phase 1. These inputs were necessary for the development of the Class 3 estimate (estimate classifications are based on American Association of Cost Engineers International [AACEI] Recommended Practice No. 17R-97, “Cost Estimate Classification System,” and 18R-97, “Cost Estimate Classification System – as applied in Engineering, Procurement and Construction for the Process Industries”). Engineering developed preliminary designs (10 to 15 percent of the key aspects of the designs), quantified equipment sizes, and provided arrangement and quantities for the Estimating department. Technical and cost input for the major equipment was solicited and received from key suppliers. Additionally, tunneling and marine works estimates were received from specialty suppliers and validated by the Estimating department. The schedules for the permitting, design, construction, and commissioning for each technology were developed based on supplier input, industry experience, quantity unit rates, and historical information from previous projects.

For Phase 2, five closed-cycle technology variants and two screening systems selected in Phase 1 were evaluated, all of which were deemed to be technically feasible in Phase 1. The five closed-cycle technologies evaluated were:

- Passive draft dry/air cooling
- Mechanical (forced) draft dry/air cooling
- Wet natural draft cooling
- Wet mechanical (forced) draft cooling
- Hybrid wet/dry cooling

The Phase 1 assessment also evaluated several potential design alternatives to replace or enhance the existing DCPP shoreline intake structure. Two design alternatives were selected as candidates for further evaluation in the Phase 2 stage of the assessment. These alternatives are:

- Onshore mechanical (active) intake fine mesh screening system using new dual-flow screens to replace the existing flow-through screens associated with the circulating water (CW) pumps (six screens per unit). Existing flow-through screens associated with the safety-related auxiliary saltwater (ASW) system (one per unit) would not be replaced. The new dual-flow screens would include new fine mesh screen panels and a new fish recovery (collection and return) system.
- Offshore modular wedge wire screen assemblies and tunnel to transport the ocean water to the existing intake cove. The existing intake cove opening to the Pacific Ocean would be closed. Two stop log gates would be incorporated in the cove closure to provide an emergency means of supplying water to the plant intake structure in the event of an unforeseen issue with the offshore modular wedge wire screen assemblies or tunnel.

1.1 Criterion 10, Licensing Nuclear-Specific Assessment

10 CFR 50.59 describes the review that is necessary to determine whether a change, test, or experiment in a licensed nuclear power plant must be approved by the USNRC before being implemented.

10 CFR 50.59 allows the licensee to make changes to a plant or its procedures, or to conduct tests or experiments, without prior USNRC approval if the proposed activity does not require a change to the Technical Specifications (TSs) and does not significantly change analyses or their conclusions as documented in the Final Safety Analysis Report Updated (FSARU). This provides assurance that the change, test, or experiment would not adversely affect the ability to safely shut down the plant, to maintain the plant in a safe shutdown condition, and to ensure the ability to maintain offsite radiological consequences of an accident within the limits of 10 CFR Part 100.

As discussed above, Criterion 10 of the Phase 2 assessment is a 10 CFR 50.59 feasibility assessment to determine whether NRC approval of the alternative technology would be required. The assessment considered the eight nuclear design change criteria.

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

Consequently, subject to the limitations of the Phase 2 assessment information, implementation of the closed-cycle cooling technology, the onshore 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.

Section 3 of the Phase 2 report provides a more detailed discussion of Criterion 10 (Nuclear-specific assessment).

1.2 Criterion 11

The Criterion 11 effort included developing a preliminary/conceptual design for each technology to the extent necessary to support preparation of a Class 3 cost estimate and project implementation schedule. The Criterion 11 effort also included completing preliminary engineering (10 to 15%) of key design aspects that would most influence and support development of the Class 3 cost estimate. The engineering effort included defining equipment sizes, layout arrangements, and quantities to support cost estimate development. Selected major equipment suppliers (cooling towers, pumps, water treatment equipment, large valves, large piping, transformers, and offshore specialty contractors [tunneling and marine works]) were consulted to validate technical data and cost estimates included herein. Key aspects of each of the noted Criterion 11 elements are summarized in the following sections:

1.2.1 Permitting

The initial Phase 1 permitting assessment focused on identifying the applicable (required) permits and approvals for construction and operation of the selected technologies. A comprehensive list of potentially applicable permits and approvals at the federal, California, county, and municipal level (as applicable) was developed.

The subsequent Phase 2 permitting assessment focused on identifying the critical path (longest duration) initial preconstruction permitting processes and the associated project costs. The preconstruction permits are those approvals that directly support site mobilization, physical site access, and initial construction activities associated with the technology option.

The efforts to conduct a successful California Environmental Quality Act (CEQA) review would be the primary critical path permitting process. The CEQA lead agency may be a shared responsibility among a number of key regulatory departments (e.g., San Luis Obispo County, California State Lands Commission [CSLC]). The requisite U.S. Army Corps of Engineers (USACE) Section 404 permit, California Coastal Commission (CCC) Coastal Development Permit, CSLC Lease, and National Pollutant Discharge Elimination System (NPDES) permit modification would have potentially lengthy review processes but would all be essentially bounded by the critical path CEQA/Environmental Impact Report (EIR) review process.

The cost and schedule requirement to secure the major permits applicable to each alternative were developed based on discussions with key relevant regulatory authorities and from associated website resources.

Legal costs associated with managing appeal processes and related litigation were not included. Additionally, the bulk of the potential mitigation costs would be developed through negotiation and are consequently not included in the cost estimate. The permitting requirements, along with the associated cost and schedule requirements anticipated for each of the technologies, is summarized in Section 4 of the report. The cost and schedule are addressed in Sections 6 and 7, respectively. Depending of the technology option, the permitting durations range from 3 to 5 years.

1.2.2 Preliminary Design

Section 4 of the report summarizes the preliminary design completed for each of the technology options assessed in the Phase 2 effort: the onshore mechanical (active) intake fine mesh screening system, the offshore modular wedge wire screening system, and the five closed-cycle cooling technology variants.

1.2.2.1 Closed Cooling

Highlights of the closed cooling preliminary design development include the following:

- Increased condenser pressure results in reduced turbine output. The largest source of lost generation is, as expected, due to reduction in the gross output of a unit due to higher backpressure operation. In addition, the additional auxiliary loads of some of the cooling system options (fans, additional pumping power, etc.) also lead to a reduction in plant net output. The average yearly lost generation (assuming 90% capacity factor) range from 53.6 to 97.3 MW.

- The cost of the de-rated output resulting from the installation of these technologies has not been included as part of the installation cost estimate for the technologies.

- The ability of the steam turbine to operate at higher condenser backpressures resulting from a closed cooling system was reviewed. The DCPP-specific “protection diagram” provided by PG&E indicates that, for full-load operation, the high backpressure alarm point is 9 inches HgA and the high backpressure trip point is 10.5 inches HgA. Maximum backpressures with wet cooling options will not approach the alarm setting. For the dry cooling options, modification of the steam turbines is considered necessary.

- With respect to the major civil/structural effort, the five alternative closed-cycle cooling technologies can be divided into two groups: wet (includes natural draft, mechanical [forced] draft, and hybrid variants) and dry (includes natural draft and mechanical [forced] draft variants). Preliminary civil designs were prepared to size major structures such as cooling tower foundations, new pumphouses and header boxes, the storage pond, desalination and water treatment plant foundations, and mountain excavation quantities.

- It will be necessary to excavate a portion of the mountains immediately north of the DCPP power block to an elevation of 115’ to provide the space needed to build the new cooling towers. The number of cooling towers needed is technology specific. The location of the new cooling towers has been chosen carefully to provide the most economical solution and to preclude impact to the nearby archeological site. Tower locations are shown on the plant site rendering included as Figure 1-4. The tower pictured was supplied courtesy of SPX Cooling Technologies Inc. The leveled area required at elevation 115’ for the two cooling towers arrangement is approximately 62 acres and for the four cooling towers arrangement is approximately 109 acres. The estimated excavation quantities for the two-tower and four-tower general arrangements, with 7-percent haul ramps, is approximately 190 million cubic yards and 316 million cubic yards respectively.

- 230 kV Line Relocation: The existing two-circuit 230 kV line that provides the main source of offsite power for DCPP and the northernmost 500 kV circuit that transmits DCPP Units 1and 2 electrical output off site via the Gates transmission intertie require rerouting. Three two-circuit high voltage transmission towers of the existing 230 kV line and one single-circuit high voltage tower of the existing 500 kV line must be moved. The relocated line would consist of four new towers, the first being just outside the 230 kV substation on the opposite side of Pecho Valley Road.

- The primary differences between wet cooling towers and dry cooling towers are that a wet cooling tower consumes water due to evaporation, drift, and blowdown and achieves lower cold water temperatures because of the difference between wet and dry bulb temperatures. Makeup water to replenish losses to the environment (i.e., through cooling tower evaporation) would be provided by a combination of freshwater from a new onsite desalination plant and industrial wastewater and potable water to be supplied from local resources.

It should be noted that the State Water Board is currently developing amendments to the Water Quality Control Plan for Ocean Waters of California. The amended Plan, once adopted, may include requirements for intake and/or brine discharges that could result in restrictions or additional requirements on the use of desalination at the site.

1.2.2.2 Offshore Modular Wedge Wire

The concept selected for installing the offshore modular wedge wire screening technology involves enclosing the existing intake cove to form a shoreline basin and extending a new circulating water (CW) conveyance system, either tunnel or buried piping, from the basin to the ocean. Wedge wire screen assemblies would be attached to the ocean end of this conveyance system to enable it to supply filtered seawater to the newly created intake basin, which would be sealed to prevent direct seawater inflow.

The offshore location of the wedge wire screens is dependent on local bathymetry and biological sensitivity and the need to provide adequate depth above and below the screens to maintain their hydraulic performance. The open sea oceanographic setting and geological characteristics offshore of DCPP pose significant challenges to this type of conveyance system; consequently, two alternative concepts, tunnel and buried piping, were considered. The final estimate was based on the tunnel concept based on the lowest total installed cost of the system.

The use of offshore wedge wire screens at the DCPP site would require a due diligence survey and field testing investigation before implementation. The design would be based on a maximum slot flow-through velocity of 0.5 fps. Potential debris loading in a marine environment favors larger screen slot sizes, while fish, egg, and larvae exclusion favors smaller slot sizes that increase the blockage potential. Due to this conflicting requirement, two slot sizes (6 mm and 2 mm) are being considered for in situ testing at the site. The cost estimate for the offshore wedge wire system technology is based on the use of a 2-mm slot size screen.

The situ pilot testing of the two screen slot sizes (2 mm and 6 mm) would be completed to evaluate entrainment, impingement, and debris effects on screen performance. This pilot testing is essential to evaluate both the biological and engineering feasibility of the 2.0-mm and 6.0-mm cylindrical wedge wire screens to determine their biological exclusion efficiency in comparison to an open port and their performance in controlling biofouling and debris clogging.

1.2.2.3 Onshore Mechanical Fine Mesh

The onshore mechanical fine mesh screening technology involves using smooth woven fine mesh screens in the nominal rectangular size of 1 mm x 6 mm to achieve substantial entrainment reduction of fish, eggs, and larvae and using a fish recovery system to achieve impingement mortality reduction of fish, eggs, and larvae. Specifically, the onshore mechanical fine mesh screening technology consists of replacing six of the existing flow-through coarse mesh traveling screens per unit, located in the plant intake structure, with dual-flow traveling screens with fine mesh. Using dual-flow screens along with larger screen panels provides more than twice the screen surface area per screen compared to the existing flow-through screens, thus resulting in substantial reduction in through-screen velocity. The fine mesh screens selected would reduce velocity from about 1.95 fps to 1 fps. In addition, a fish recovery system would be incorporated to collect fish, eggs, and larvae impinged on the new dual-flow screens. Eggs and larvae impinged on the fine mesh screens and fish collected inside the fish bucket would be removed, collected, and returned back to the sea via a new fish return pipeline.

Even though this technology does not comply with the maximum 0.5 fps through-screen velocity for impingement mortality reduction described in the *California Once-Through Cooling Policy* rules, the inclusion of a fish recovery system provides the alternative mitigation measures that support compliance with the *California Once-Through Cooling Policy* requirements.

In order for the plant to operate reliably, an automatic trash raking system is needed to remove large debris trapped on the trash racks located upstream of the plant traveling screens. The cost of designing and constructing an automatic trash removal system has not been estimated as part of this effort.

1.2.3 Schedule and Cost Estimate

Based on the preliminary design data and the conceptual approaches developed for construction and startup of the selected options, a Level 1 schedule and Class 3 cost estimate was developed for each. Details regarding the construction approach are provided in Section 5 of the report and the schedule and cost estimate discussions are provided in Sections 6 and 7, respectively.

Bechtel considered the concerns provided to the Nuclear Review Committee following Phase 1 on January 23, 2013, by Mr. Laurence G. Chaset for the Friends of the Earth and the January 23, 2013, letter from Mr. Noah Long and Mses. Angela Kelley, Sarah Sikich, and Sara Aminzadeh representing the Natural Resources Defense Council, Heal the Bay, and the California Coastkeeper Alliance. The concerns brought up in these letters were considered and addressed as appropriate as part of the Phase 2 effort.

1.3 Phase 2 Results

The overall findings of the report are provided in Table 1-1 below, which presents the costs and schedule estimates for each technology. The cost data is a Class 3 cost estimate as defined by the Association for the Advancement of Cost Engineering International (AACEI), the estimate includes 20% contingency and an expected accuracy range of -20% to +30%. Section 7 of the report includes a detailed discussion of the cost estimate development, including qualifications and assumptions, and exclusions.

Table 1-1. Technology Cost and Schedule Summary

Technology	Cost in Millions	Schedule Duration in Years
Closed-cycle cooling		
Mechanical (forced) draft dry/air cooling	$8,519 – $12,453	13
Passive draft dry/air cooling	$8,412 – $12,353	13
Wet mechanical (forced) draft cooling	$6,875 – $9,955	14
Wet natural draft cooling	$8,504 – $12,431	14
Hybrid wet/dry cooling	$6,854 – $9,923	13
Onshore mechanical fine mesh screening	$371 - $493	8
Offshore modular wedge wire screening	$261 – $407	10

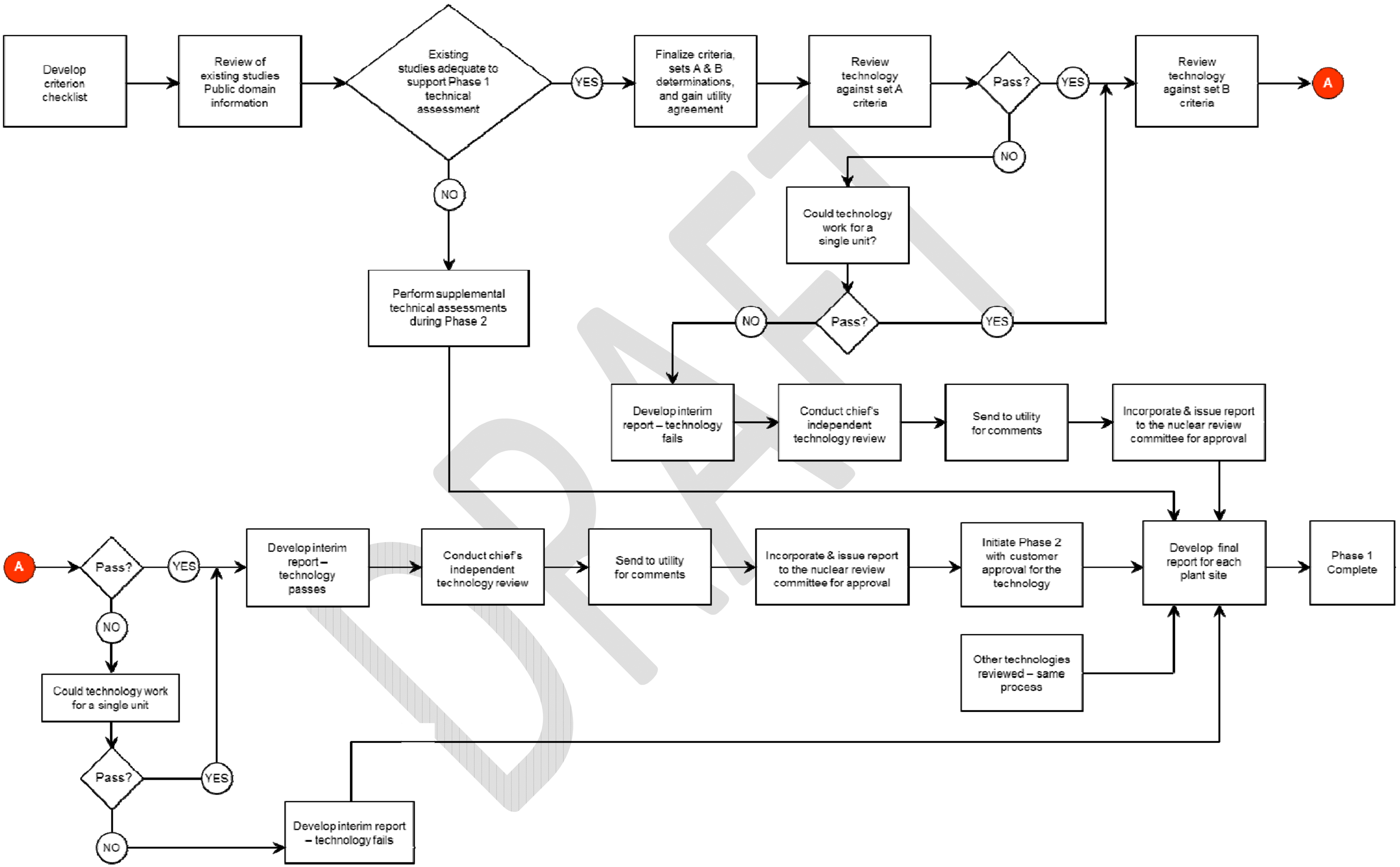


Figure 1-1. Phase 1 Review Process for Each Technology

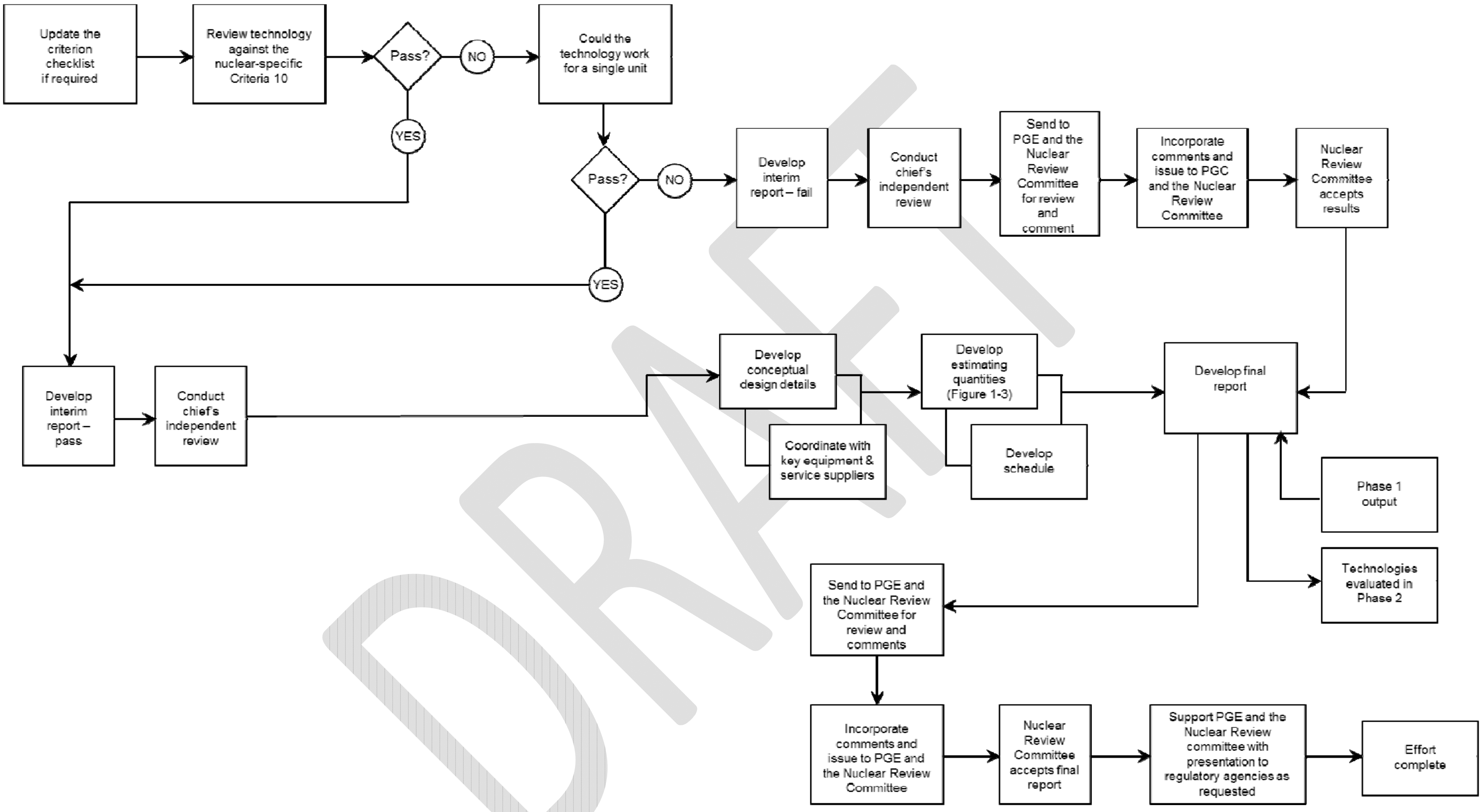


Figure 1-2. Phase 2 Review Process for Each Technology

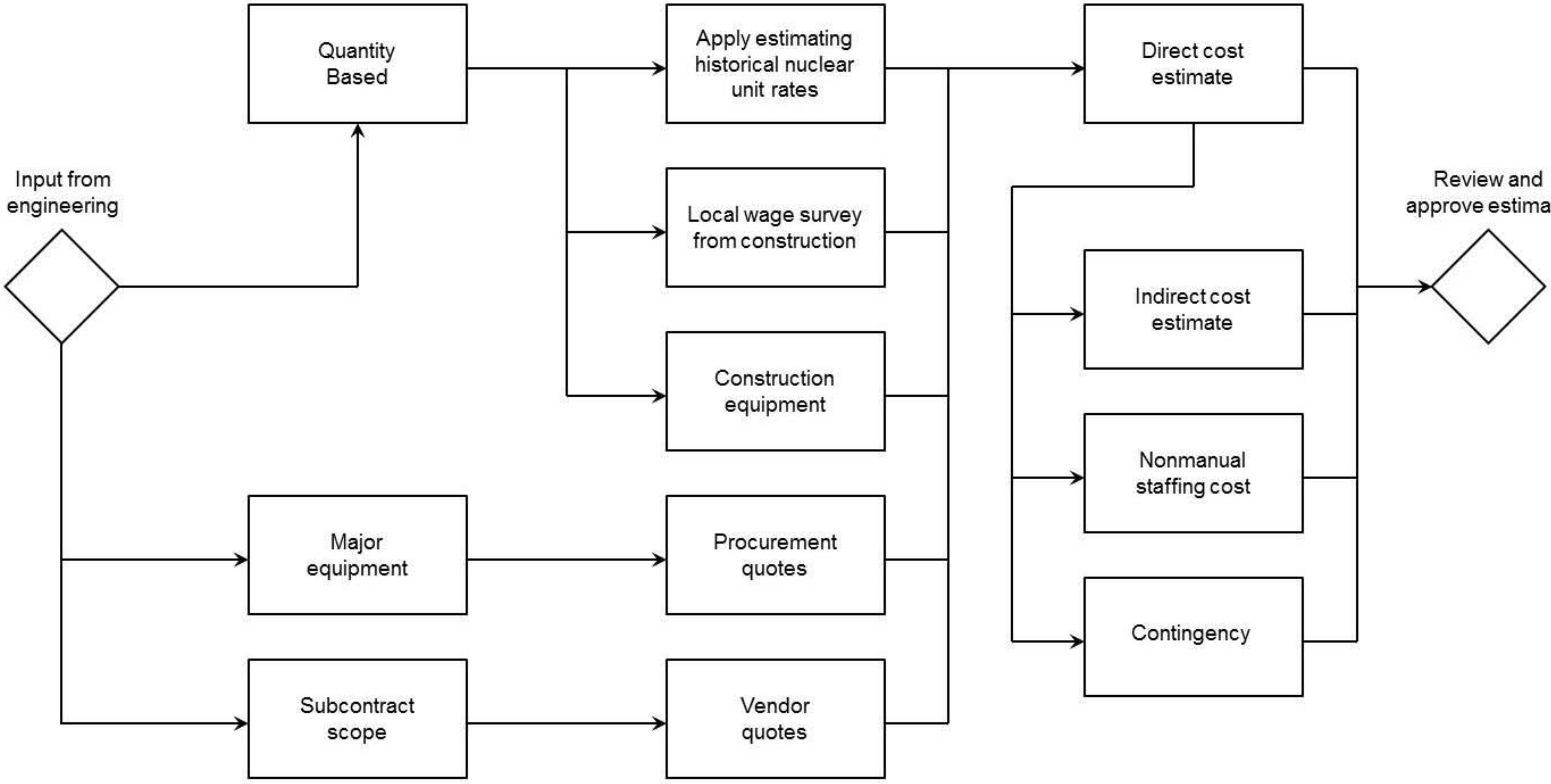


Figure 1-3. Phase 2 Estimating Process for Each Technology

Figure 1-4. Plant Site Rendering

Table 1-2. Overall Conclusions

Criterion	Status of Each Technology											
	Passive Draft Dry/Air Cooling	**Mechanical (Forced) Draft Dry/Air Cooling**	**Wet Natural Draft Cooling**	**Wet Mechanical (Forced) Draft Cooling**	**Hybrid Wet/Dry Cooling**	**Deepwater Offshore Intake**	**Initial Intake Relocation**	**Onshore Mechanical (Active) Intake Fine Mesh Screening Systems**	**Offshore Modular Wedge Wire or Similar Exclusion Screening Systems**	**Operational Strategies to Reduce Impingement and Entrainment**	**Source Water Substrate Filtering/Collection Systems**	**Variable Speed Cooling Water Pumping Systems**
External Approval and Permitting	No fatal flaws	No fatal flaws	Fatal flaw for saltwater towers associated with lack of sufficient PM-10 emission offsets. No fatal flaws for reclaimed/freshwater towers.	Fatal flaw for saltwater towers associated with lack of sufficient PM-10 emission offsets. No fatal flaws for reclaimed/freshwater towers.	Fatal flaw for saltwater towers associated with lack of sufficient PM-10 emission offsets. No fatal flaws for reclaimed/freshwater towers.	No fatal flaws	No fatal flaws	No fatal flaws	No fatal flaws	No fatal flaws	No fatal flaws	No fatal flaws
Impingement/Entrainment Design	Satisfies *California Once-Through Cooling Policy* criteria requirements.	Satisfies *California Once-Through Cooling Policy* criteria requirements	Satisfies *California Once-Through Cooling Policy* criteria requirements	Satisfies *California Once-Through Cooling Policy* criteria requirements	Satisfies *California Once-Through Cooling Policy* criteria requirements	Studies have shown that the entrainment is not likely to be improved for this design, so this is considered not to be viable.	No fatal flaws, but the technology's effectiveness with entrainment of fish eggs and larvae is indeterminate.	No fatal flaws, but the existing screens need to be replaced with dual flow-type traveling screens with fine mesh panels and fish collection and return systems.	No fatal flaws, but the technology's effectiveness regarding entrainment impact mitigation needs better characterization.	Cannot satisfy *California Once-Through Cooling Policy* criteria requirements	No fatal flaws	Cannot satisfy *California Once-Through Cooling Policy* criteria requirements
Environmental Offsets	Some negative impacts, no fatal flaws	Some negative impacts, no fatal flaws	Some negative impacts, no fatal flaws	Some negative impacts, no fatal flaws	Some negative impacts, no fatal flaws	No fatal flaws	No fatal flaws	No fatal flaws	No fatal flaws	Weak overall net positive benefit	No fatal flaws	Weak overall net positive benefit

Criterion	Status of Each Technology											
	Passive Draft Dry/ Air Cooling	Mechanical (Forced) Draft Dry/Air Cooling	Wet Natural Draft Cooling	Wet Mechanical (Forced) Draft Cooling	Hybrid Wet/Dry Cooling	Deepwater Offshore Intake	Initial Intake Relocation	Onshore Mechanical (Active) Intake Fine Mesh Screening Systems	Offshore Modular Wedge Wire or Similar Exclusion Screening Systems	Operational Strategies to Reduce Impingement and Entrainment	Source Water Substrate Filtering/ Collection Systems	Variable Speed Cooling Water Pumping Systems
First-of-Kind-to-Scale	No fatal flaws.	No fatal flaws	No fatal flaws	No fatal flaws	No fatal flaws	Not evaluated	No fatal flaws	No fatal flaws	No fatal flaws	Not evaluated	Fatal flaw – this technology has not been used for a water supply system of this size and is impractical.	Not evaluated
Operability of General Site Conditions	No fatal flaws	No fatal flaws	No fatal flaws	No fatal flaws	No fatal flaws	Not evaluated	No fatal flaws.	No fatal flaws	No fatal flaws	Not evaluated	Low reliability and ever-decreasing lateral efficiency make this technology a fatal flaw.	Not evaluated
Seismic and Tsunami Issues	No fatal flaws	No fatal flaws	No fatal flaws	No fatal flaws	No fatal flaws	Not evaluated	No fatal flaws	No fatal flaws	No fatal flaws	Not evaluated	No fatal flaws	Not evaluated

Criterion	Status of Each Technology											
	Passive Draft Dry/ Air Cooling	Mechanical (Forced) Draft Dry/Air Cooling	Wet Natural Draft Cooling	Wet Mechanical (Forced) Draft Cooling	Hybrid Wet/Dry Cooling	Deepwater Offshore Intake	Initial Intake Relocation	Onshore Mechanical (Active) Intake Fine Mesh Screening Systems	Offshore Modular Wedge Wire or Similar Exclusion Screening Systems	Operational Strategies to Reduce Impingement and Entrainment	Source Water Substrate Filtering/ Collection Systems	Variable Speed Cooling Water Pumping Systems
Structure and Construction	No fatal flaws based on the assumption that additional land adjacent to the Owner-controlled area can be acquired as necessary to accommodate tower placement	No fatal flaws based on the assumption that additional land adjacent to the Owner-controlled area can be acquired as necessary to accommodate tower placement	No fatal flaws	No fatal flaws	No fatal flaws	Not evaluated	No fatal flaws	No fatal flaws	No fatal flaws	Not evaluated	No fatal flaws	Not evaluated
Maintenance	No fatal flaws	No fatal flaws	No fatal flaws	No fatal flaws	No fatal flaws	Not evaluated	No fatal flaws	No fatal flaws	No fatal flaws	Not evaluated	No practical maintenance program, which causes it to be a fatal flaw	Not evaluated
Conclusion	Technology is a candidate for Phase 2 review.	Technology is a candidate for Phase 2 review.	Technology is a candidate for Phase 2 review.	Technology is a candidate for Phase 2 review.	Technology is a candidate for Phase 2 review.	Technology is not a candidate for Phase 2 review.	Technology is a candidate for Phase 2 review.	Technology is a candidate for Phase 2 review.	Technology is a candidate for Phase 2 review.	Technology is not a candidate for Phase 2 review.	Technology is not a candidate for Phase 2 review.	Technology is not a candidate for Phase 2 review.

Note: The Environmental Offsets Criterion refers to broad environmental subject matter – not the specific air emission offsets addressed in the External Approval and Permitting Criterion.

2 Introduction

Bechtel Power Corporation’s “Independent Third-Party Interim Technical Assessment for the Alternative Cooling Technologies or Modifications to the Existing Once-Through Cooling System for Diablo Canyon Power Plant*,”* Report No. 25762-000-30R-G01G-00009, issued on November 5, 2012 (Phase 1 report) (Attachment 1), describes the findings of Phase 1 of an assessment of the viability of the technologies noted in the Scope of Work Report prepared for the Diablo Canyon Power Plant (DCPP) by the Nuclear Review Committee to Oversee Special Studies for the Nuclear-Fueled Power Plants Using Once-through Cooling and dated November 7, 2011. The report is in support of the Nuclear Review Committee initiative to identify strategies to implement the *California Policy on the Use of Coastal and Estuarine Waters for Power Plant Cooling*. This strategy is intended to comply with the *California Once-Through-Cooling Policy*. The Phase 1 report concludes that the following technologies are technically feasible (based on assessment checklist Criteria 1 through 9) for DCPP:

- Onshore mechanical (active) intake fine mesh screening systems
- Offshore modular wedge wire systems
- Closed-cycle cooling systems (five closed-cycle cooling variations, including hybrids)

Phase 2 of the effort includes completing the nuclear-specific assessment (assessment checklist Criterion 10) and then, based on the results of the Criterion 10 assessment, proceeding with the cost and schedule (Criterion 11) assessment for each technology that passes the Criterion 10 evaluation. The Criterion 11 effort includes developing a preliminary design for each technology to the extent necessary to prepare the cost estimate and complete the implementation schedule assessment.

This report contains the Criterion 10 assessment for the three technologies selected from Phase 1 and a description of the preliminary engineering effort performed to obtain adequate technical information to be used in preparing the cost estimate and schedule to implement each of those technologies.

3 Licensing Nuclear-Specific Assessment (Criterion 10)

The final Phase 1 report on alternate cooling technologies or modifications to the existing once-through cooling systems for DCPP evaluated eight technologies. Of the eight, the following three were approved by the Nuclear Review Committee for further consideration in Phase 2:

- Onshore mechanical (active) intake fine mesh screening systems
- Offshore modular wedge wire systems
- Closed-cycle cooling systems

The first step in the Phase 2 effort is to complete the Criterion 10 evaluation for each of the technologies to be considered. This evaluation is provided in Section 4 for each technology.

Criterion 10 is among the criteria specified by the Nuclear Review Committee to Oversee Special Studies for the Nuclear-fueled Power Plants Using Once-through Cooling for evaluating the feasibility of alternative technologies to reduce the impingement and entrainment of aquatic organisms in the cooling water. Criterion 10 describes eight areas of U. S. Nuclear Regulatory Commission (USNRC) interest to be assessed:

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

Criterion 10 is a feasibility assessment based on regulatory requirements established by 10 CFR 50.59, to determine whether USNRC approval of the alternative technology is required.

3.1 Alternatives for Closed-Cycle Cooling Technology

The closed-cycle cooling technology reviewed in the Phase 1 assessment replaces the existing once-through cooling with a closed loop in which the cooling water is continuously circulated. The heat picked up by the circulating water (CW) in the main condenser is dissipated to the general environment (the atmosphere) in cooling towers. Five variants of closed-cycle cooling technologies were evaluated. The assessment concluded that replacing the DCPP once-through cooling systems with any of the five variants of closed-cycle cooling technologies evaluated is technically feasible. Makeup water to replenish losses to the environment (i.e., through cooling tower evaporation) would be provided by a combination of freshwater from a new onsite desalination plant and industrial wastewater and potable water to be supplied from local resources. Therefore, all five variants were recommended as candidates for further evaluation in the Phase 2 stage of the assessment.

The five closed-cycle cooling technologies evaluated were:

1. Passive draft dry/air cooling
2. Mechanical (forced) draft dry/air cooling
3. Wet natural draft cooling
4. Wet mechanical (forced) draft cooling
5. Hybrid wet/dry cooling

Natural draft towers rely on convection currents to move air through the tower. These currents are created by the difference in air density between the inside of the tower, where the air is warmer as it picks up heat from the CW, and the outside of the tower, where the air is cooler at general ambient temperature. Forced draft towers use fans to drive the air through the tower.

Dry towers use finned tubes for heat transfer. When the CW passes through these finned tubes, its heat content is transferred by conduction and convection to the air passing over the fins/tubes. In a wet tower, the CW is sprayed though nozzles into direct contact with the air passing through the tower and is cooled by evaporation as it falls into the tower basin. A hybrid tower uses both wet and dry methods in a stacked arrangement, with the dry section on top to eliminate the visible plume generated by the wet section.

3.2 Alternatives to Existing Intake Technology

The Phase 1 assessment also evaluated several potential design alternatives to replace or enhance the existing DCPP shoreline intake structure. Two design alternatives were selected as candidates for further evaluation in the Phase 2 stage of the assessment. These alternatives are:

1. *Onshore mechanical (active) intake fine mesh screening systems* using new dual-flow screens to replace the existing flow-through screens associated with the CW pumps (six per unit). Existing flow-through screens associated with the safety-related auxiliary saltwater (ASW) system (one per unit) would not be replaced. The new dual-flow screens would include new fine mesh screen panels to replace the existing coarse mesh screens plus a new fish recovery (collection and return) system for each new dual-flow traveling water screen. Additional water required for the larger dual-flow screens and fish recovery system would be provided by additional pumps supplementing the existing screen wash system. New pumps would be located in the bays serviced by the new screens.

2. *Offshore modular wedge wire or similar exclusion screening systems* using offshore wedge wire screen assemblies and piping to transport the ocean water to the existing intake cove. The existing intake cove opening to the Pacific Ocean would be closed. Two stop log gates would be incorporated in the cove closure to provide an emergency means of supplying water to the plant intake structure in the event of an unforeseen issue with the offshore wedge wire screen assemblies and piping.

3.2.1 10 CFR 50.59

10 CFR 50.59 describes the review that is necessary to determine whether a change, test, or experiment in a licensed nuclear power plant must be approved by the USNRC before being implemented.

10 CFR 50.59 allows the licensee to make changes to a plant or its procedures, or to conduct tests or experiments, without prior USNRC approval if the proposed activity does not require a change to the Technical Specifications (TSs) and does not significantly change analyses or their conclusions as documented in the Final Safety Analysis Report Updated (FSARU). This provides assurance that the change, test, or experiment would not adversely affect the ability to safely shut down the plant, to maintain the plant in a safe shutdown condition, and to ensure the ability to maintain offsite radiological consequences of an accident within the limits of 10 CFR Part 100. More specifically, the change, test, or experiment cannot:

1. Result in more than a minimal increase in the frequency of occurrence of an accident previously evaluated in the FSARU

2. Result in more than a minimal increase in the likelihood of occurrence of a malfunction of a structure, system, or component (SSC) 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

3.2.2 FSARU

The FSARU provides a summary level description of the plant SSCs, including the controls, monitoring, and protective features that ensure that the plant can be safely operated and controlled under various normal, abnormal, and accident conditions. It also provides a discussion of normal, abnormal, and accident operations, including analyses of a spectrum of transients and accidents and the results of those analyses. The focus is on the safety-related SSCs and their supporting features that provide the ability to safely control and shut down the plant, and to maintain it in a safe shutdown condition, under probable and extreme conditions.

The DCPP FSARU describes the circulating water system (CWS) in Section 10.4.5. The Design Bases section, 10.4.5.1, states that the system provides cooling water to condense steam entering the main condenser and that it also serves the intake coolers, condensate cooler, and service cooling water (SCW) heat exchangers. The CWS Safety Evaluation section, 10.4.5.3, states that the CW pumps are not required for the (nuclear) safety of the units but that provisions are incorporated in the design to ensure their dependable operation for reliable operation of the plant. In Section 9.2.1, the SCW system is described as a closed system used to cool non-safety-related equipment in the secondary portion of the plant. CWS acceptability is based on meeting the requirements of General Design Criteria (GDC) 4 as it relates to design provisions provided to accommodate the effects of discharging water that may result from a failure of a component or piping in the CWS. The requirements of GDC 4 are met when the CWS design includes provisions to accommodate the effects of discharging water that may result from a failure of a component or piping in the CWS. Consequently, Section 10.4.5.4 provides a flooding analysis discussion and details of the CWS design and operating pressures and the connection to the main condenser, noting that significant flooding of the turbine building with seawater due to CWS failure is a highly improbable event. It also describes a flooding analysis based on the failure to properly secure a waterbox manway cover. In Section 9.2.5, the ultimate heat sink is identified as the Pacific Ocean, which is the source of cooling water to the non-safety-related CWS and SCW heat exchangers and to the safety-related ASW system. The availability of the ultimate heat sink to provide cooling when required under severe conditions is discussed in Section 2.4.11.6.

3.3 Assessment of Closed-Cycle Cooling Technology

The following is an assessment of the five alternative closed-cycle cooling system heat transfer technologies that were determined to be technically feasible in the Phase 1 assessment. The closed-cycle cooling technology designs can use wet, dry, or hybrid wet/dry cooling methods. Dry cooling technologies require minimal makeup water to account for system leaks/losses after the closed system is initially charged. Wet cooling technologies, because of their operating principle, require a greater volume of makeup water to compensate for evaporation, blowdown, and drift losses. As such, makeup requirements vary depending on the cycles of concentration at which the wet cooling towers are operated. For the purposes of this assessment, both dry and wet closed-cycle cooling technologies are discussed together.

The five closed-cycle cooling technologies evaluated are:

1. Passive draft dry/air cooling
2. Mechanical (forced) draft dry/air cooling
3. Wet natural draft cooling
4. Wet mechanical (forced) draft cooling
5. Hybrid wet/dry cooling

3.3.1 Seismic

The seismic requirements for a design change can be summarized as ensuring that seismically induced structural or functional failure of any new SSCs would not adversely affect safety-related SSCs. Direct effects, such as falling on a safety-related SSC, and indirect effects, such as functional failure affecting the ability of a safety-related SSC to perform its safety function, must be either demonstrated as acceptable or prevented from happening.

The new cooling towers would be located remote from the power block and safety-related SSCs so that their partial or total structural failure would not adversely affect any safety-related functions. The new pumphouse(s) for the new CW pumps would be located within the existing power block area and would be sufficiently separated from safety-related SSCs as to pose no direct or indirect adverse effects.

Functional failures of the closed-cycle cooling system would not be expected to adversely affect safety-related SSCs or functions since the safety-related cooling requirements of the ASW system would continue to be met since they would not be functionally modified by this change. The existing supports and piping associated with the component cooling water heat exchangers and interfacing ASW system components are seismically designed and would not be adversely affected by the proposed modifications.

3.3.2 Operability

Replacement of once-through cooling with closed-cycle cooling would increase the operating temperature of the CW and increase main condenser backpressure. This would result in decreased turbine efficiency and reduced electrical output from the main generator. It may be necessary to modify the low-pressure turbine so that it can operate at higher condenser backpressures. The higher condenser backpressure decreases the margin to alarm set points; however, sufficient margins would be maintained to provide assurance that there would be no significant increase in the probability of turbine trips. It is intended that when the closed-cycle cooling system design is finalized, there would be sufficient margin between the turbine trip set point and higher condenser pressure so that the probability of more frequent turbine trips would not increase significantly.

3.3.3 Transient Analyses

As mentioned in Section 3.3.2, the closed-cycle cooling technology alternatives would increase the operating temperature of the CW and increase main condenser backpressure. However, sufficient margin between new operating backpressures and the turbine trip point would be maintained to minimize the potential for increased turbine trips. As part of the design of the closed-cycle cooling system, a pressure transient analysis would be performed to ensure that adequate design parameters are identified for piping and associated components. No transient analyses associated with safe shutdown of the plant are expected to be adversely affected by the closed-cycle cooling technology.

3.3.4 Nuclear Fuel (Accident Analyses)

3.3.4.1 Auxiliary Saltwater System

The safety-related ASW system is not affected by this modification. The CWS and the SCW system do not provide cooling to any component required for safe shutdown. The CW 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 CW temperature. This increase is not expected to adversely affect FSARU accident analyses since these systems serve no safety-related functions.

3.3.4.2 Single Failure

The conversion of the once-through cooling system to closed-cycle cooling design technologies would not adversely affect the safety-related function of the ASW system since this system is not expected to be modified. Closed-cycle cooling is not expected to adversely affect any single failures evaluated in the FSARU because the CWS and the SCW system have no safety-related functions, nor do they support any safety-related functions. There would be four CW pumps per unit in lieu of the current two per unit. Operation of the four pumps in the closed-cycle cooling system in lieu of two once-through pumps would not result in additional adverse single failures. The forced draft cooling towers would have fans but, due to the number of fans, single fan failures should have negligible effects on CWS operation and performance. Dependable pump operation in the closed-cycle cooling system would remain a high priority to ensure reliable plant operation.

3.3.5 Hydraulic Design

The hydraulic design for closed-cycle cooling would be developed to ensure efficient and reliable hydraulic performance of the non-safety-related CWS. The safety-related ASW system remains functionally unchanged in the final design.

3.3.6 Probabilistic Risk Assessment

The replacement of non-safety-related once-through cooling with closed-cycle cooling is not expected to adversely affect the probabilistic risk assessment. The CWS has no safety-related function, nor does it support any safety-related functions. The safety-related ASW system remains unchanged in the final design.

3.3.7 Instrumentation, Controls, and Alarms

The design of the instrumentation, controls, and alarms for the closed-cycle cooling would provide monitoring and indication for flows, temperatures, pressures, motor currents, etc., to provide operators with required evidence of system operating conditions and trends, similar to the existing once-through cooling.

3.4 Assessment of Intake Technology Alternatives

The following is an assessment of the two intake technology design alternatives that were selected in Phase 1 as candidates for further evaluation:

- Alternative 1–Onshore Mechanical (Active) Intake Fine Mesh Screening System

- Alternative 2–Offshore Modular Wedge Wire or Similar Exclusion Screening Systems

Alternative 1 is discussed in Section 3.4.1, and Alternative 2 is discussed in Section 3.4.2.

3.4.1 Alternative 1–Onshore Mechanical (Active) Intake Fine Mesh Screening System

3.4.1.1 Seismic

The seismic requirements for the new dual-flow fine mesh screening system, including the fish recovery system, would be same as the existing intake structure seismic design requirements. The safety-related SSCs associated with the ASW system would remain unchanged. The replacement of flow-through screens with dual-flow type screens would not pose an adverse impact from a seismic perspective.

The intake and discharge structures do not perform an active safety-related function. They are seismically designed and indirectly support a safety-related function by structurally supporting the ASW pumps, associated once-though screens, and related piping located at the intake structure and the component cooling water system's heat exchangers located in the turbine building and related piping located at the discharge structure. The final design for the new intake and discharge structures for the closed-cycle cooling should ensure that seismically induced structural or functional failure of any new SSCs would not adversely affect safety-related SSCs.

3.4.1.2 Operability

The dual-flow screens and fine mesh screen panels would be sized to reduce the overall velocity across the screening system. The existing common traveling screen servicing the intake bays associated with each unit's safety-related ASW pumps would not be modified. Therefore, modification of the traveling screens on the non-safety-related intake bays would not adversely affect the operation of the safety-related ASW system. It is intended that the new screen modifications would not adversely affect any SSCs serving the safety-related ASW pumps. The significant reduction of mesh opening (from the current 9.53 mm down to 1 to 2 mm), would result in a substantially higher debris load on the screen panels. This much higher debris loading on the screen panels must be removed to avoid overloading or collapsing the screen panels. The new design would provide the required removal capability. For the fish recovery system to be effective, fish, eggs, and larvae must be continuously removed. The new rotating dual-flow screen design would need to be continuously operated and be equipped with variable speed drive to increase the screen rotation speed as needed due to changing debris loading.

3.4.1.3 Transient Analyses

The dual-flow screens and fine mesh screen panels would be sized to ensure a low pressure drop across the overall system and provide required flow to the CW pumps. No modification would be made to the traveling screens servicing the intake bays associated with the safety-related ASW system. It is intended that the new fine mesh screen modifications would not adversely affect any SSCs serving the safety-related ASW system. No transient analyses associated with safe shutdown of the plant would be adversely affected by the new fine mesh screen modifications.

3.4.1.4 Nuclear Fuel (Accident Analyses)

The CWS and the SCW system do not provide cooling to any component required for safe shutdown. The CW 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 conversion of the existing flow-through screens to dual-flow type would not affect the screens serving the safety-related ASW pumps. Consequently, the final design for the dual-flow screens and fine mesh screen panels is not expected to adversely affect FSARU accident analyses.

3.4.1.5 Single Failure

The traveling screens associated with the safety-related ASW system would not be modified. The conversion of the existing flow-through screens to dual-flow screens for the intake bays servicing the CW pumps would not adversely affect any single failures evaluated in the FSARU because the CWS and the SCW system have no safety-related functions, nor do they support any safety-related functions. The final designs for the shoreline intake structure, including the dual-flow screens and fine mesh screen panels, would ensure that the single failure requirements for the safety-related ASW and component cooling water systems remain unaffected.

3.4.1.6 Hydraulic Design

As indicated in Section 3.4.1.3, the dual-flow screens and fine mesh screen panels would be sized to ensure a low pressure drop across the overall system. The final design would also consider the increased pressure drop effects due to postulated blockages of the fine mesh screen panels. It is intended that the new screen modifications, including the fish recovery system, would not adversely affect any SSCs serving the safety-related ASW pumps.

3.4.1.7 Probabilistic Risk Assessment

The modifications to the shoreline intake structure, including the dual-flow screens and fine mesh screen panels, are not expected to adversely affect the probabilistic risk assessment since the overall design philosophy remains unchanged.

3.4.1.8 Instrumentation, Controls and Alarms

The design of the instrumentation, controls, and alarms for the fine mesh dual-flow screens, including the fish recovery system, would provide for monitoring of flows, temperature, pressures, motor currents, etc., to provide operators with required evidence of system operating conditions and trends.

3.4.2 Alternative 2–Offshore Modular Wedge Wire or Similar Exclusion Screening Systems

3.4.2.1 Seismic

The offshore modular wedge wire system, in conjunction with the closure of the intake cove, would functionally replace the existing cove opening. The offshore modular wedge wire screening system would be seismic and non-safety-related. The two stop-log gates located in the cove closure would be seismic and safety-related to ensure that a second source of water is available for the ASW system. Because of the offshore, submerged location of the modular wedge wire screening system, the final design would accommodate both seismic design loads and wave forces that would be encountered in the open sea environment.

The remote offshore location of the modular wedge wire screening system, including the piping manifolds, vertical shaft, and breakwater enclosure, would ensure that seismically induced structural or functional failure of any new SSCs would not adversely affect safety-related SSCs.

3.4.2.2 Operability

The offshore modular wedge wire system would functionally replace the intake cove opening. The offshore modular wedge wire screening system would be sized to ensure a low pressure drop across the overall system and a low velocity across the wedge wire screens. The offshore screen/piping design would be based on a low pressure drop across the wedge wire screen's intake system and a large piping or tunnel diameter to minimize the added offshore component head loss compared to the existing shoreline intake system. The wedge wire screen slots would be sized to provide a balance between the reduction in impingement/entrainment and the required additional maintenance as a result of their susceptibility to clogging. Extensive in situ testing would be conducted during the project's detailed design phase to demonstrate that the screen slot size selected is not prone to blockage in the marine environment. The frequency of inspection and cleaning would be directly proportional to the seasonal marine growth and debris condition at the screens. Emergency openings (i.e., stop-log gates) would be incorporated in the breakwater extension to ensure a continual water supply to the ASW pumps to maintain their safety function. The final design for the offshore modular wedge wire screening system would not increase the risk for unit trips.

3.4.2.3 Transient Analyses

The offshore modular wedge wire screening system would be sized to ensure a low pressure drop across the overall system. This would ensure that the ultimate heat sink would remain available to provide cooling water to the non-safety-related CWS and SCW system. It is intended that the new offshore modular wedge wire screening system modifications would not adversely affect any SSCs serving the safety-related ASW pumps. No transient analyses associated with safe shutdown of the plant are expected to be adversely affected by the new offshore modular wedge wire screening system modifications.

3.4.2.4 Nuclear Fuel (Accident Analyses)

The CWS and the SCW system do not provide cooling to any component required for safe shutdown. The CW pumps are not required for the safety of the units. A complete shutdown of the SCW system would not affect safe reactor shutdown. The installation of the offshore modular wedge wire screening system would not adversely affect the screens serving the safety-related ASW pumps. Seismically designed and safety-related dual stop-log gates located in the cove closure would provide a second source of water to the ASW system. The safety-related saltwater cooling system is not affected by this modification because it remains in the original once-through configuration. Consequently, the final design for the offshore modular wedge wire screening system is not expected to adversely affect FSARU accident analyses.

3.4.2.5 Single Failure

The installation of the new offshore modular wedge wire screening system is not expected to adversely affect any single failures evaluated in the FSARU because the CWS and the SCW system have no safety-related functions, nor do they support any safety-related functions. The final design for the offshore modular wedge wire screening system would ensure that the single failure requirements for the safety-related ASW and component cooling water systems remain unaffected. Emergency openings (i.e., stop-log gates) would be incorporated in the breakwater extension to ensure a continual water supply to the ASW pumps to maintain their safety function.

3.4.2.6 Hydraulic Design

As indicated in Sections 3.4.2.2 and 3.4.2.3, the offshore modular wedge wire screening system would be sized to ensure a low pressure drop across the overall system. The final design would also consider the blockage of the screens due to seasonal marine growth and debris. The complete stoppage of flow may result in vacuum conditions inside the screen that could damage the screen. This would be considered as part of the hydraulic design. It is intended that the new offshore modular wedge wire screening system would not adversely affect any SSCs serving the safety-related ASW pumps.

3.4.2.7 Probabilistic Risk Assessment

The installation of the new offshore modular wedge wire screening system is not expected to adversely affect the probabilistic risk assessment.

3.4.2.8 Instrumentation, Controls and Alarms

No new instrumentation is provided as part of the offshore wedge wire screening system. Existing plant instrumentation would provide means to monitor plant intake flow, levels, temperatures, etc., to provide operators with the required evidence of system operating conditions and trends.

3.5 Conclusion—Criterion 10 Assessment

Criterion 10 is a 10 CFR 50.59 feasibility assessment to determine whether USNRC approval of the alternative technology would be required. Eight nuclear design change criteria were considered in the assessment:

1. Seismic issues
2. Operability
3. Transient analyses
4. Nuclear fuel (accident analyses)
5. Single failures
6. Hydraulic design
7. Probabilistic risk assessment
8. Instrumentation controls and alarms

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?
2. Result in more than a minimal increase in the likelihood of occurrence of a malfunction of an SSC 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?

Consequently, subject to the limitations of the Phase 2 assessment information, implementation of the closed-cycle cooling technology, the onshore 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.

3.6 Facility Operating License/Technical Specifications

The DCPP Facility Operating Licenses and TSs were reviewed to identify all requirements associated with the once-through cooling cycle SSCs. Specifically, the review focused on the need to revise any TS requirements associated with the CWS, SCW system, ASW system, and ultimate heat sink. This review did not identify the need to revise any TS requirements that would require a LAR. However, the TS Bases discussion for the ultimate heat sink (B 3.7.9) may need to be updated to describe the closed-cycle cooling technology. Revisions to the TS Bases do not require prior USNRC approval.

3.7 Environmental Protection Plan (Non-Radiological)

The DCPP Facility Operating Licenses include a facility nonradiological environmental protection plan (EPP) as Appendix B, *Environmental Protection Plan (Nonradiological)*. 10 CFR 50.59 does not apply to changes to the plan because a method for control of plan changes is described in the plan itself. Changes are submitted to the USNRC as license amendments and would include an assessment of the environmental impact and supporting justifications. However, in accordance with Section 3.3 of the plan, changes in plant design or operation and performance of tests or experiments required to achieve compliance with other federal, state, or local environmental regulations would not be subject to prior USNRC approval.

4 Preliminary Design Development

Ultimately, the onshore mechanical (active) intake fine mesh screening system, the offshore modular wedge wire screening, and the closed-cycle cooling technologies were selected for the Phase 2 assessment. This section presents a description of the preliminary design development for each of these three technologies.

4.1 Onshore Mechanical (Active) Intake Fine Mesh Screening Technology

The onshore mechanical fine mesh screening technology involves using smooth woven fine mesh screens in the nominal rectangular size of 1 mm x 6 mm to achieve substantial entrainment reduction of fish, eggs, and larvae and using a fish recovery system to achieve impingement mortality reduction of fish, eggs, and larvae. Specifically, the onshore mechanical fine mesh screening technology consists of replacing six of the existing flow-through coarse mesh traveling screens per unit, located in the plant intake structure, with dual-flow traveling screens with fine mesh. Using dual-flow screens along with larger screen panels provides more than twice the screen surface area per screen compared to the existing flow-through screens, thus resulting in substantial reduction in through-screen velocity. The fine mesh screens selected would reduce velocity from about 1.95 fps to 1 fps. In addition, a fish recovery system would be incorporated to collect fish, eggs, and larvae impinged on the new dual-flow screens. A fish bucket attached to the bottom of each screen panel would hold the fish along with sufficient water as the screen moves upward. Eggs and larvae impinged on the fine mesh screens and fish collected inside the fish bucket would be removed, collected, and returned back to the sea via a new fish return pipeline. The increased debris loading on the fine mesh would be mitigated by the increased screen surface area, higher screen rotating speed, and continuous screen operation (rotation). The existing screen wash (spray) system would be modified to fit the new dual-flow screens with a dual-pressure spray system (low pressure spray of 5 to 10 psig for fish, egg, and larvae removal and high pressure spray of approximately 60 psig for debris removal) and supplemented to provide the additional flow capacity needed to support the requirements of the larger screens for trash and fish, egg, and larvae recovery.

Even though this technology does not comply with the maximum 0.5 fps through-screen velocity for impingement mortality reduction described in the *California Once-Through Cooling Policy* rules, the inclusion of a fish recovery system provides the alternative mitigation measures that support compliance with the *California Once-Through Cooling Policy* requirements. Similarly, implementation of onshore mechanical fine mesh screening technology substantially reduces entrainment loss and marks significant improvement over the current DCPP situation since it currently has a 100-percent administrative loss of fish, eggs, and larvae due to the very large mesh opening of 9.5 mm on the existing flow-through traveling water screens.

In order for the plant to operate reliably, an automatic trash raking system is needed to remove large debris trapped on the trash racks located upstream of the plant traveling screens. Although the plant has a design for an automatic raking system, it cannot be installed on the existing structure due to the installation of the required plant security system. Currently, plant personnel manually remove large debris. This inefficient method of trash removal at times causes the plant to reduce output until the cleaning can be completed. The cost of designing and constructing an automatic trash removal system has not been estimated as part of this effort but would have to be added if the onshore mechanical fine mesh screening technology is selected for implementation.

No safety-related systems are affected by this modification.

4.1.1 Hydraulic Evaluation of the Dual-Flow Screen Retrofit

As shown in General Arrangement Drawing 25762-110-P1K-WL-00070, the rotating axis of the new dual-flow screens would be rotated 90 degrees from the current flow-through screen design. Three screens serve each CW pump. The general flow characteristics of a dual-flow screen and its comparison to a flow-through screen design were described in the Phase 1 report, Section 3.5.

Based on the available space in the existing pump intake, the replacement screen panel width can be up to 14 feet, which is significantly larger than the existing 10-foot screen width. As with the dual-flow screen design, CW would pass through both the ascending and descending faces of the screen. This flow, combined with the larger screen panel width, would reduce the average through-screen velocity to about 1 fps from the existing 1.95 fps at low water level. The significant reduction in average through-screen velocity to 1 fps, combined with continuous screen operation at up to a high speed of 40 fpm, provides an available screen carrying capacity that enables finer mesh screen panels, up to 1 mm size, to be used to mitigate an expected increase of debris loading on the fine mesh screen panels. An increase of debris loading is obvious since the debris in the size range of 1 mm to 9.5 mm would otherwise pass the existing screen panels but would be blocked by the new screens with 1 mm size. In addition, to further mitigate the debris issue, a prerequisite to the fine-mesh, dual-flow screen retrofit is to convert the existing manual cleaning of the upstream trash racks to an installed automatic raking system that would effectively clean larger size debris, such as kelp.

Due to the orientation of the dual-flow screen, the flow exiting the screen is through the middle section of the screen well. This results in a more concentrated flow pattern leaving each screen. Even though the exit velocity would be higher than that for the existing flow-through screen, hydraulic evaluation indicates that the current CW pump suction arrangement should tolerate this velocity increase, primarily due to the elaborate use of the formed suction inlet design, a smooth and accelerating turn toward the pump impeller, as shown in Section A of General Arrangement Drawing 25762-110-P1K-WL-00070. However, to confirm this hydraulic assessment, a physical CW pump intake model test should be conducted by a reputable hydraulic laboratory during the final design process if this technology is selected for implementation. Depending on the testing results, it may be necessary to add a surface beam/baffle downstream of the dual-flow screen exits.

4.1.2 Justification of Selecting 1 mm Fine Mesh Opening

Fine mesh screens fitted to the traveling water screens belong to the active “collect and transfer” design with a mesh size sufficiently small to minimize entrainment loss of fish, eggs, and larvae. As background information, the existing DCPP traveling water screens have a mesh size of 9.5 mm, which essentially allows all fish, eggs, and larvae to pass through and suffer a 100-percent administrative entrainment loss during plant operation. Any reduction in the number of fish, eggs, and larvae entrained presents an improvement over the current situation of total entrainment loss.

Section 4.2.4 of the Phase 1 report provides supporting information on the selection of the rectangular mesh with an effective mesh opening of 1 or 2 mm to achieve improvement in entrainment loss reduction. Additional information was made available to Bechtel during the Phase 2 assessment that indicates a need for an effective mesh opening of 1 mm.

A Tenera report, *Length Specific Probabilities of Screen Entrainment of Larval Fishes Based on Head Capsule Measurements*, dated July 31, 2013, provides screen entrainment probabilities calculated for six slot/screen widths (0.75 mm, 1 mm, 2 mm, 3 mm, 4 mm, and 6 mm) based on the mathematical relationships between overall notochord length of the larvae and the parameters of head capsule width and depth. The report conservatively assumes that all available samples approach the screen head on. The samples were collected near the intakes of eight power plants in central and southern California, including samples collected at DCPP from 1996 to 1999. In this report, a length-specific probability of entrainment for each slot/screen size was calculated for both head width and depth. The probability of entrainment for each notochord length was determined as the larger value of either the head width entrainment probability or the head depth probability. The probabilities were calculated over a size range that approximately corresponds to the range of the lengths of larvae that would be potentially entrainable.

Out of 15 species evaluated, Tenera reported that average percentage reductions in mortality by slot/screen width are as follows:

Slot Size	0.75 mm	1 mm	2 mm	3 mm	4 mm	5 mm
Average percentage reduction in mortality	77.1%	67.6%	34.6%	15.8%	7.8%	1.8%

It would not be possible to use a 0.75 mm slot/screen size because that size would provide insufficient screen surface area based on the available space of the existing pump intake; furthermore, the net result would be only a small percentage reduction in mortality compared to using the 1 mm slot/screen opening. However, the Tenera results listed above show that using a 1 mm slot/screen size results in a major improvement in entrainment loss over the 2 mm and larger sizes.

Considering the information in the Tenera report, the available space in the existing pump intake for screen retrofit, and the better hydraulic characteristics of rectangular screen mesh as opposed to square mesh, fine mesh screens with 1 mm x 6 mm woven mesh were selected for the Phase 2 assessment effort.

4.1.3 Mechanical Design

Six existing flow-through traveling screens per unit would be replaced with larger dual-flow traveling screens for a total of 12 screens for two units. The concrete deck at elevation 17'-5" would require new cutouts to accommodate the installation of new traveling fine mesh screens that support the CW pumps. The auxiliary system traveling screens would not be replaced and would not require modification. The enlargement of the existing traveling screen opening in the concrete would remove portions of the original debris trough imbedded in the concrete deck. The remaining debris trough would be abandoned in place and covered as required. The new debris trough would be routed to the existing debris grinder located between the Unit 1 and Unit 2 traveling screens in the center of the common intake structure. The trough would sit on deck elevation 17'-5". Each screen debris trough would connect to header troughs that would be routed in the most economical manner to the debris grinder.

A second trough above the debris trough is provided for fish, egg, and larvae collection. A fish deflector sill would be installed to bridge the gap between the screen panel and fish trough to keep fish, eggs, and larvae from falling through the gap. Each fish trough would be collected into a common trough and routed to the ocean north of the existing intake structure.

Two additional screen wash water pumps, one for each unit, would be provided to supplement the existing three pumps. The new Unit 1 screen wash pump and strainer would be located in front of CW pump 1-2 at elevation –2'-1". The new Unit 2 screen wash pump and strainer would be located in front of CW pump 2-1 at elevation –2'-1". This location provides the most space to accommodate these components. The new pump's suction nozzle would extend into the CW forebay at a depth equal to 1'-0" below the extreme low tide water level (–2'-4"). The new pump nozzle would be approximately 10 feet above the CW pump suction nozzle and 4 feet forward of the CW pump suction nozzle. The two pump discharge nozzles would be routed to a new extension of an existing 24-inch header. This flanged header pipe can be extended at each end to accommodate the new equipment. The Unit 1 and Unit 2 automatic strainers would receive their suction from the 24-inch header. The strainers would be connected to a common 16-inch-diameter header that would distribute its flow to each Unit 1 and Unit 2 fine mesh screen. This existing piping is about 12 feet overhead. This allows the strainer basket to be removed and the new screen pumps to be installed. The new traveling fine mesh screens would be connected to existing 6-inch piping. This configuration was chosen to reduce cost by using existing piping and supports. It eliminates unnecessary core drilling of additional penetrations of the upper deck. The location of the new screen wash pumps and strainers is near a perimeter wall and allows the surrounding space to be used as a laydown area for other equipment repair or placement.

Six-inch y-strainers would be added at each new traveling screen spray header. Individual isolation and pressure control valves would be provided at each traveling screen. Mechanical equipment associated with this technology is summarized in the equipment list, 25762-110-M0X-YA-00006. New valves being added are summarized in the valve list, 25762-110-M6X-YA-00006.

Two major screen suppliers were contacted to obtain the technical information needed to perform the preliminary design. These suppliers assisted in maximizing the screen surface area that could be installed in the existing structure—which resulted in minimizing the through-screen velocity to about 1 fps—in conjunction with using a slot/screen size (nominal 1 mm x 6 mm) that would effectively collect fish, eggs, and larvae. The suppliers also helped to identify the design requirements for a recovery system for fish, eggs, and larvae impinged on the screen panels. The suppliers provided screen performance information; preliminary physical drawings; equipment weights; electrical requirements; spray wash flow requirements for debris and fish, egg, and larvae removal; and guidance on transporting fish, eggs, and larvae. The screens would be equipped with variable speed drives (with a range of about 10 to 40 fpm). The materials of construction would be primarily stainless steel with fiberglass splash housing, troughs, spray piping, and fish return trough. Cathodic protection would be provided by replaceable sacrificial anodes with an estimated life of 5 years.

A piping and instrumentation (P&I) schematic (25762-110-M6K-WT-00001) was developed for the screen wash spray system to show its piping sizes and components as well as how it would interface with the existing screen wash system. Lists of new valves and inline piping components were generated to identify the required scope to complete the system. Existing piping is a lined piping; new piping would be fiberglass. Valves would be ductile iron or duplex stainless steel, depending on size and service.

General arrangement drawings (25762-110-P1K-WL-00070, -00071) were developed to identify the new location for the dual-flow traveling screens, screen wash pumps, and screen wash strainers and the routing of the fish return trough.

The following assumptions are associated with the mechanical portion of the design:

- There has been no significant degradation to the existing screen wash pump performance.
- The existing spray piping is reusable (has not deteriorated).
- A bar rack debris removal system would be added to the system if this technology is selected for implementation.

4.1.4 Control System Design

Control systems and equipment have been designed in accordance with the instrumentation and controls shown on P&I Schematic 25762-110-M6K-WT-00001 and the equipment described in the mechanical section of this report. A new vendor-supplied local control panel with operator interface would be provided for each new traveling screen and associated screen wash system. The existing traveling screen panel would be decommissioned and removed. The new panels would be installed at the locations of the old traveling screen panels in the Unit 1 and Unit 2 electrical equipment rooms located in the existing intake structure. New panels would also be provided for the two existing ASW traveling screen systems that are otherwise not being replaced or modified.

A new control panel would be furnished for the two new screen wash pumps. This panel would be located in the general vicinity of the existing screen wash control panel. The two new automatic backwash strainers would each have vendor-supplied control panels located in the general vicinity of the strainers.

Alarms would be generated by the local controlling device or programmable logic controller (PLC) to indicate potential loss of operating equipment. Pump, motor, strainer, and screen/spray system trouble or malfunction indications would be provided to operators via common alarms as per existing design.

A pressure control valve would be provided at each new traveling screen to control the screen wash spray water pressure. Local pressure indicators would also be furnished downstream of each pressure control valve. A pressure transmitter and local pressure gauge would be provided downstream of each automatic backwash strainer. The pressure transmitters would interface with the dual-flow traveling screen and screen wash spray controls. A differential pressure gauge would be provided across each automatic backwash strainer and would interface with the strainer controls.

Existing intake level instrumentation would be retained and interfaced with the new traveling screen controls.

4.1.5 Civil Design

The Civil discipline has performed preliminary engineering to support the development of the price and schedule for adding replacement screens and making related modifications to the existing intake structure.

Replacing the through-flow screens with larger dual-flow screens necessitates making structural modifications to the intake structure. The modifications would be to the concrete deck, where the dual-flow screens would be situated at a 90-degree angle relative to the existing screens. Each new screen requires a larger east–west footprint. The new screens would be anchored to the walls of the existing intake structure.

4.1.5.1 Description of Civil Structure

The existing single-flow screens are supported on the intake structure, and fish and debris are collected, sent to the grinder, and then discharged to the ocean north of the plant, beyond the breakwater.

To accommodate the new dual-flow screens, the intake structure deck would be modified by cutting it to provide larger openings.

The fish recovery system would be a fiber-reinforced-polymer (FRP) pipe that would run along the new screens above the existing concrete deck. It would direct fish, eggs, and larvae to the ocean through a vertical shaft, a tunnel, and a concrete conduit, thereby securing their release to the ocean. Refer to General Arrangement Drawing 25762-110-P1K-WL-0071 for details of the modifications and the addition of the fish recovery system.

4.1.5.2 Seismic Classification

The intake structure is a Seismic Design Class II reinforced concrete building housing and supporting Design Class I equipment. Thus, the structure is designed to avoid collapse that would impair equipment operation.

The fish recovery system is designed as Seismic Category II, and its failure would not affect plant operations during a seismic event.

4.1.5.3 Summary of Civil Deliverables

Civil modifications are planned to accommodate the replacement of the existing single-flow screens with new dual-flow screens as follows:

1. Modify the existing intake structure:
    a. Modify the deck by increasing existing opening sizes to accommodate each new dual-flow screen (opening sizes increase in the east–west direction).
    b. Design anchors for the screens.
    c. Rebuild the voids (between the existing opening and the new screens).
    d. Cut two openings in the existing slab for the installation of the new pumps.
2. Install the new fish recovery system:
    a. Provide FRP pipe to recover fish, eggs, and larvae and direct them to the ocean.
    b. Provide a support system for the FRP pipe.

c. Drill a vertical shaft in the ground.

d. Drill a horizontal tunnel.

e. Provide a concrete conduit and a header at the end of the concrete conduit.

The following assumptions are associated with the Civil portion of the design:

- The concrete deck and the intake structure are adequate for new slab openings.
- The existing trash trough is abandoned in place.
- No other modifications are required in the intake structure.
- The traveling screens will be designed so that the fish return will be at elevation 23’-0” to allow a 4-foot minimum clearance from the concrete deck level at elevation 17.5’ and to provide sufficient elevation to obtain the proper flow for the fish return line.
- The new raking system for trash racks would be designed separately at a future date if this technology is selected for implementation.
- The safety classification of the new structure in front of the existing intake structure is Seismic Category I and Design Class II (similar to the existing intake structure classification).
- No underground utilities are required for the fish recovery tunnel and Construction can tunnel through the rock area.
- No new fence is required (minor existing fence modification may be required, but were not considered in this estimate).

4.1.6 Electrical Design

The overall additional electrical load for this modification is approximately 140 hp, which is relatively minimal. The existing power distribution system has the required capacity for the incremental load. The existing 480 V intake load center switchgear would feed the loads to the extent possible. Existing feeders would be used to swap the existing screen loads with the new screen loads.

The instrumentation list and quantities were the primary inputs for the electrical design. Input data used to develop the quantities were:

- Mechanical equipment lists depicting the pumphouse power requirements
- P&I schematics depicting the system components for the various options
- General arrangement drawings

The resulting major load change would be to replace the existing traveling screens with new ones having lower power requirements. The existing 350 hp screen wash pumps would remain in service. This option also requires additional new 200 hp screen wash pumps (one per unit) that would be fed from the existing load centers by using a spare breaker. Even after taking into account the proposed minimal load addition (approximately 140 hp) at the 480 V level, the loading on upstream transformer 14D and the feeding secondary winding of farther upstream transformer UAT12 is less than 80 percent. Therefore, the load change is acceptable.

The duct banks and trays that feed the existing traveling screens would be used for the replacement screens. The plan is to use existing raceway system from the motor control centers

(MCCs) to the new screens. No new tray or duct bank would be required. A small amount of conduit would be required for the new screen wash pump.

The input was provided to estimating in the form of electrical single-line drawings and a document that quantifies cables and conduit.

4.1.7 Permitting

The initial Phase 1 permitting assessment focused on identifying the applicable (required) permits and approvals for construction and operation of the onshore mechanical (active) fine mesh screening system. A comprehensive list of potentially applicable permits and approvals at the federal, California, county, and municipal level (as applicable) was developed. The applicability of each permit/approval to the fine mesh screening system was evaluated. Those permits and approvals that were deemed applicable were subsequently scrutinized to characterize the expected duration and complexity of the regulatory review process. Ultimately, the onshore mechanical fine mesh screening system option was selected for the Phase 2 assessment.

The subsequent permitting assessment focused on identifying the critical path (longest duration) initial preconstruction permitting processes and the associated project costs. The preconstruction permits are those approvals that directly support site mobilization, physical site access, and initial earthwork/foundations for the subject cooling system technology option. The costs include the direct permit filing, impact mitigation, and permitting application development (services) costs.

4.1.7.1 Cost and Schedule Evaluation

The cost and schedule to secure the following major applicable permits were developed based on discussions with key relevant regulatory authorities and from associated website resources:

- California Environmental Quality Act (CEQA) – Final Notice of Determination
- Section 404/10 Permit, U.S. Army Corps of Engineers (USACE)
- California Public Utilities Commission (CPUC)
- Coastal Development Permit, California Coastal Commission (CCC)
- Coastal Development Lease, California State Lands Commission (CSLC)
- National Pollutant Discharge Elimination System (NPDES) Industrial Discharge Permit, Central Coast Regional Water Quality Control Board (CCRWQCB) and California State Water Resources Control Board (SWRCB)
- Dust Control Plan, San Luis Obispo County Air Pollution Control District (SLO-APCD)
- Local Approvals, San Luis Obispo County (SLO)

Table IFMS-1 summarizes the key cost and schedule details and assumptions for the onshore mechanical (active) intake fine mesh screening system. Legal costs associated with managing appeal processes and related litigation have not been included. The bulk of the potential mitigation costs would be developed through negotiation and are consequently not included in the cost estimate.

Table IFMS-1. DCPP Environmental Permit/Approval Cost Assessment:
Onshore Mechanical (Active) Intake Fine Mesh Screening System

Permit/ Approval	Cost Discussion	Responsibility	Permit Review Period	Filing Costs	Remediation or Mitigation Costs	Permitting Service Costs
Section 404/10 Permit – USACE	No filing fees are associated with the Section 404 permit application, although there is a nominal fee ($10–$100) associated with preparing an Environmental Assessment (EA). Labor costs for preparing an individual permit application = 1,000 hours @ $150/hr.	Owner	120 days from complete application (goal); 12 months (expected but aligned with CEQA)	$100	Undetermined	$150,000
Section 401 Water Quality Certificate – CCRWQCB	Fill & Excavation Discharges: $944 + $4,059 x disturbed area (acres) Dredging Discharges: $944 + $0.15 x cy Channel and Shoreline Discharges: $944 + $9.44 x discharge length (ft) (California Code of Regulations [CCR] Title 23§2200) Assumption: 2,000 ft of shoreline impacts. Labor costs: Contained in Section 404/10.	Owner	Aligned with Section 404/10 Permits	$19,284	Undetermined	$0
Section 7 Consultation with U.S. Fish and Wildlife Service (USFWS), Endangered Species Act of 1973	By virtue of its Section 404/10 Permit, the project would have sufficient “federal nexus” (federal funding, federal lands) to trigger USFWS consultation. Associated costs are inherent in the CEQA process.	Owner	Part of CEQA review	$0	Undetermined	$0
California Department of Fish and Wildlife (CDFW) Review	CDFW consultation will be conducted in parallel with the Section 7 review. CEQA document filing related fee ($2,995.50 and county clerk processing fee $50). (CDFW, 2013)	Owner	Part of CEQA Review	$3,050	Undetermined	$0
CPUC Approval	While formal CPUC review and approval may prove necessary, the primary costs of this process are associated with the CEQA review process. The CPUC could be the lead CEQA agency or share this role with another regulatory organization (e.g., CCC, SLO). These CEQA costs are addressed in the County Conditional Use Plan Approval Process.	Owner	About 20–24 months if required	$0	Undetermined	$0

Permit/ Approval	Cost Discussion	Responsibility	Permit Review Period	Filing Costs	Remediation or Mitigation Costs	Permitting Service Costs
Coastal Development Permit – CCC/Local Coastal Programs	The CCC indicates that the filing fee for non-residential development is $53,000 (CCC, 2008). There may be additional fees for reimbursement of reasonable expenses, including public notice costs. CEQA costs are covered in the County Condition Use Plan Approval Process. Labor costs for preparing/submitting related forms and documentation = 2,000 hours @ $150/hr.	Owner	A 3–9 month process is advertised, but it would be aligned with the CEQA review process	$53,000	Undetermined	$300,000
Coastal Development Lease – CSLC and potential CEQA Lead Agency	The Commission lease-related fees include (CSLC, 2011): Industrial Lease: $25,000 Dredge Lease Fee: $1,500 Filing Fee: $25 Labor costs for preparing/submitting related forms and documentation = 3,000 hours @ $150/hr.	Owner	Depends on duration of CEQA review process; about 2 years	$26,525	Undetermined	$450,000
Dust Control Plan or Construction Activity Management Plan (CAMP) – SLO-APCD	While SLO-APCD does not list any specific fee for the Dust Control Plan, other California Air Resources Board (CARB) entities are known to charge $300 to reimburse review costs. If the construction ozone precursor emissions (ROG + NOx) exceed the SLO-APCD quarterly significance threshold of 6.3 tons, the SLO County CEQA Handbook (SLO-APCD, 2012) defined mitigation rate is $16,000 per ton of ozone precursor plus 15% administrative fee. The current assumption is that precursor emissions are below this threshold. Labor costs for preparing/submitting the plan = 80 hours @ $150/hr.	Contractor	1-month plan development process	$0	Undetermined	$12,000
NPDES Industrial Discharge Permit – CCRWQCB and SWRCB	The operating project is incurring annual fees based on its current discharge rate, which is not expected to change appreciably with the addition of this modified intake system. Consequently, any associated fee structure is not expected to change. Labor costs for revising NPDES permit to reflect new intake structure = 500 hours @ $150/hr.	Owner	About 6 months, but likely to be aligned with CEQA review process	$0	Undetermined	$75,000

Permit/ Approval	Cost Discussion	Responsibility	Permit Review Period	Filing Costs	Remediation or Mitigation Costs	Permitting Service Costs
Conditional Use Plan Amendment – San Luis Obispo County Department of Planning and Building (SLO-DPB) and Potential CEQA Lead Agency	As the CEQA lead agency or co-lead, the county would assess fees for development of the Initial Study, environmental coordination fees, and Environmental Impact Report (EIR) processing fees (SLO-DPB, 2012). Initial Study Cost: $14,603 Other fees include: CalFire Review: $603 Health Department Review: $600 Geological Review: $2,671 (minimum) Resource Conservation District Review: $375 (minimum) Labor costs for EIR consultant + 50% premium = 4,000 hours @ $150/hr x 1.5.	Contractor	Depends on duration of CEQA review process; about 2 years	$20,000	Undetermined	$900,000
Notification of Waste Activity – Resource Conservation and Recovery Act (RCRA) Hazardous Waste Identification Number (Small Quantity Generator) – Construction Phase – Department of Toxic Substance Control, U.S. Environmental Protection Agency (USEPA), San Luis Obispo County Environmental Health Services (SLO-EHS) – California Unified Program Agency	Securing the Construction Phase Hazardous Waste ID (if necessary) does not demand a filing fee. Labor costs for preparing/submitting related forms = 4 hours @ $150/hr.	Contractor	1–2 weeks if required	$0	Undetermined	$600
Building Permits – SLO-DPB and San Luis Obispo County Department of Public Works (SLO-DPW): Grading Site Plan Reviews/Checks Mechanical, Plumbing, and Electrical Tanks Fire Inspections	SLO-DPB has a complex fee schedule (SLO-DPB, 2012). Recent SLO County experience on a significant solar PV project indicates that overall building permit and inspection fees could total $750,000. Labor costs for preparing/submitting related engineering packages = 2,000 hours @ $150/hr.	Contractor	4–6 weeks for initial permits following completion of CEQA review and conditional use permit	$750,000	Undetermined	$300,000
Fire Safety Plan Approval, Certificate of Occupancy, Flammable Storage – SLO Fire Department	Revisions to the existing Fire Safety Plan are not expected to result in additional filing or direct regulatory fees. The initial filing fee of $408 would probably not apply. Labor costs for revising Fire Safety Plan = 20 hours @ $150/hr.	Contractor	1 month for plan approval	$0	Undetermined	$3,000
TOTAL				**$872,000.00**	**$0.00**	**$2,190,600.00**

4.1.7.2 Summary

The list of potentially applicable federal, state, and local permits for the onshore mechanical (active) intake fine mesh screening system reflects the potentially significant impacts to the onshore and near-shore marine environment, primarily related to returning fish, eggs, and larvae system back to the sea. The efforts to conduct a successful CEQA review would be the primary critical path permitting process. The CEQA lead agency may be a shared responsibility among a number of key regulatory departments (e.g., SLO, CSLC). The requisite USACE Section 404 permit, CCC coastal development permit, CSLC lease, and NPDES permit modification would have potentially lengthy review processes but would all be essentially bounded by the critical path CEQA/EIR review process.

The CEQA review process duration varies. The shortest path appears to be a nominal 210-day (7-month) period that would include the minimum 30-day review period to determine that the initial CEQA application is complete. This process culminates in a Negative Declaration and does not involve developing a comprehensive EIR. However, the fine mesh screening system review process would likely demand preparation of an EIR, which would serve to significantly extend this review process. The process—inclusive of the initial 30-day completeness review, a 1-year EIR review, and a so-called 90-day “reasonable extension” triggered by compelling circumstances recognized by both the applicant and lead agency—would then extend out to 16 months. (CEQA Flowchart)

The CEQA review process would be extended even further by conservatively adding an additional 8 months to cover “unreasonable delays” ostensibly associated with the applicant’s difficulty in supplying requested information. Collectively, this longer and probably more applicable 2-year CEQA review process would likely follow a 1-year period of permit application development. The other permitting processes are assumed to proceed in parallel to the critical path CEQA review process.

The total permit filing and permitting service costs associated with this 3-year permitting process would be approximately $3.0 million. As noted earlier, this 3-year period does not reflect the impact of permit appeals, litigation, or potentially negotiated CEQA-related mitigation fees. In recognition that such complications may occur, the project execution schedule adds a 3-month appeal period following the CEQA final decision.

4.1.7.3 Sources

1. California Coastal Commission (CCC) Permit Application Instructions, Appendix E Filing Fee Schedule (3/17/2008).
2. California Code of Regulations (CCR) Title 23§2200 Annual Fee Schedules – Subpart a(3) Dredge and Fill Materials.
3. California State Lands Commission (CSLC), Land Management Division Application Guidelines (10/12/2011).
4. California Department of Fish and Wildlife CEQA Document Filing Fees, 2013 http://www.dfg.ca.gov/habcon/ceqa/ceqa_changes.html.
5. California State Water Resources Control Board (SWRCB) Fee Schedule 2012-2013, 2012 http://www.swrcb.ca.gov/resources/fees/docs/fy12_13_fee_schedule_npdes_permit.pdf.
6. California Environmental Quality Act (CEQA) Flowchart for Local Agencies: California Code – Section 21151.5, http://www.ceres.ca.gov/planning/ceqa/flowchart.html.
7. San Luis Obispo County Air Pollution Control District (SLO-APCD) CEQA Air Quality Handbook – A Guide for Assessing the Air Quality Impacts for Projects Subject to CEQA Review, April 2012.

8. San Luis Obispo County Department of Planning and Building (SLO-DPB) – Fee Schedule 2012-2013, 2012.

4.2 Offshore Modular Wedge Wire Screening Technology

The concept selected for installing the offshore modular wedge wire screening technology involves enclosing the existing intake cove to form a shoreline basin and extending a new CW conveyance system, either tunnel or buried piping, from the basin to the ocean. Wedge wire screen assemblies would be attached to the ocean end of this conveyance system to enable it to supply filtered seawater to the newly created intake basin, which would be sealed to prevent direct seawater inflow. (See Process Flow Diagram 25762-110-M6K-WL-00006.)

The offshore location of the wedge wire screens is dependent on local bathymetry and biological sensitivity and the need to provide adequate depth above and below the screens to maintain their hydraulic performance. The open sea oceanographic setting and geological characteristics offshore of DCPP pose significant challenges to this type of conveyance system; consequently, two alternative concepts, tunnel and buried piping, were considered. The final selection would be based on the lowest total installed cost of the system.

4.2.1 Existing Conditions and Basic Data

4.2.1.1 Seawater Level and Wave Climate Conditions

DCPP is located on a coastal terrace above a rocky shoreline with bathymetry characterized by a sloping bedrock bottom with steep relief, rocky pinnacles, and prominent rocky ridges (Figure 4.2-1). The ocean water level normally varies between 0 and +6 feet mean lower-low water (MLLW) datum. Mean sea level zero is equivalent to +2.6 feet MLLW. Maximum tidal range is approximately 9 feet and extends from 7 feet above MLLW to approximately 2 feet below MLLW. The sub-tidal zone reaches a maximum depth of approximately 60 feet below MLLW within 100 feet of shore in some areas (Figure 4.2-2).

Normal wave activity is in the 5-to-10-foot range, with storms generating waves between 20 and 30 feet. During the storm season between September 1997 and August 1998, peak swells exceeded 10 feet on 64 days. The DCPP cooling water intake is located in an area of significant production of marine algae, including surface kelp and understory algae. Kelp growth can reach 2 feet per day during the growing season between June and October. DCPP is located in a “wet marine” weather environment where ocean winds are commonly 10 to 25 miles per hour and can reach 40 to 50 miles per hour. Rainfall averages 20 inches per year, and the normal daily weather pattern is characterized by wet/foggy conditions in the morning and mild to strong winds in the afternoon (Reference 1).

Daily mean seawater temperature ranges from approximately 10.5°C (50.9°F) in May to approximately 15°C (59°F) in September. The maximum seawater temperature is approximately 18°C (64°F) (Reference 1).

4.2.1.2 Cooling Water Flow Requirements

DCPP currently uses a common shoreline intake structure to withdraw cooling water from the ocean to two independent once-through systems, one for each unit. The intake structure is protected by two breakwaters that extend offshore to form a semi-enclosed intake cove. Each unit is serviced by two single-speed CW pumps. The cooling water flow rate ranges for Unit 1 from 778,000 gpm to 854,000 gpm and for Unit 2 from 811,000 gpm to 895,000 gpm. In addition, for each unit, there are two ASW pumps that must remain operational at all times (Reference 1). The total design flow is 1,753,000 gpm.

Figure 4.2-1. DCPP Site Location Map (Contour elevations = feet below MLLW)

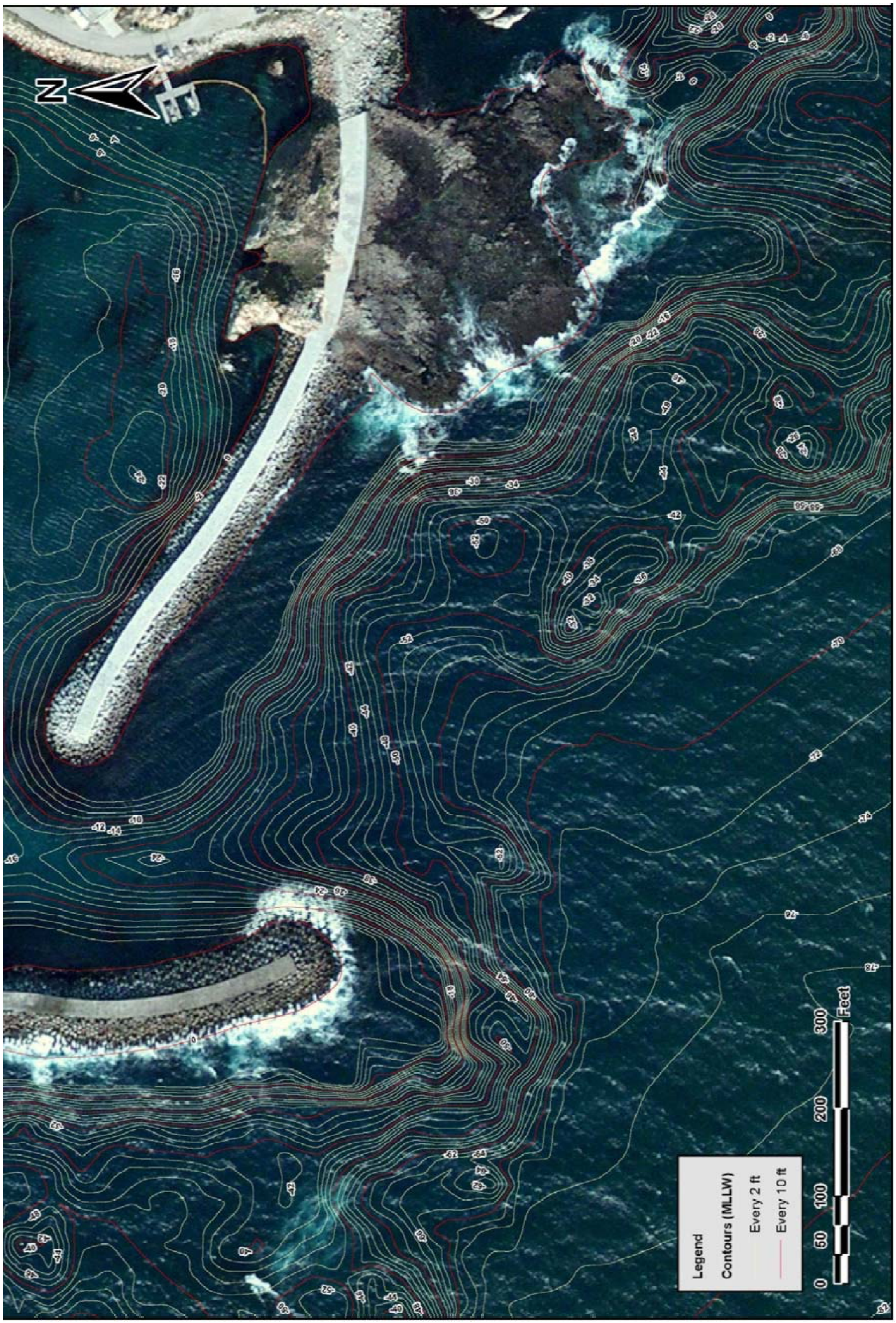


Figure 4.2-2. DCPP Bathymetry Map (Contour elevations = feet below MLLW)

4.2.1.3 Site Geology and Geotechnical Engineering Data

Geotechnical information is limited, and hydrographic/bathymetry, seismic, geophysical, and geotechnical subsurface investigations would be performed for final design.

The geomorphic regions in the area of DCPP offshore include the Islay shelf to the north and the Santa Rosa Reef shelf to the south (Reference 2). Both shelves have a rocky near-coast portion and a sediment-covered portion further offshore. As reflected in the contours of the seabed (Figure 4.2-1), the near-coast portion is steeper than the sediment-covered offshore portion.

Lithologically, the seabed offshore of DCPP consists of two exposed formations: (i) the Obispo Formation to the south of the breakwater and (ii) a marine-deposit-covered portion further offshore (Reference 2). The Obispo Formation (T_{mo}) is a roughly 1,300-foot-thick section of marine volcanic deposits and is exposed from the DCPP breakwater to the Shoreline fault. Regional lithology within the Obispo Formation varies considerably, but along the DCPP coastline, three subunits are recognized: (i) resistant tuff (T_{mor}), (ii) fine-grained sandstone and claystone (T_{mof}), and (iii) intrusive diabase bedrock (T_{mod}). The resistant tuff subunit (T_{mor}) is exposed along the coastline from the base of Green Peak to the south headland of Discharge Cove and is structurally repeated at the north headland of Discharge Cove. The fine-grained sandstone and claystone subunit (T_{mof}) is exposed along the coastline from the south headland of Discharge Cove to south of Crowbar Hill and is probably structurally repeated north of Crowbar Hill. This fine-grained subunit is more than 330 feet thick and consists of regularly bedded sandstone with minor shale and mudstone that coarsens gradually up-section.

The diabase bedrock subunit (T_{mod}) has intruded into the resistant tuff subunit along approximately 3,000 feet of coastline south of DCPP. This dike/sill complex is also mapped in the intertidal zone directly south of the breakwater at Intake Cove. The offshore marine deposits (Q_s) consist of sand and silty sand with minor gravel deposits that become finer grained progressively offshore. Thin dune-like sand sheets (Q_{sw}) cover parts of the sea floor beyond the Shoreline fault. These are well-defined, low, less-than-3-feet-high, dune-like features with long wave lengths, approximately 82 to 410 feet. There is evidence of their mobile, ephemeral nature. At the base of the marine sand and silt, a gravel-cobble lag is inferred to overlie the top of the bedrock. In summary, the DCPP offshore consists of diabase bedrock exposed near the existing breakwaters and covered with thin sediment further offshore. There is no available information regarding the state of weathering and strength (rippability) of the offshore diabase. If it is considered not feasible to excavate trenches in offshore rock by conventional methods, then removing rock by low-charge blasting can be the alternative. In that case, the impact of blasting on the aquatic life, the power plant, and the nearby faults should be assessed. Effects can be minimized by using multiple small charges. The same considerations apply to the tunnel or piping system that would convey water from the assemblies to the shoreline basin.

4.2.1.4 Site Seismicity

From the available information, there is indication for presence of the Shoreline fault located about 1,800 feet offshore of the DCPP. The fault is estimated to be 600 feet offshore of the DCPP inner breakwater, and for both concepts (tunnel and piping systems) the footprint of the wedge wire assembly area is very close to the Shoreline fault, if not overlapping. Based on several qualitative and indirect quantitative estimates of slip rate (the fault zone lies entirely offshore and there are no identified geomorphic features that can be reliably used as lateral offset markers), the interpreted slip rate on the Shoreline fault zone ranges from 0.02 inch/year (0.05 mm/yr) to possibly 0.04 inch/year (1 mm/yr), with a preferred range of 0.008 to 0.012 inch/year (0.2 to 0.3 mm/yr). The slip rate could also be zero (Reference 2). Thus, for both concepts (tunnel and piping), the systems/structures should be designed to withstand the ground motions from this fault and any impact of a potential slip. The extent of the fracture zone is not known at this time but can be estimated beforehand by drilling boreholes and performing geophysical tests during detail engineering studies.

4.2.2 Alternative Concept A: Offshore Tunnel

4.2.2.1 Offshore Tunnel System Description

Figures 4.2-3 through 4.2-10 and Drawing 25762-110-M6K-WL-00006 show the schematic arrangement of the offshore tunnel alternative, which includes a 30-to-32-foot-diameter tunnel that would be constructed using a tunnel-boring machine (TBM) to connect the main drop shaft to the offshore drop shafts. The offshore tunnel length would be approximately 1,000 feet, depending on the bathymetry, geology, and seismology conditions. The extent of tunnel lining would depend on the rock and fault conditions encountered during geological and geotechnical investigations. For the purposes of the estimate, 30 percent of the tunnel is assumed to be lined. The main drop shaft diameter would be similar to or larger than that for the tunnel to provide TBM access. A construction access shaft (not shown in the figures) may be required to facilitate construction sequencing.

The shoreline basin would be constructed by extending the existing inner breakwater westward and closing the intake cove from direct contact with the open sea. The only connection of the basin to the sea would be through the tunnel for normal operation conditions and through an emergency conduit (Figure 4.2-10) to ensure the continued supply of water for operation of the ASW pumps.

4.2.2.2 System Components for Offshore Tunnel Alternative

Wedge wire screen assemblies would be used as the source for intake water withdrawal for the system and would be designed to restrict the intake water velocity, mitigate potential impingement, and reduce entrainment. The total design flow would be 1.753 million gpm. Two screen slot size alternatives were considered:

a. 6-mm-slot-opening screens—Installation of the wedge wire screens would include designing, furnishing, and installing wedge wire screens at each of the vertical pipe flanges above the seabed. Thirty 8-foot-nominal-diameter, 35-foot-long wedge wire screens would be required.

b. 2-mm-slot-opening screens—Installation of the wedge wire screens would include designing, furnishing, and installing wedge wire screens at each of the vertical pipe flanges above the seabed. Forty-eight 8-foot-nominal-diameter, 35-foot-long wedge wire screens would be required.

Connection piping (laterals) would be buried or partially trenched, and anchored to the seabed.

Offshore intake drop shafts – The five (for 6-mm-slot openings) or six (for 2-mm-slot openings) shafts connecting the wedge wire screen manifolds to the offshore intake tunnel would have 12-foot finished inside diameters and would be located approximately 1,000 feet offshore. The shafts would receive water inflow from the wedge wire screen connection piping (laterals). The shafts would be sealed to allow only water flow from the connection piping. An access opening would be provided in the shaft cover to permit inspection and maintenance access. The work would include rock excavation down to the tunnel intersection, spoil disposal, and shaft lining as required.

Offshore intake tunnel – The tunnel would extend from the offshore intake drop shafts to the onshore main drop shaft, with an estimated length of approximately 1,000 feet. The tunnel would be designed to convey the total intake water requirements. The work would include the excavation of the tunnel in rock, spoil disposal, tunnel support, and internal tunnel lining (grouting and reinforcement of walls) as required (for budgetary price, 30 percent of tunnel length was assumed to be lined).

Onshore main drop shaft – This shaft would be constructed in the existing shoreline basin (intake cove) and intersect with the offshore intake tunnel. The shaft would be sized to accommodate DCPP water flow requirements. The design, fabrication, and installation of screens and debris protection at the top of the shaft would also be provided. The work would include rock excavation down to the tunnel intersection, spoil disposal, and shaft lining as required.

Breakwater – An enclosed shoreline basin would be constructed by extending the east portion of the existing breakwater. The design and materials of the breakwater extension would be similar to those of the existing restored breakwater.

The existing and new breakwaters would be sealed to prevent entry of fish, eggs, and larvae. Engineering evaluations would be made to provide assurance that such measure would not undermine the stability of the breakwater during wave attacks, since pervious breakwaters reduce the magnitude of the impact force.

Emergency backup water supply – Precast reinforced concrete box culverts, including vertical concrete walls and stop logs, would be designed and installed within the new portion of the breakwater. Their design would facilitate stop log installation and removal. The conceptual sketch of this structure is shown in Figure 4.2-10.

It would be necessary to stockpile excavated/dredged tunnel, shaft, and lateral-placement material either on the DCPP site or within a maximum of 5 miles off site. An access road to the existing east breakwater would also need to be constructed. Dredging activities should have minimal impact on the aquatic life.

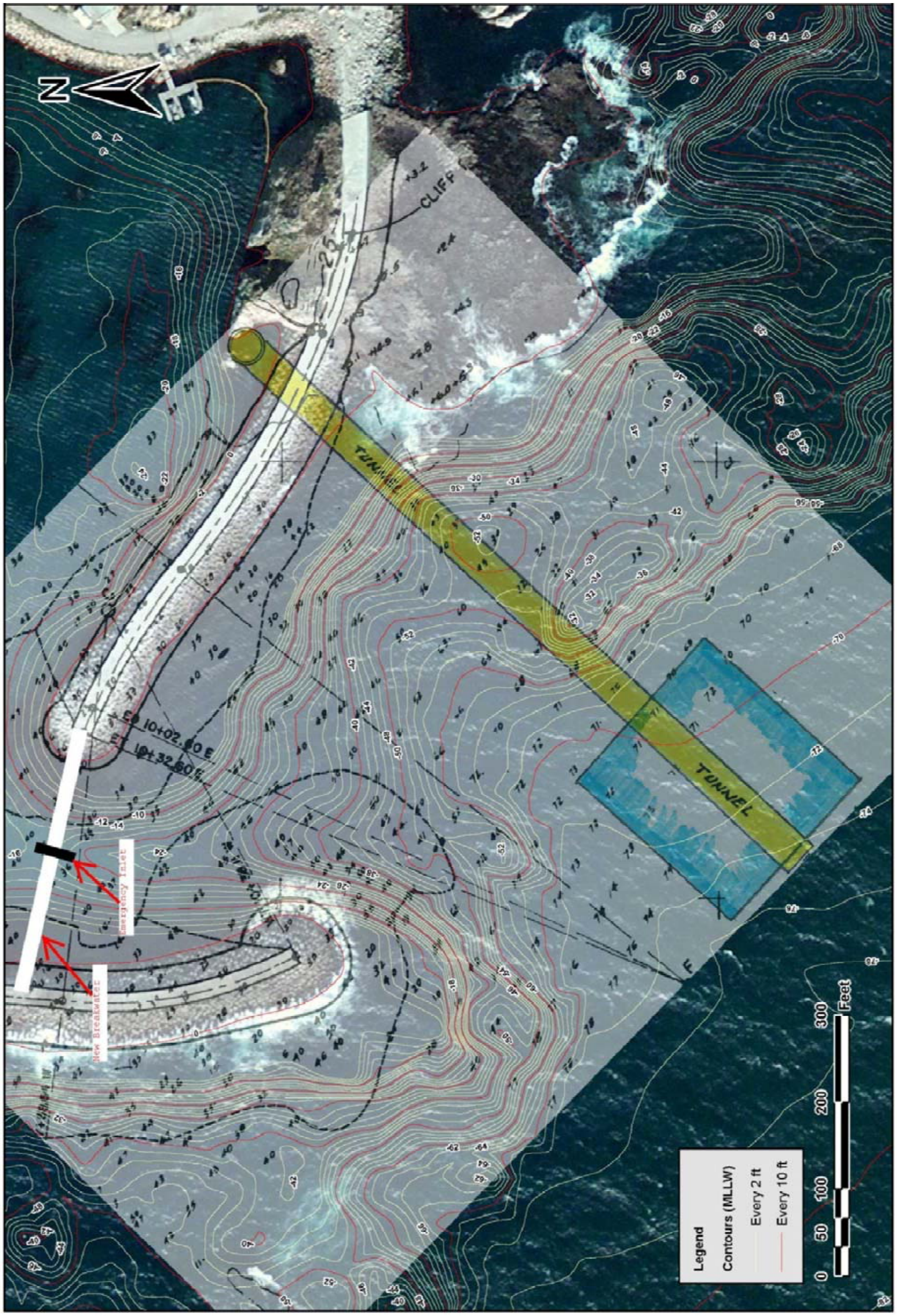


Figure 4.2-3. DCPP Bathymetry/Tunnel for 6-mm-Slot Screen Layout (Contour elevations = feet below MLLW)

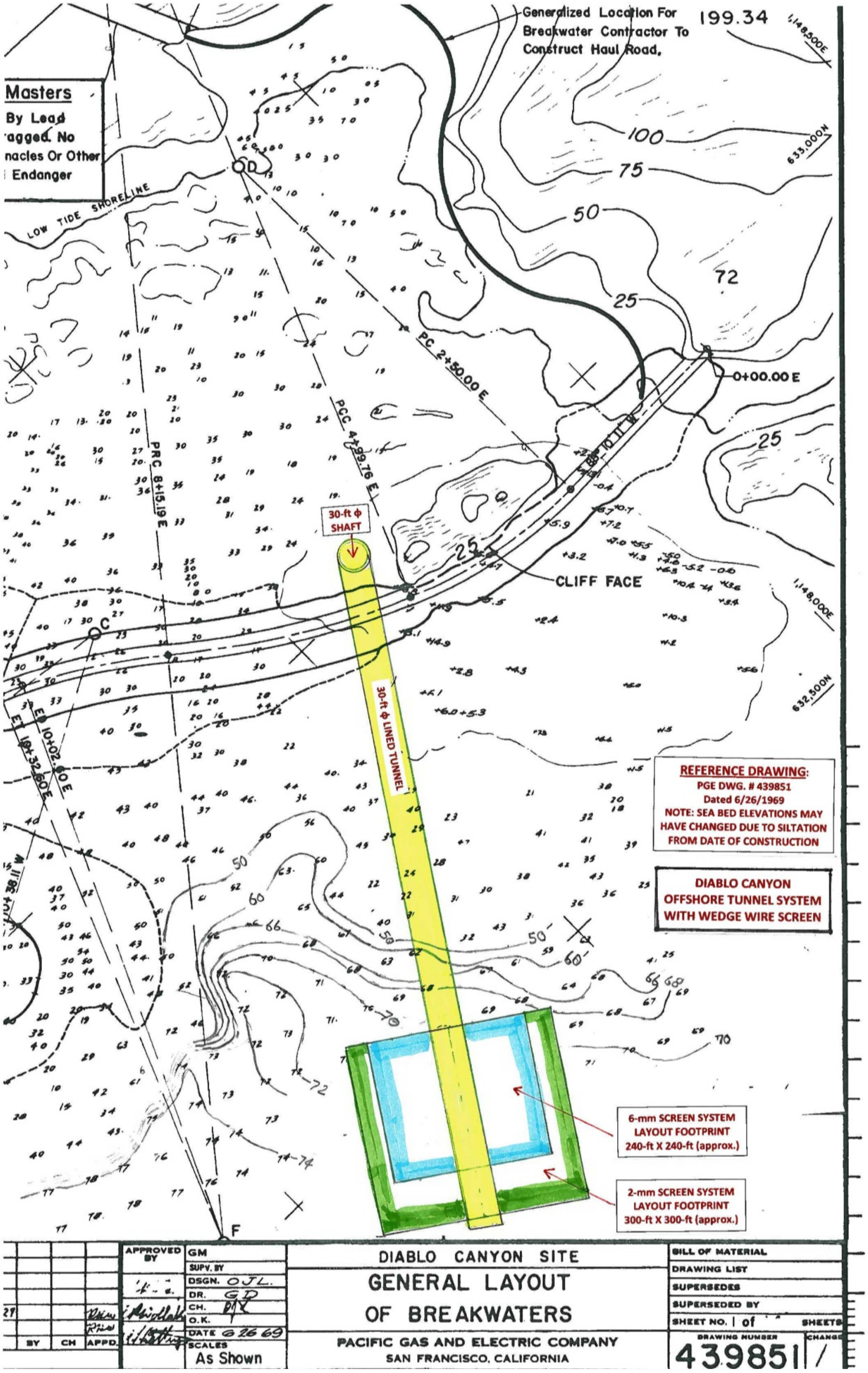


Figure 4.2-4. DCPP General Layout of Breakwaters

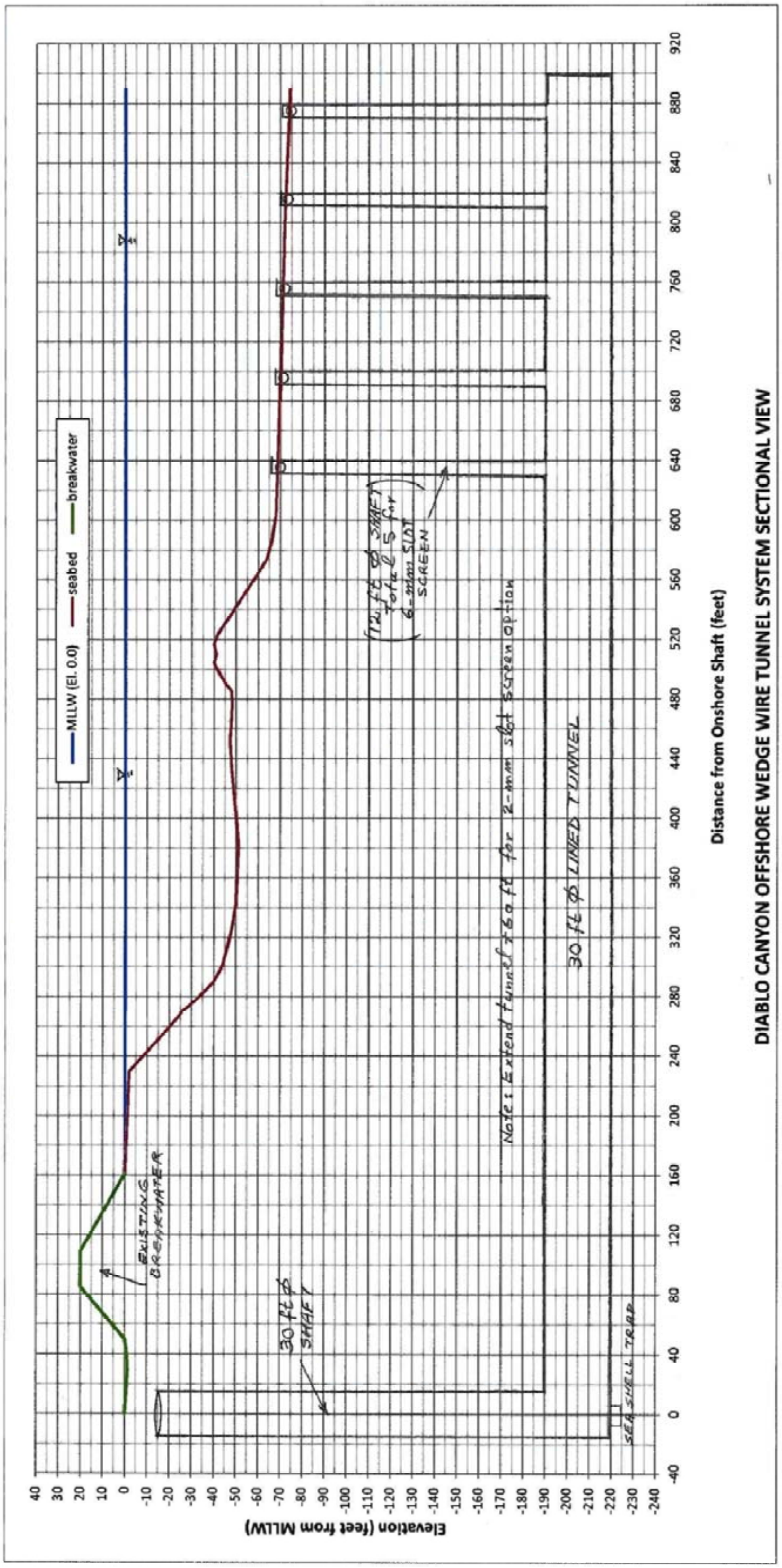
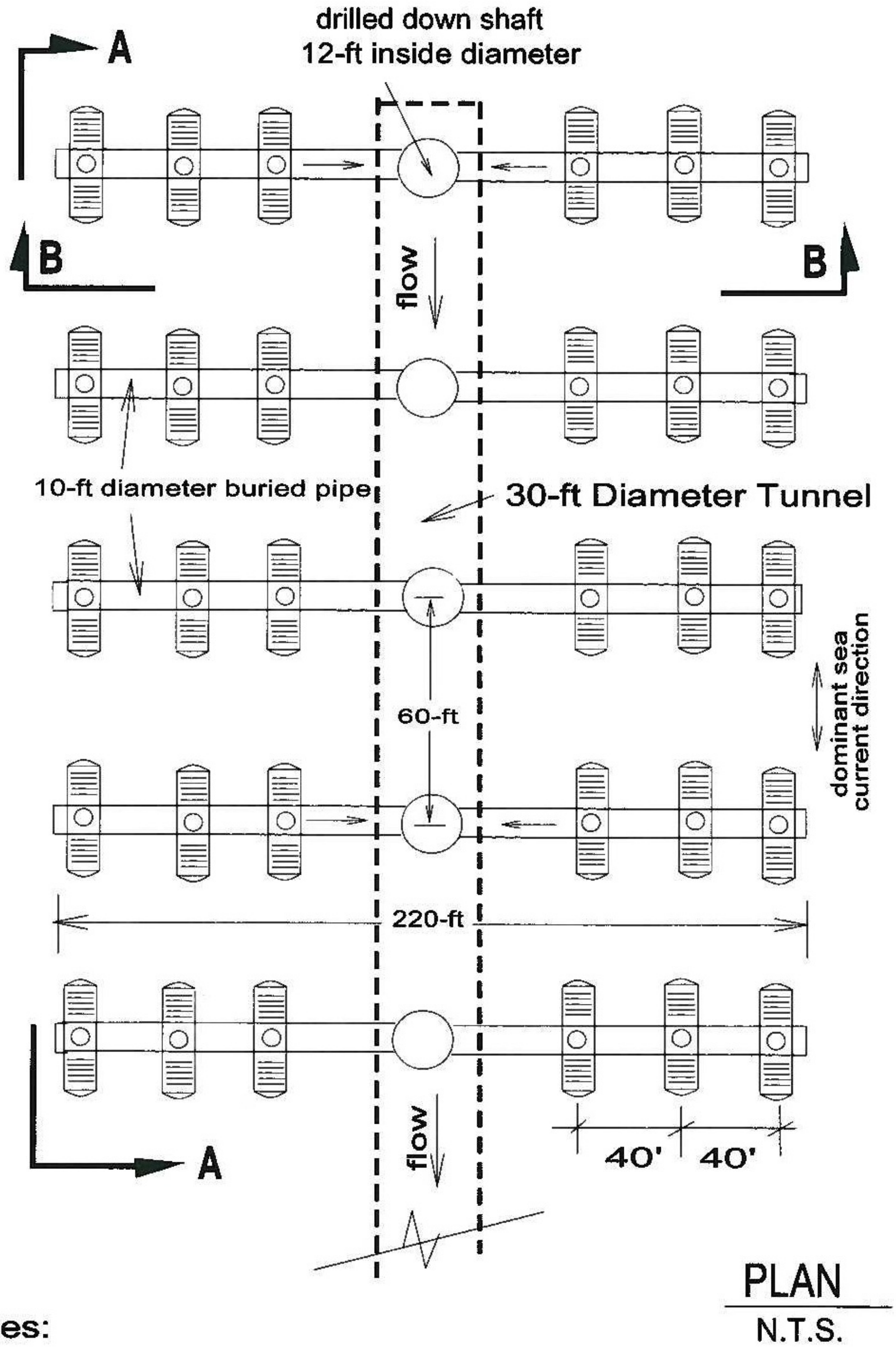


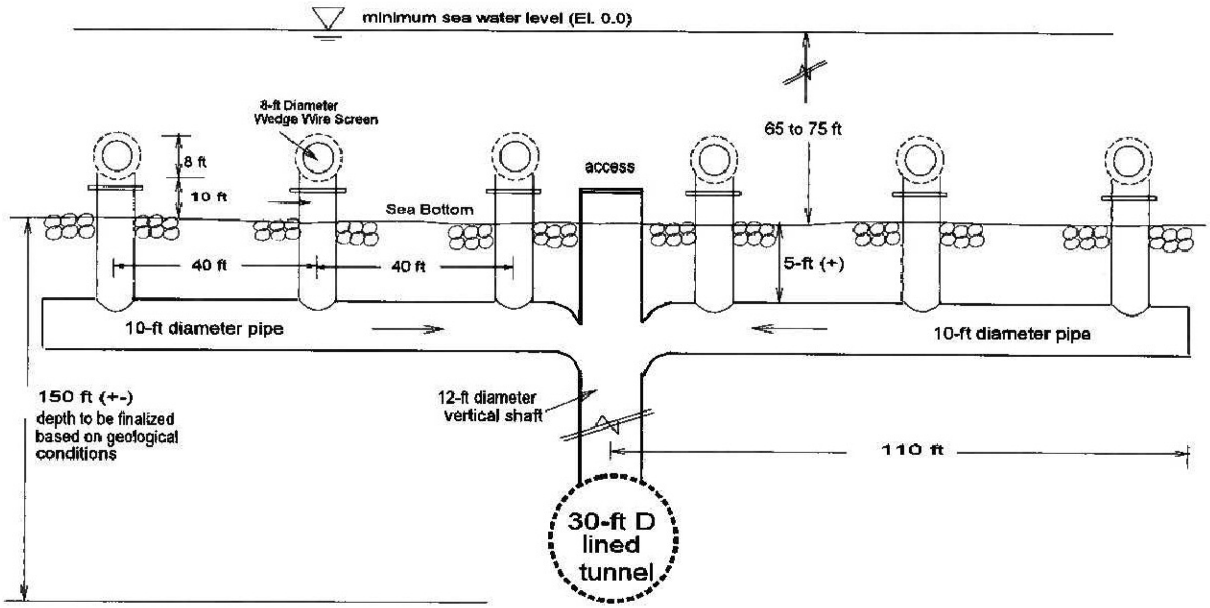
Figure 4.2-5. DCPP Offshore Modular Wedge Wire Tunnel System (Sectional View)



Notes:

1. Total Thirty (30) 8-ft diameter 6-mm Slot Wedge-Wire Tee-Screens
2. 6-mm Wedge Wire Screens, Z-Alloy Material, with End Cones
3. The total design flow is 1.753 million gpm.
4. Riprap placement on area over buried pipes and under the screens.

Figure 4.2-6. DCPP 6-mm-Slot Modular Wedge Wire Screen Intake System (Plan View)



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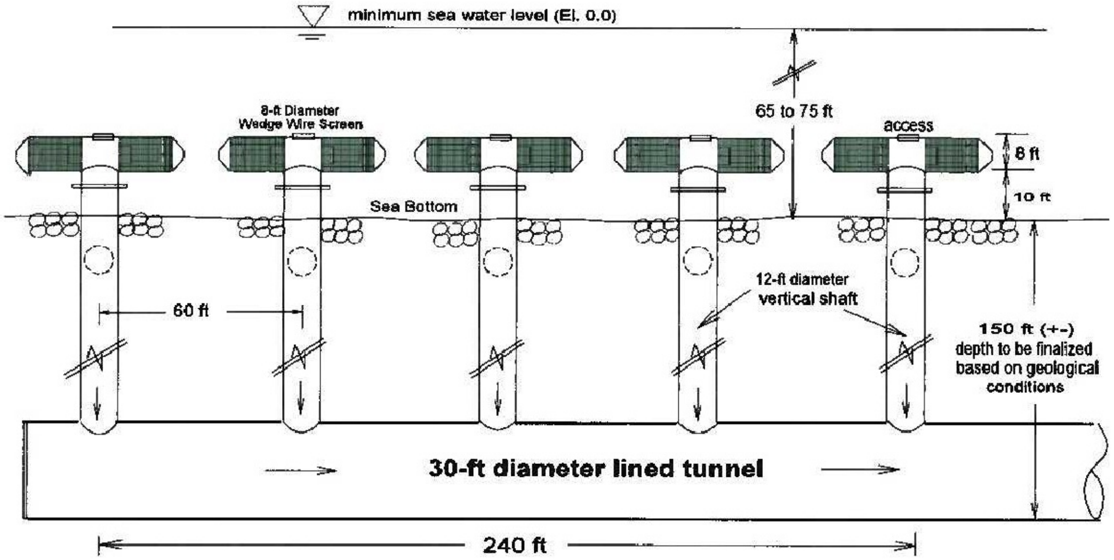

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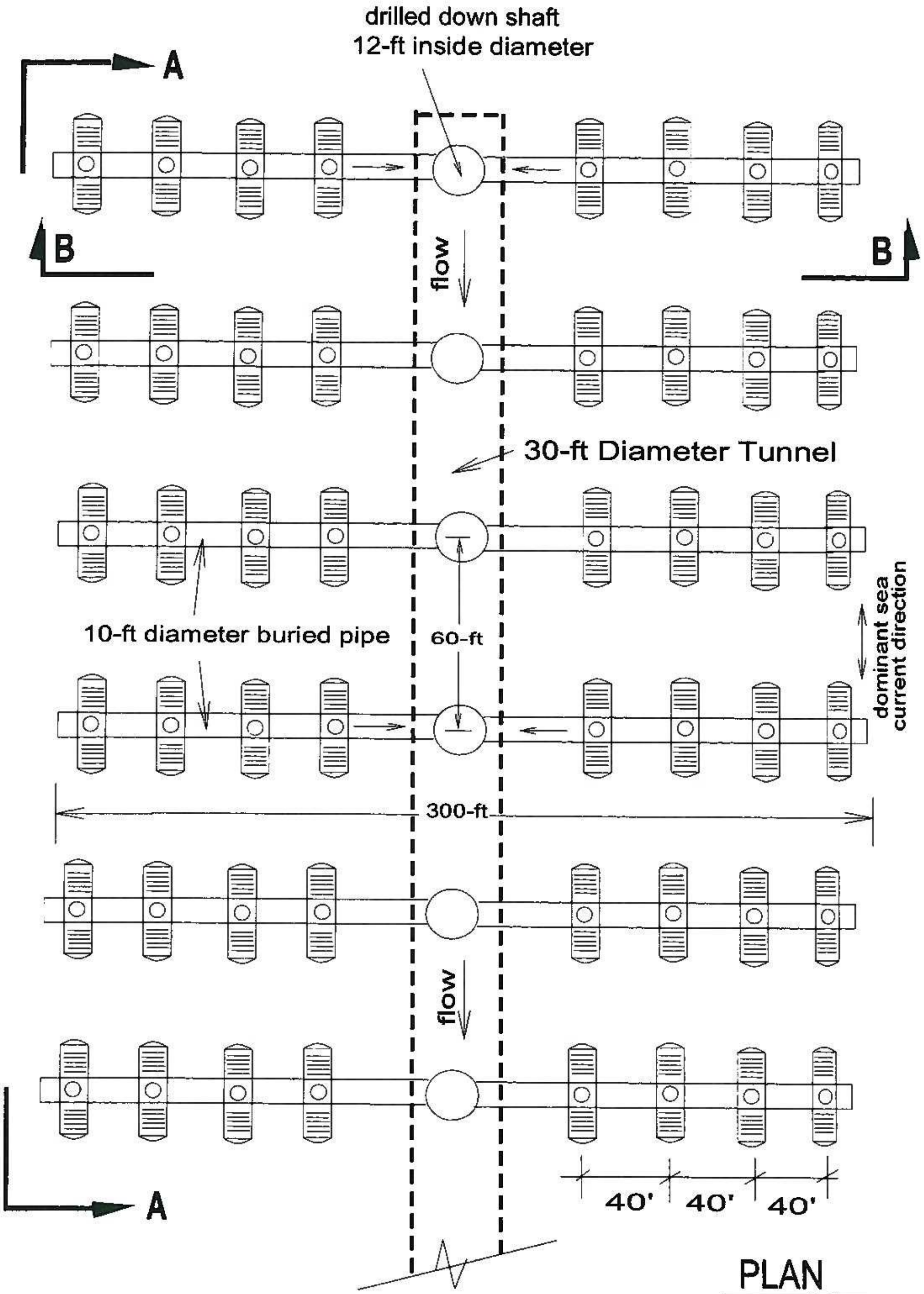
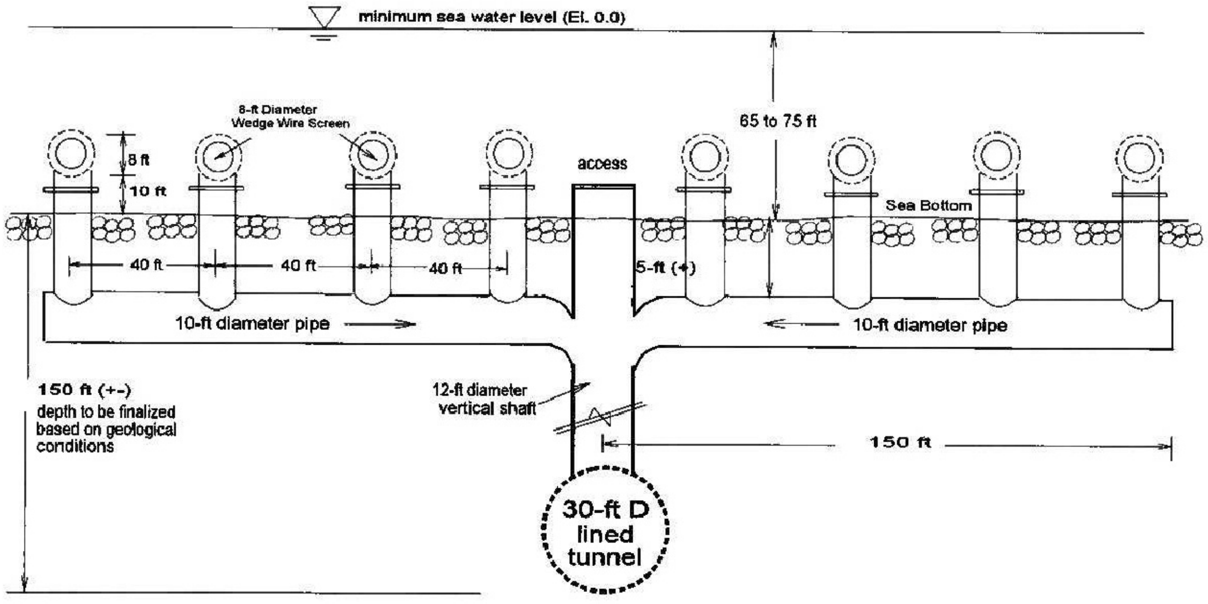
Figure 4.2-7. DCPP 6-mm-Slot Modular Wedge Wire Screen Intake System (Sectional Views)



Notes:

1. Total Forty Eight (48) 8-ft diameter 2-mm Wedge-Wire Tee-Screens
2. 2-mm Wedge Wire Screens, Z-Alloy Material, with End Cones
3. The total design flow is 1.753 million gpm.
4. Riprap placement on area over buried pipes and under the screens.

Figure 4.2-8. DCPP 2-mm-Slot Modular Wedge Wire Screen Intake System (Plan View)



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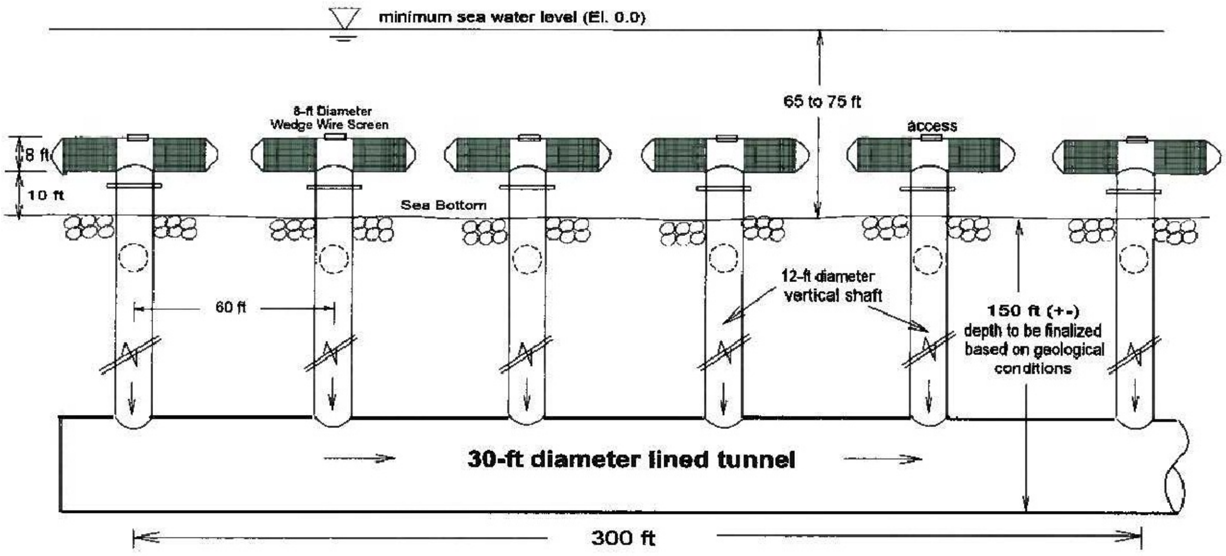

Section A-A
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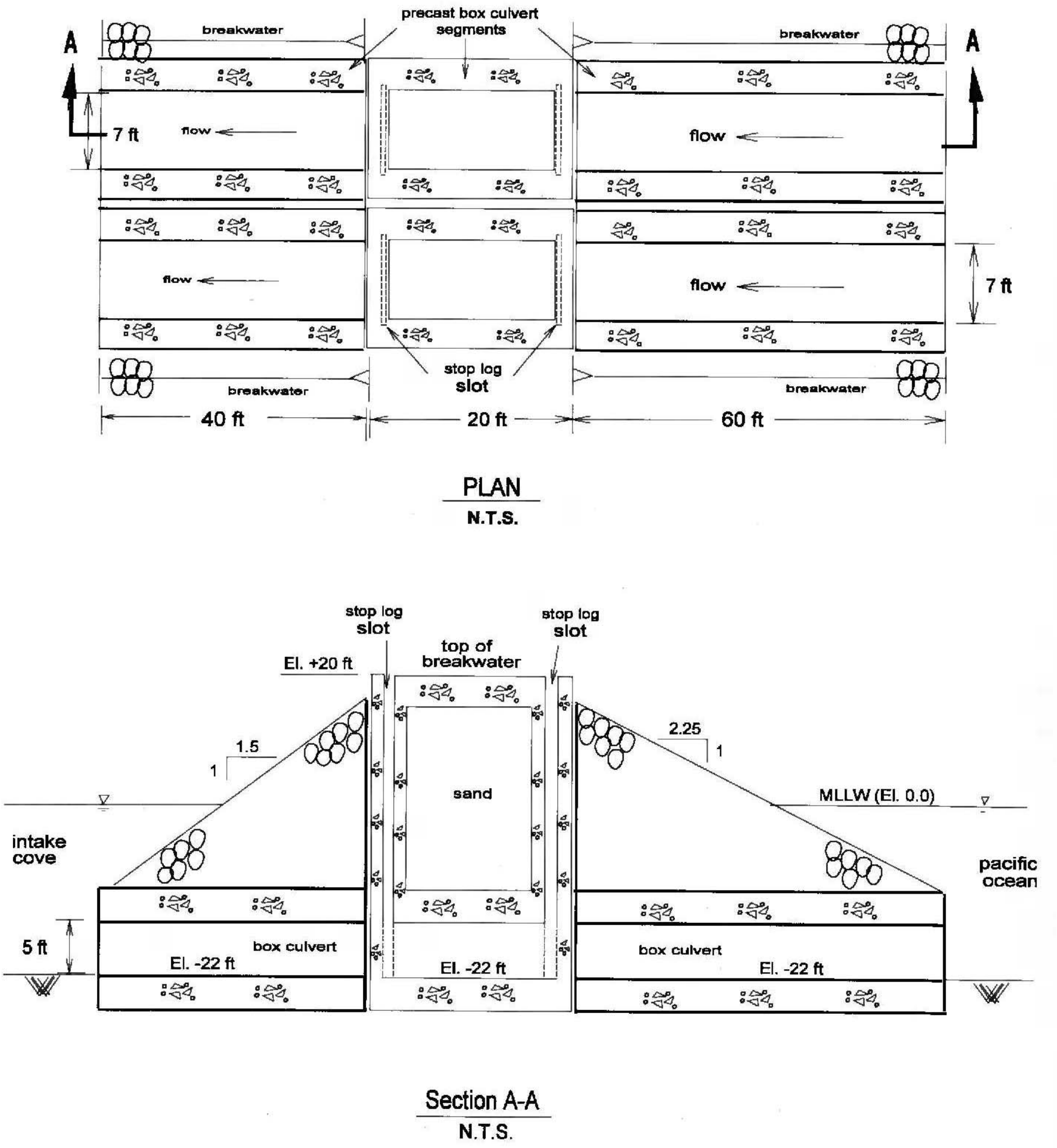
Figure 4.2-9. DCPP 2-mm-Slot Modular Wedge Wire Screen Intake System (Sectional Views)



Note: Emergency cooling intake structure will be located inside the new breakwater.

Figure 4.2-10. DCPP Emergency Cooling Water Intake Structure Details

4.2.2.3 Engineering Requirements for Offshore Tunnel

The final depth of the tunnel below seabed and its alignment would be based on an evaluation of local geological conditions. The tunnel would extend from the inner side of the eastern breakwater to the offshore wedge wire screen assemblies. Drop shafts would connect the assemblies to the tunnel. To connect the drop shafts to the assemblies, 10-foot-diameter horizontal pipe manifolds would be buried in trenches 15 feet below the seabed. The alternative to trenching would be to anchor the 10-foot-diameter pipe manifolds to the seabed (secured and covered with a rock mound on top). This alternative would have to take the following, at a minimum, into consideration: minimum available water depth, seabed movement sediment and debris (kelp), seabed geology, and wave action. For the purpose of the estimate, the tunnel option was considered. The 6-mm wedge wire screen assemblies would require a footprint of about 220 feet by 240 feet in which the multiple trenches would be opened to a depth of 15 feet below the seabed. The 2-mm wedge wire system would require a footprint of approximately 300 feet by 300 feet.

For the tunneling concept, depending on the site conditions evaluation, various remediation techniques can be considered to deal with fault zones involving soil/rock under water pressure. One solution may be to seal and strengthen the ground ahead of the working face. In deep tunnels, a permanent strengthening and sealing is often required and can be obtained by grouting. Injecting grout that subsequently hardens into the ground increases the ground’s strength, stiffness, and imperviousness. The result is a treated region of ground with improved properties surrounding the opening. After a TBM is used to excavate a hollow cylinder, the inner surface of the excavated area is supported by a temporary or permanent lining. In practice, grouted bodies with a diameter corresponding to two or at most three times the tunnel diameter have proved adequate. To minimize the impact of a potential shear and consequent disruption of water flow to the plant, installing a pipe inside the tunnel can also be considered.

Warning buoys would be installed in the area of the wedge wire screen array to avoid shipping impacts on the screens.

General Arrangement Drawing 25762-110-P1K-WL-00060 was developed to aid in obtaining budgetary information from specialty contractors for the installation of the offshore work.

4.2.3 Alternative Concept B: Multiple Offshore Buried Pipes

4.2.3.1 Offshore Buried Pipe System Description

The buried pipe alternative consists of multiple offshore buried pipes that collectively supply water to the shoreline basin formed by the breakwater enclosure. Each buried pipe would be connected to its own dedicated offshore wedge wire assembly.

Figures 4.2-11 through 4.2-18 show the schematic arrangement of the buried pipe alternative. The pipes would pass underneath the new breakwater to supply filtered water to the enclosed basin. On the discharge side, each pipe would have a headwall to mitigate erosion concerns and minimize pipe movement.

The shoreline basin would be constructed by extending the existing inner breakwater westward to close the intake cove from direct contact with the open sea. The only connection of this basin to the sea would be through the buried pipes. Similar to the tunnel alternative, emergency gates would be provided to ensure the continued supply of water to the intake to maintain the safe operation of the service water pumps if screen clogging is imminent under high-debris load conditions.

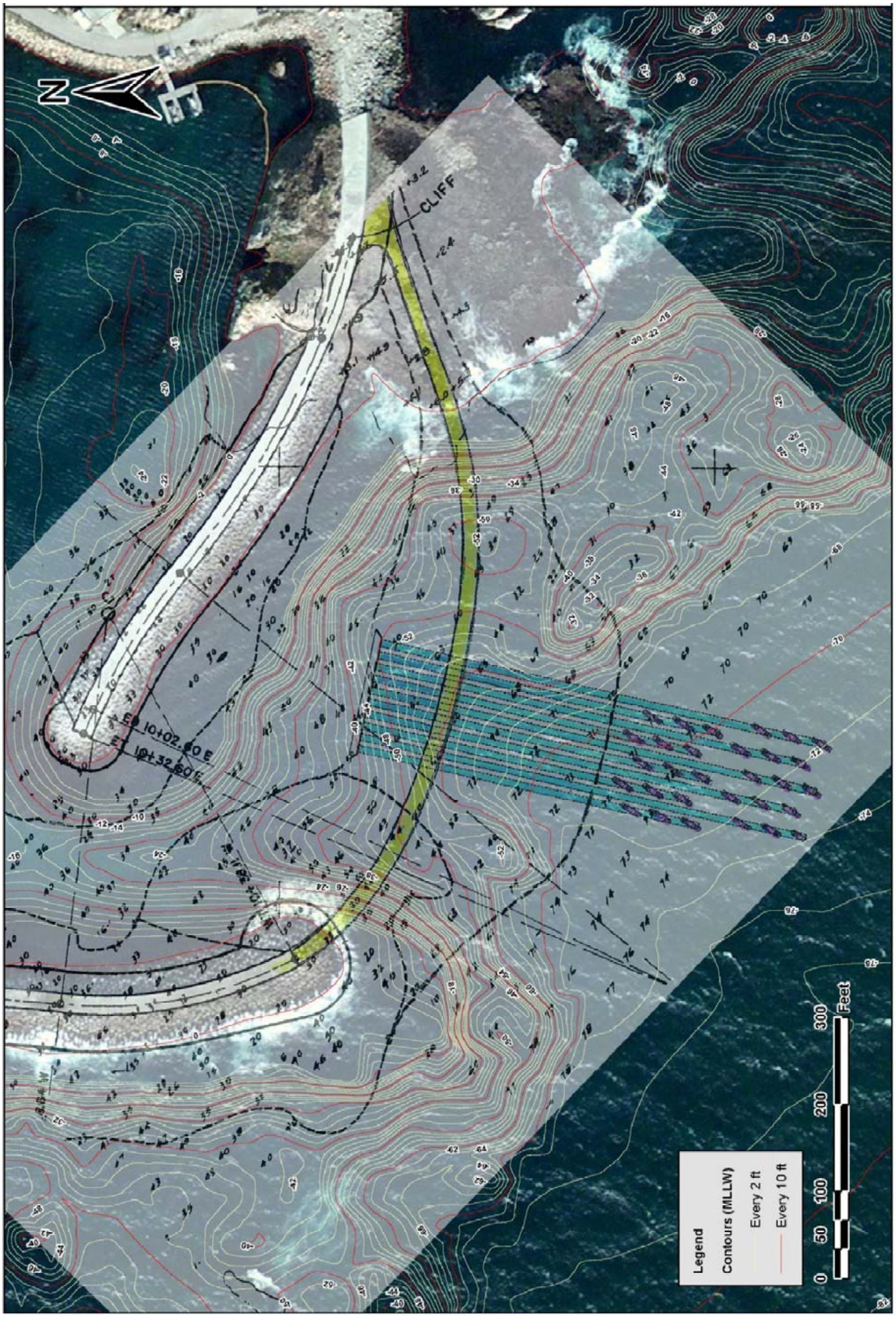


Figure 4.2-11. DCPP Bathymetry/Buried Pipe Layout with 6-mm-Slot Screens (Contour elevations = feet below MLLW)

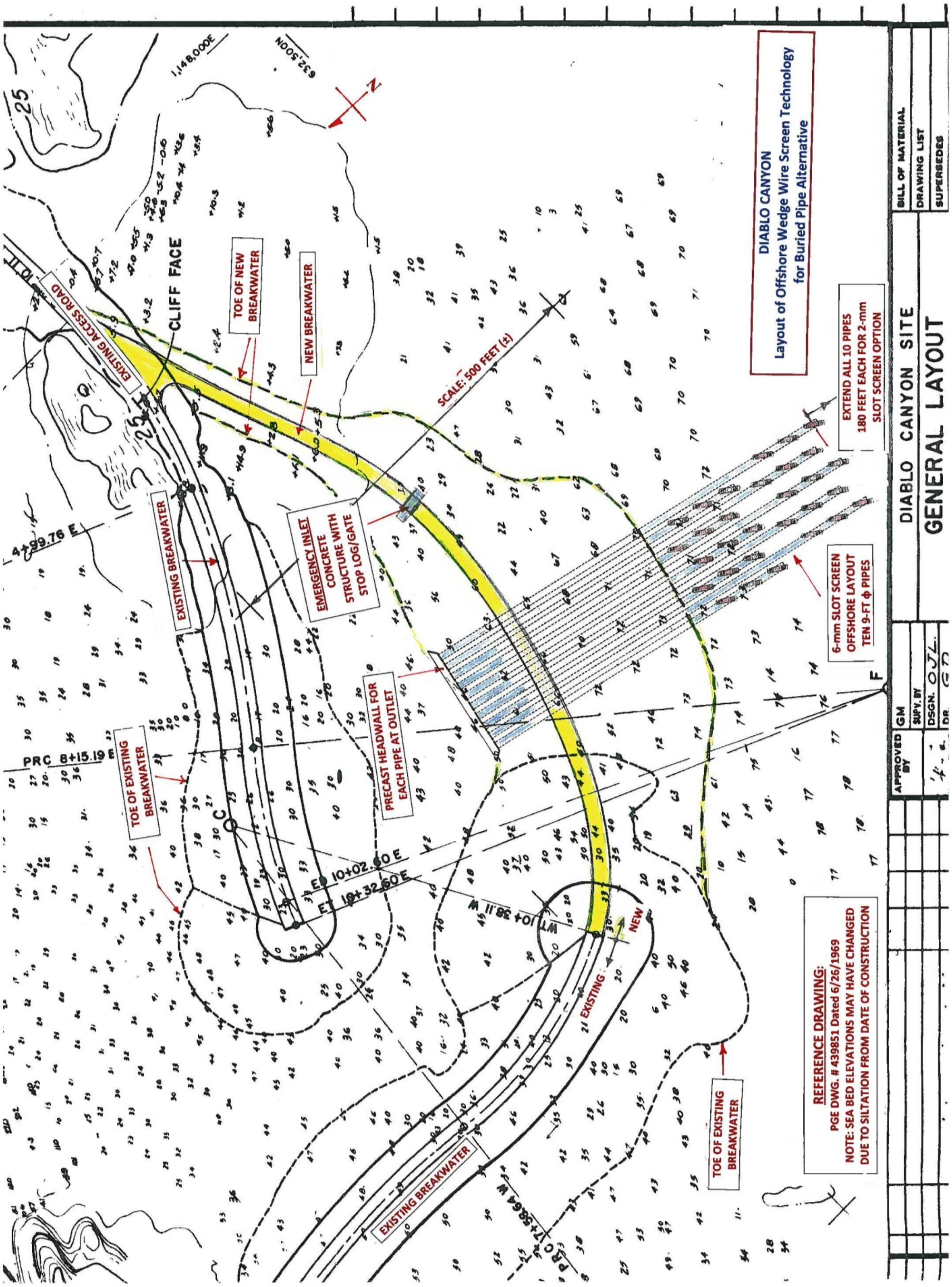


Figure 4.2-12. DCPP Layout of Offshore Modular Wedge Wire Screen Technology (Buried Pipe Alternative)

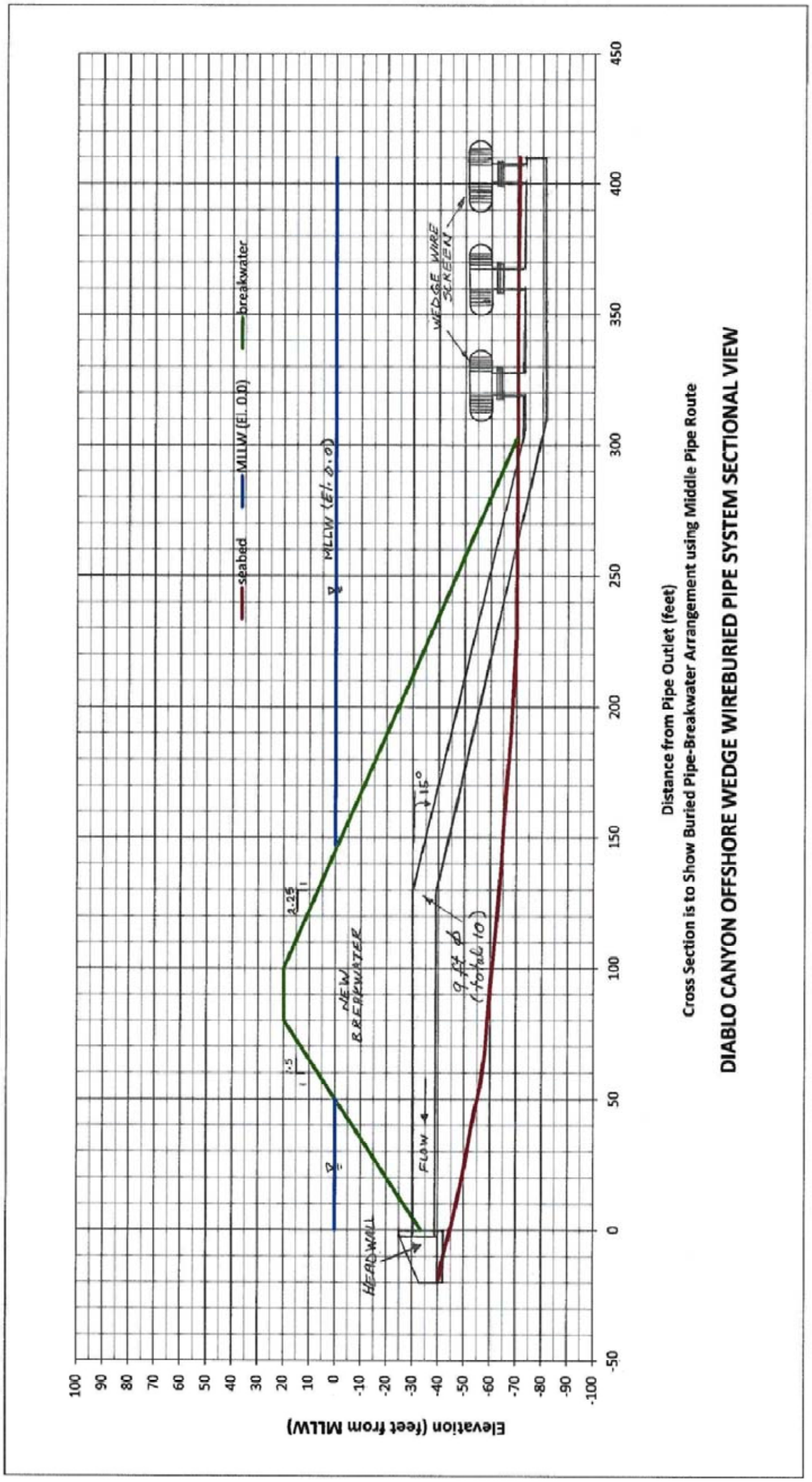
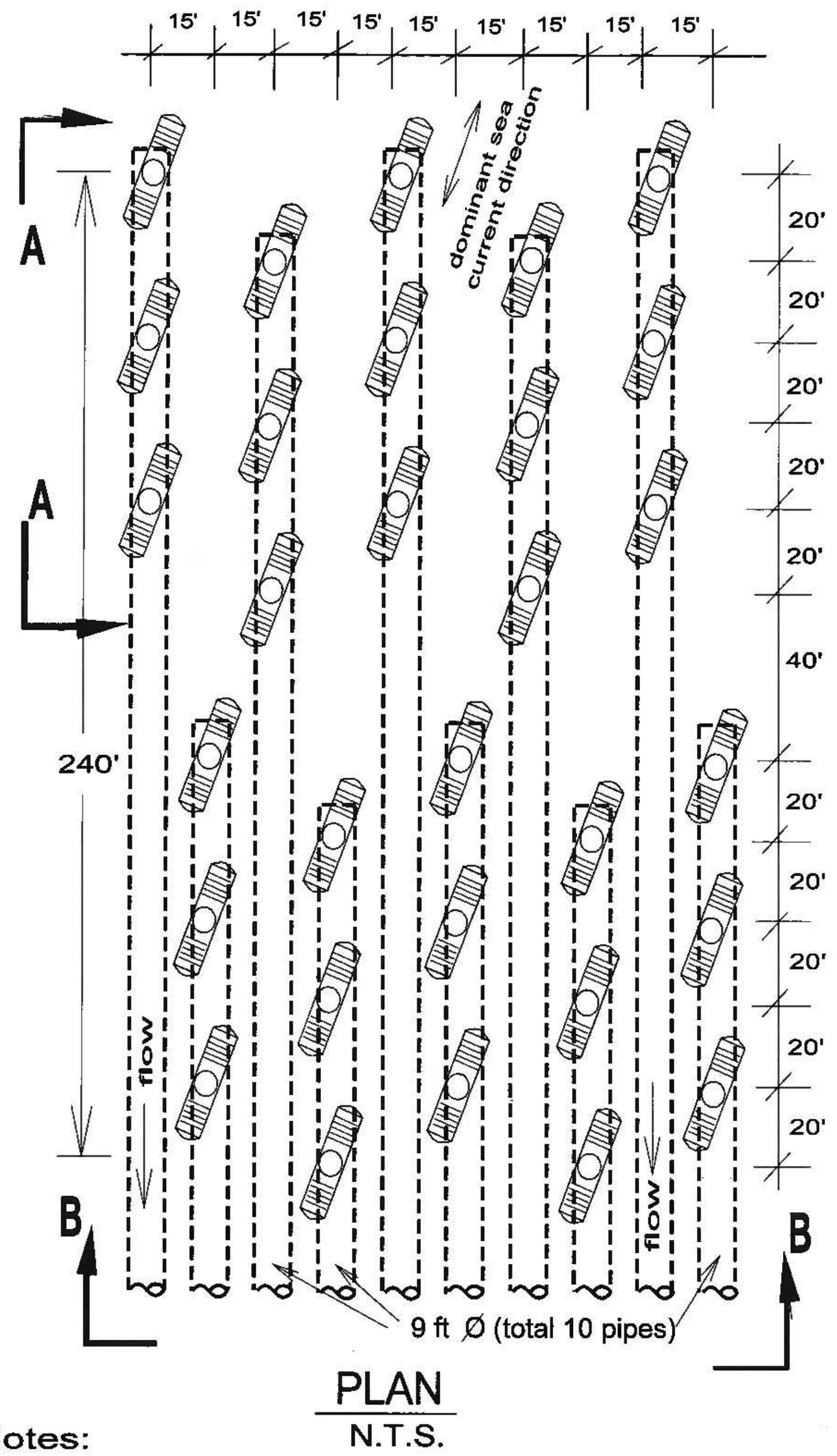


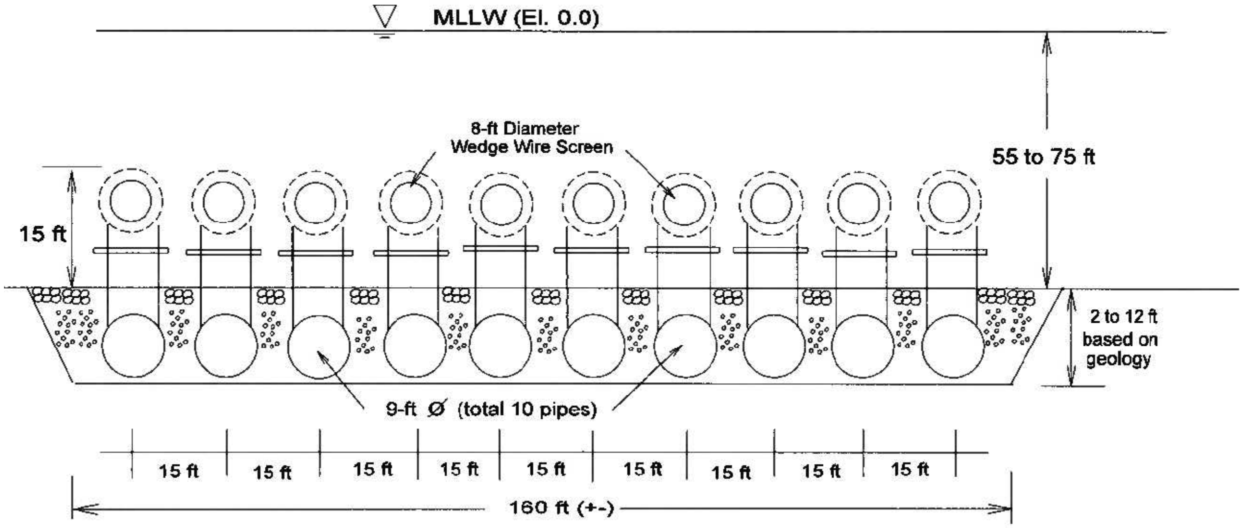
Figure 4.2-13. DCPP Offshore Modular Wedge Wire Buried Pipe System (Sectional View)



Notes:

1. Total Thirty (30) 8-ft diameter 6-mm Slot Wedge-Wire Tee-Screens
2. 6-mm Wedge Wire Screens, Z-Alloy Material, with End Cones
3. The total design flow is 1.753 million gpm.
4. Riprap placement on area over buried pipes and under the screens.

Figure 4.2-14. DCPP 6-mm-Slot Modular Wedge Wire Screen Intake System (Plan View)



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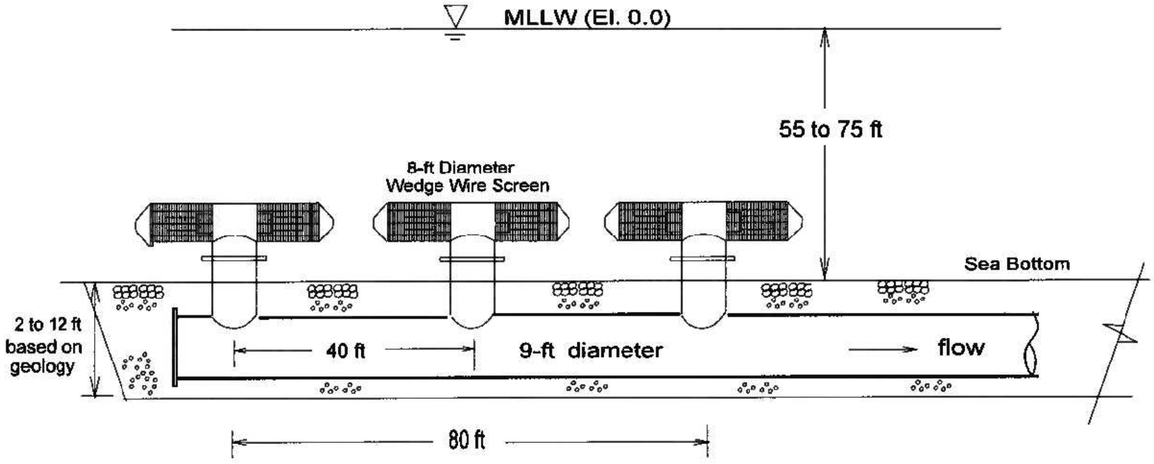

Section A-A
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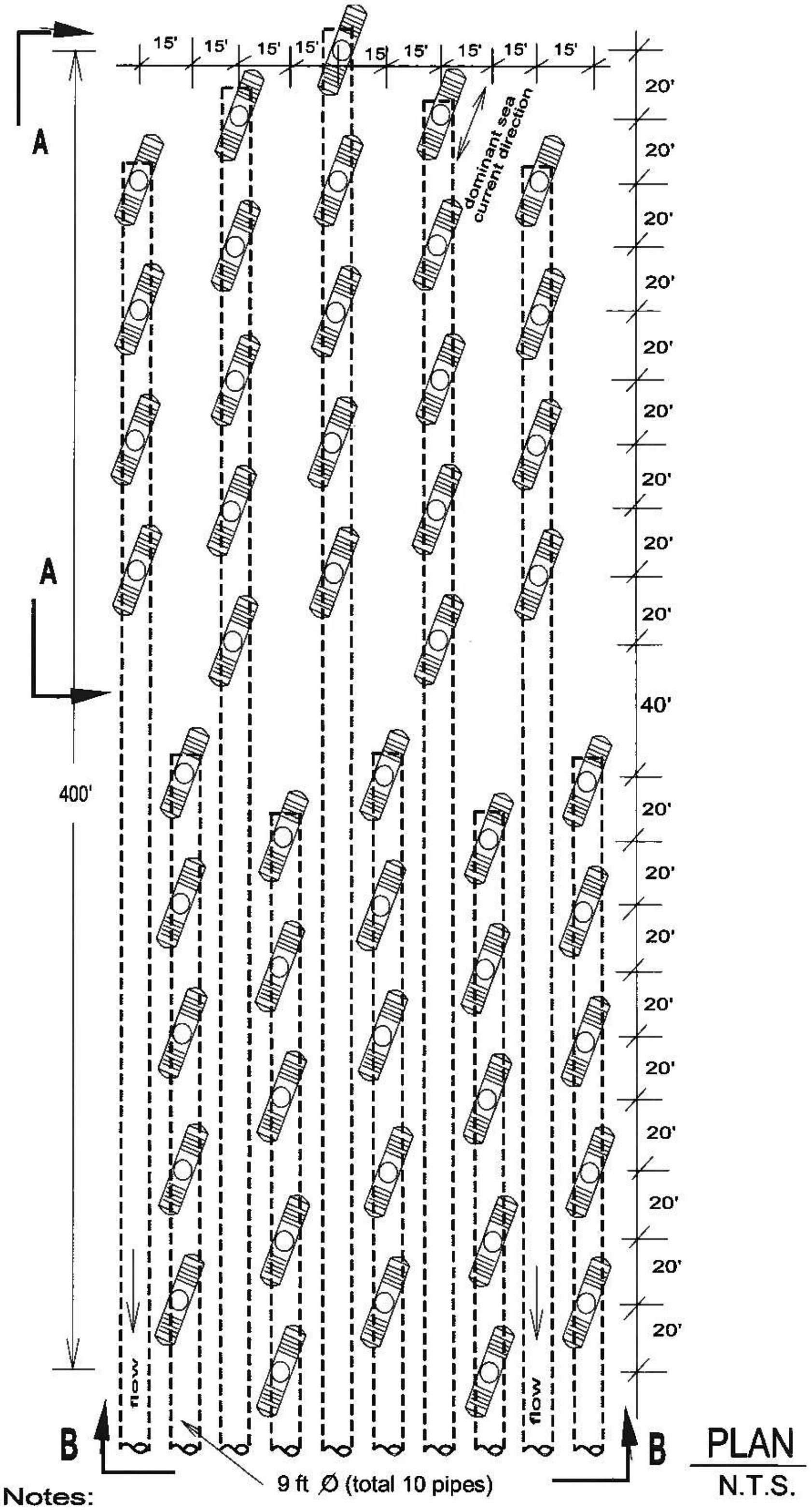
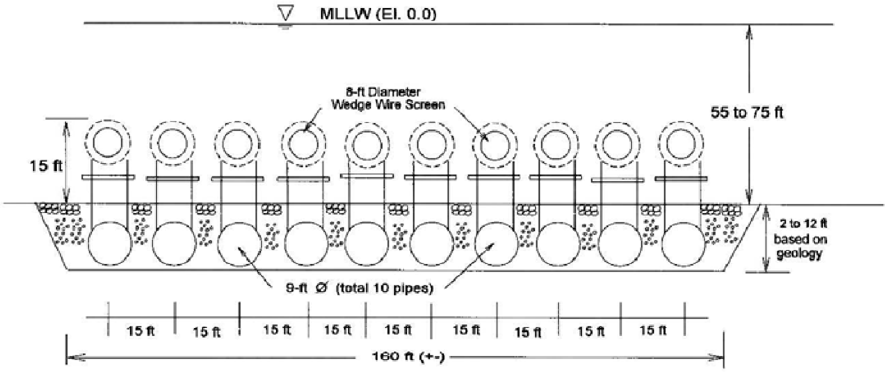
Figure 4.2-15. DCPP 6-mm-Slot Modular Wedge Wire Screen Intake Assembly (Sectional Views)



Notes:

1. Total Forty Eight (48) 8-ft diameter 2-mm Slot Wedge-Wire Tee-Screens
2. 2-mm Wedge Wire Screens, Z-Alloy Material, with End Cones
3. The total design flow is 1.753 million gpm.
4. Riprap placement on area over buried pipes and under the screens.

Figure 4.2-16. DCPP 2-mm-Slot Modular Wedge Wire Screen Intake System (Plan View)



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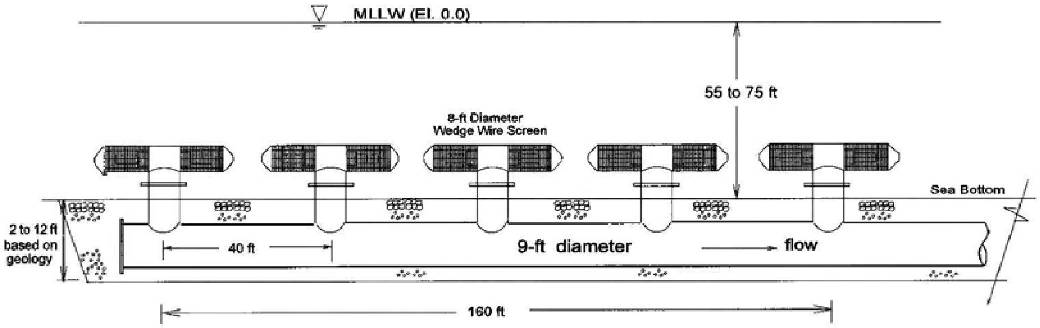

Section A-A
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Figure 4.2-17. DCPP 2-mm-Slot Modular Wedge Wire Screen Intake Assembly (Sectional Views)

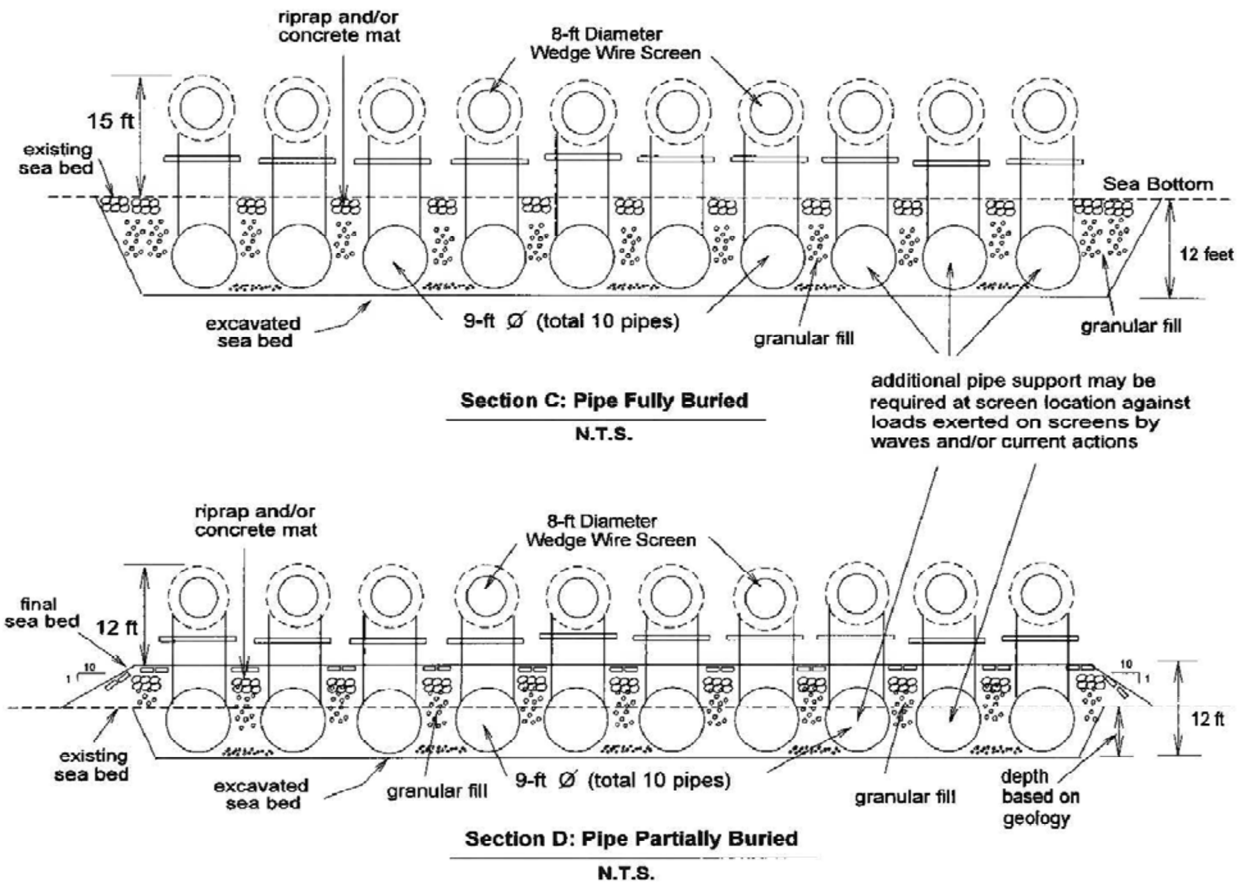


Figure 4.2-18. DCPP Potential Buried Pipe Trench Scenarios (Based on Seabed Geology)

4.2.3.2 System Components for Offshore Buried Pipes Alternative

Wedge wire screen assemblies (see Figures 4.2-14 through 4.2-18) **–** Wedge wire assemblies would be used as the intake water source for the system and would be designed to restrict the intake water velocity and mitigate potential impingement. The total design flow is 1.753 million gpm. The screen assemblies would use a system design intended for applications consistent with the project environmental conditions:

a. 6-mm-slot-opening screens – Installation of the wedge wire screens would include designing, furnishing, and installing wedge wire screens at each of the vertical pipe flanges above the seabed. The conceptual design requires thirty 8-foot-nominal-diameter, 35-foot-long wedge wire screens. Three wedge wire screens would be connected to each 9-foot-diameter pipe via a flanged connection.

b. 2-mm-slot-opening screens – Installation of the wedge wire screens would include designing, furnishing, and installing wedge wire screens at each of the vertical pipe flanges above the seabed. The preliminary design requires forty-eight 8-foot-nominal-diameter 35-foot-long wedge wire screens. Four or five wedge wire screens would be connected to each 9-foot-diameter pipe via a flanged connection.

Pipes – Ten 9-foot-diameter pipes with an average length of 450 feet for 6-mm-slot screens and 600 feet for 2-mm-slot screens would be designed, procured, and installed to convey water from the screens to the enclosed shoreline basin. Whether the pipes were trenched or anchored would depend on location, seabed profile, geotechnical conditions, and which would cause the least environmental impact. Pipe material would be FRP.

New breakwater – The new breakwater, located west of the existing one, would be designed and constructed to provide an enclosure to the shoreline basin (intake cove). Design and construction would be based on duplicating the existing breakwater.

The existing and new breakwaters would be sealed on the basin side to exclude fish, eggs, and larvae from entering the basin. Engineering evaluations would be made to provide assurance that such measure would not undermine the stability of the breakwater during wave attacks, since pervious breakwaters are designed to reduce the magnitude of the impact force.

Emergency backup water supply – Precast reinforced concrete box culverts, including vertical concrete walls and stop logs, would be designed and installed within the new portion of breakwater. Their design would facilitate stop log installation and removal. The conceptual sketch of this structure is shown on Figure 4.2-10.

Headwalls – Ten precast reinforced concrete headwalls would be designed and installed at each pipe outlet located on the inner side of the new breakwater.

It would be necessary to stockpile excavated/dredged tunnel, shaft, and lateral-placement material either on the DCPP site or within a maximum of 5 miles off site. An access road to the existing east breakwater would also need to be constructed. Dredging activities should have minimal impact on the aquatic life.

4.2.3.3 Engineering Requirements for Offshore Buried Pipes Alternative

For the offshore buried pipe alternative, the wedge wire assembly requirements are the same as those discussed for the offshore tunnel concept, with the exception of pipe manifold size and flow conveyance system to the intake cove. The 2-mm or 6-mm wedge wire screen assemblies would be buried in trenches (or anchored to the seabed) depending on the minimum available water depth, seabed geology, and wave action. The alignment of the buried pipes can be adjusted based on local geological conditions. Based on the geotechnical information, the pipes could be either clustered in two groups of five, with each group buried in a trench approximately 80 feet wide, or all placed together in a single 160-foot-wide trench. The trench(es) would terminate at the shoreline basin (intake cove), the pipes would be installed, and then the new breakwater would be constructed over them. The portion of the pipes running beneath the breakwater would be supported above the seabed, after suitable bedding is prepared, rather than being placed in a trench.

To create a suitable support system for either the buried pipes or the wedge wire assembly trenches, seabed strengthening may be required, depending on the extent of the fracture zone. This is expected to be a relatively minimal effort, compared to the concept involving tunnel grouting.

Warning buoys would be installed in the area of the wedge wire screen array to avoid shipping impacts on the screens.

General Arrangement Drawing 25762-110-P1K-WL-00061 was developed to aid in obtaining budgetary information from specialty contractors for the installation of the offshore work.

4.2.4 Modular Wedge Wire Screening Technology and Design Requirements

4.2.4.1 Wedge Wire Screens Details

The wedge wire screens considered for this evaluation are T-type circular cylinder screens that are 8 feet in diameter (Figures 4.2-19 through 4.2-21). The 8-foot screen is currently the largest size commercially available with operating experience. Considering the large cooling water withdrawal flow requirement, the high-capacity/high-performance screens are recommended to achieve a more evenly distributed flow across the screen face. The design would be based on a maximum slot flow-through velocity of 0.5 fps. Potential debris loading in a marine environment favors larger screen slot sizes, while fish, egg, and larvae exclusion favors smaller slot sizes that increase the blockage potential. Due to this conflicting requirement, two slot sizes (6 mm and 2 mm) are being considered for in situ testing at the site. The smaller the screen slot size, the higher the number of screens required. To meet DCPP flow requirements, forty-eight 2-mm-slot screens or thirty 6-mm-slot screens would be needed. In situ screen testing would be conducted for both slot sizes to evaluate entrainment and impingement performance versus debris clogging and biofouling.

The screen arrays would be located on the seabed at approximately the location shown on Figures 4.2-3 and 4.2-11. The bottom faces of the screens would be 7 feet above the finished seabed level. The distances shown on Figures 4.2-6 through 4.2-9 and 4.2-14 through 4.2-18 are centerline distances. As shown in the conceptual sketches for the tunnel, the screens would be grouped into five or six assemblies connected to five or six 12-foot-diameter drop shafts via 10-foot-diameter laterals. Most likely, it would be necessary to install orifice plates fabricated from biofouling-resistant material at the outlet flanges of each screen to balance flow. No air-burst system or other means of removing aquatic debris, aquatic organisms, and sediment that may accumulate on the screen surfaces would be required. The screens would be bolted to the manifold risers using frangible bolts designed to break on impact from ship hulls or anchors. The laterals would be either trenched or anchored to the seabed, depending on location and geological condition of the seabed. Adequate rip-rap or concrete mats would be provided around the completed installation to prevent erosion. The entire screen assembly would be constructed of copper-nickel alloys that resist biofouling and would be field tested before final selection.

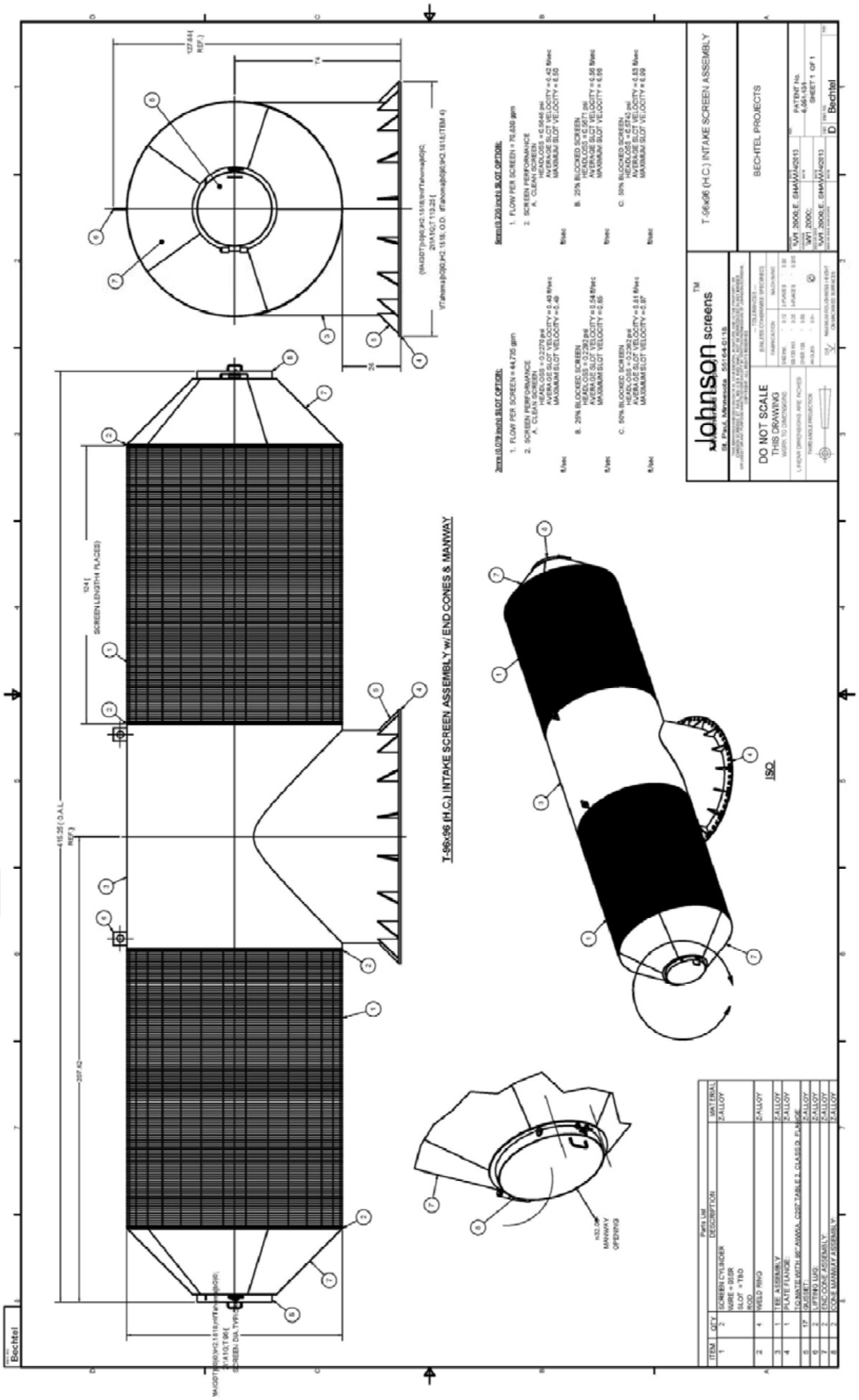
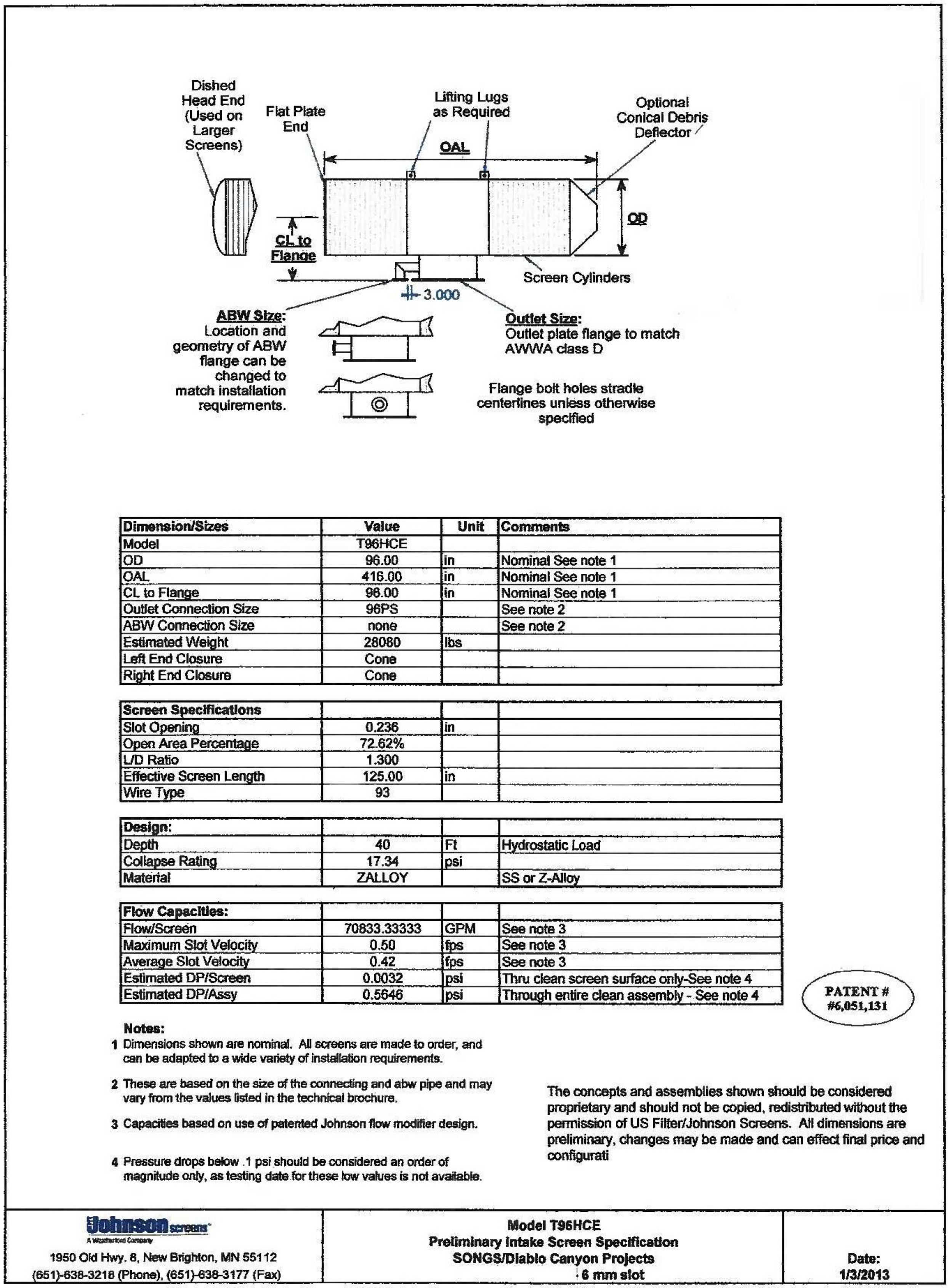


Figure 4.2-19. DCPP Intake Screen Assembly



Dished Head End (Used on Larger Screens)

Flat Plate End

Lifting Lugs as Required

Optional Conical Debris Deflector

OAL

OD

CL to Flange

Screen Cylinders

3.000

ABW Size: Location and geometry of ABW flange can be changed to match installation requirements.

Outlet Size: Outlet plate flange to match AWWA class D

Flange bolt holes stradle centerlines unless otherwise specified

Dimension/Sizes	Value	Unit	Comments
Model	T96HCE		
OD	96.00	in	Nominal See note 1
OAL	416.00	in	Nominal See note 1
CL to Flange	96.00	in	Nominal See note 1
Outlet Connection Size	96PS		See note 2
ABW Connection Size	none		See note 2
Estimated Weight	28080	lbs	
Left End Closure	Cone		
Right End Closure	Cone		

Screen Specifications			
Slot Opening	0.236	in	
Open Area Percentage	72.62%		
L/D Ratio	1.300		
Effective Screen Length	125.00	in	
Wire Type	93		

Design:			
Depth	40	Ft	Hydrostatic Load
Collapse Rating	17.34	psi	
Material	ZALLOY		SS or Z-Alloy

Flow Capacities:			
Flow/Screen	70833.33333	GPM	See note 3
Maximum Slot Velocity	0.50	fps	See note 3
Average Slot Velocity	0.42	fps	See note 3
Estimated DP/Screen	0.0032	psi	Thru clean screen surface only-See note 4
Estimated DP/Assy	0.5646	psi	Through entire clean assembly - See note 4

PATENT #
#6,051,131

Notes:

1 Dimensions shown are nominal. All screens are made to order, and can be adapted to a wide variety of installation requirements.

2 These are based on the size of the connecting and abw pipe and may vary from the values listed in the technical brochure.

3 Capacities based on use of patented Johnson flow modifier design.

4 Pressure drops below .1 psi should be considered an order of magnitude only, as testing date for these low values is not available.

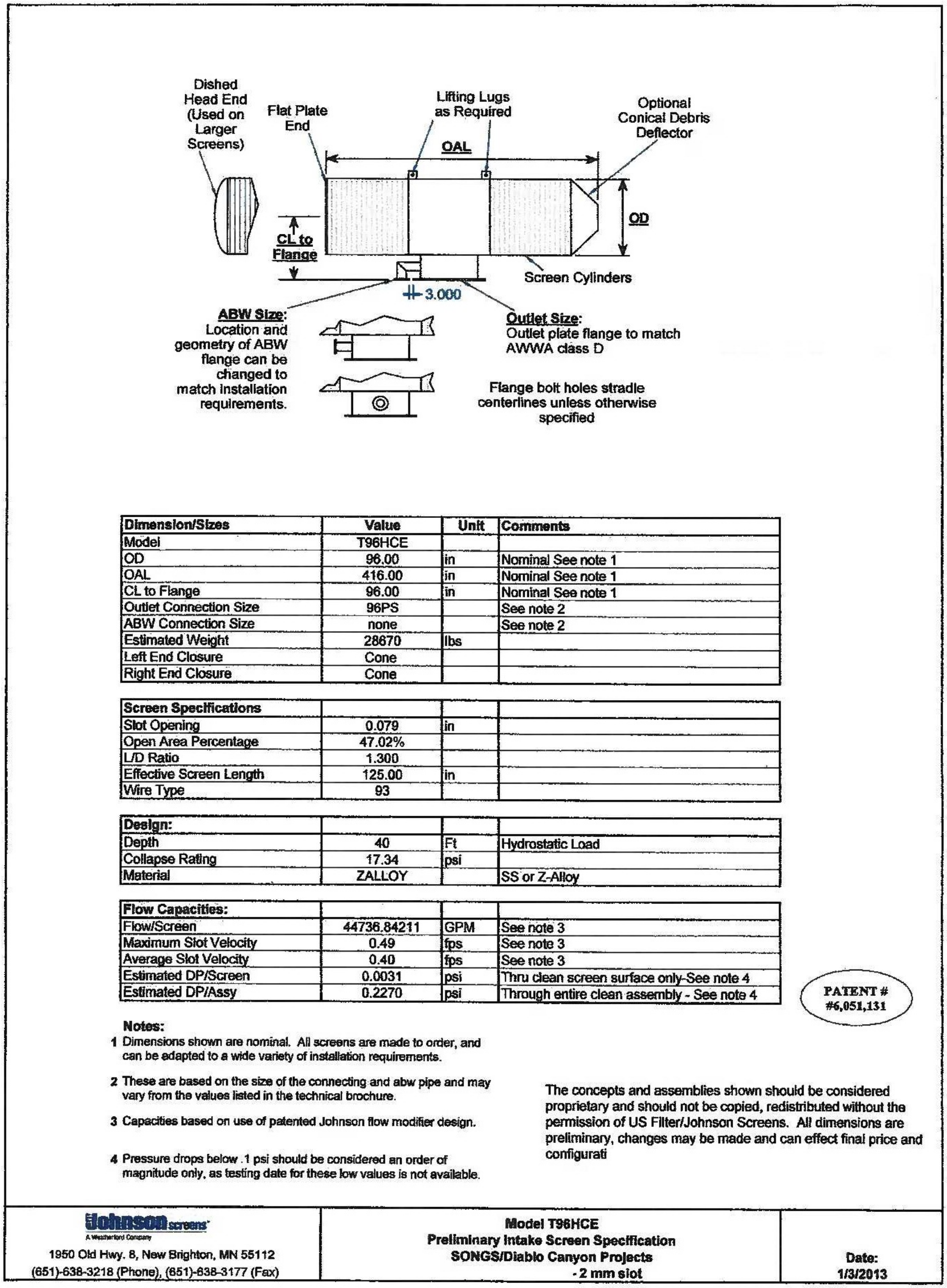
The concepts and assemblies shown should be considered proprietary and should not be copied, redistributed without the permission of US Filter/Johnson Screens. All dimensions are preliminary, changes may be made and can effect final price and configurati

Johnson screens
A Weatherford Company
1950 Old Hwy. 8, New Brighton, MN 55112
(651)-638-3218 (Phone), (651)-638-3177 (Fax)

Model T96HCE
Preliminary Intake Screen Specification
SONGS/Diablo Canyon Projects
6 mm slot

Date:
1/3/2013

Figure 4.2-20. DCPP Preliminary Intake Screen Specifications (6-mm Slots)



Dimension/Sizes	Value	Unit	Comments
Model	T96HCE		
OD	96.00	in	Nominal See note 1
OAL	416.00	in	Nominal See note 1
CL to Flange	96.00	in	Nominal See note 1
Outlet Connection Size	96PS		See note 2
ABW Connection Size	none		See note 2
Estimated Weight	28670	lbs	
Left End Closure	Cone		
Right End Closure	Cone		

Screen Specifications			
Slot Opening	0.079	in	
Open Area Percentage	47.02%		
L/D Ratio	1.300		
Effective Screen Length	125.00	in	
Wire Type	93		

Design:			
Depth	40	Ft	Hydrostatic Load
Collapse Rating	17.34	psi	
Material	ZALLOY		SS or Z-Alloy

Flow Capacities:			
Flow/Screen	44736.84211	GPM	See note 3
Maximum Slot Velocity	0.49	fps	See note 3
Average Slot Velocity	0.40	fps	See note 3
Estimated DP/Screen	0.0031	psi	Thru clean screen surface only-See note 4
Estimated DP/Assy	0.2270	psi	Through entire clean assembly - See note 4

PATENT #
#6,051,131

Notes:

1 Dimensions shown are nominal. All screens are made to order, and can be adapted to a wide variety of installation requirements.

2 These are based on the size of the connecting and abw pipe and may vary from the values listed in the technical brochure.

3 Capacities based on use of patented Johnson flow modifier design.

4 Pressure drops below .1 psi should be considered an order of magnitude only, as testing date for these low values is not available.

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Johnson screens
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(651)-638-3218 (Phone), (651)-638-3177 (Fax)

Model T96HCE
Preliminary Intake Screen Specification
SONGS/Diablo Canyon Projects
- 2 mm slot

Date:
1/3/2013

Figure 4.2-21. DCPP Preliminary Intake Screen Specifications (2-mm Slots)

4.2.4.2 Wedge Wire Screen Performance

The inherent engineering design features of wedge wire screens give them the ability to effectively minimize impingement mortality and reduce entrainment. These features include:

- Wedge wire screens provide passive screening with no moving parts.
- Screen surface velocity is uniform across the entire screen surface.
- A decelerating inward screen velocity avoids suction force.
- Screen flow-through velocity is on the order of sea current velocity.
- The screen design avoids the formation of swirling flows around the screen.
- Screens are installed above the sea bottom with no impact to benthic life.
- The screen cylindrical shape prevents attachment of debris to lower parts of the screen surface.
- Installing the screens in deeper seas (about 70-foot water depth) helps them experience substantially reduced wave action, resulting in a nearly uniform sea current velocity field around them most of the time.
- Cylindrical T-shaped wedge wire screens with end cones installed parallel to the sea currents assist in diverting floating debris from the screen surface.

4.2.5 Comparison of Offshore Modular Wedge Wire System Alternatives

Constructability and installation cost will determine the preferred alternative since the operational reliability would be the same for either tunnel or buried pipes. Screen performance and maintenance requirements are identical for both. Plant downtime during construction would be about the same since the existing system would remain operational until either alternative is constructed and in place.

Both alternatives would have the same environmental compliance.

The DCPP site has a fractured rocky shoreline with a bathymetry characterized by a sloping bedrock bottom with steep relief, rocky pinnacles, and prominent rocky ridges. These features may limit sea-bottom excavation for the pipe alternative. Similarly, the near-shore seismic fault zones would affect tunnel construction and, thus, the feasibility of the tunnel alternative. Detailed offshore geotechnical investigations and construction-method evaluations should be pursued to select the most viable alternative, considering the effect of a hypothetical offshore seismic event effect on either.

4.2.6 Final Offshore Modular Wedge Wire Screening Technology Selection

The use of offshore wedge wire screens at the DCPP site would require a due diligence survey and field testing investigation before implementation. The following efforts should be considered as part of this multidisciplinary investigation:

- Collect historic operating plant data—records, photos, reports, and fact sheets—to understand 20-plus years of operating experience.
- Collect and evaluate nearby plant experiences using wedge wire screens.
- Perform an aquatic field survey of the sea bottom to identify a suitable location for screen placement and to minimize biologically sensitive and production areas.

- If a hydrographic survey is not available, perform one to properly evaluate the local hydrodynamics of the source water to facilitate the effectiveness of reduction mechanisms afforded by the screens.
- Perform in situ pilot testing of the two screen slot sizes (2 mm and 6 mm) to evaluate entrainment, impingement, and debris effects on screen performance. This pilot testing is essential to evaluate both the biological and engineering feasibility of the 2.0-mm and 6.0-mm cylindrical wedge wire screens to determine their biological exclusion efficiency in comparison to an open port and their performance in controlling biofouling and debris clogging. The study phases would include (i) the development of the study plan, (ii) the engineering design of the wedge wire screen deployments and biological sampling facilities, (iii) the development of the biological sampling plan, and (iv) the analyses of collected data to determine the debris biofouling potential and the screen cleaning techniques/frequency for each of the two screen slot sizes, with the objective of determining which of the two is more suitable. The preliminary field pilot test plan is provided in Attachment 2.
- Field test screen construction material and slot size.
- Perform geological and geotechnical investigations of the affected offshore areas.
- Evaluate the constructability and safety of the proposed system.
- Develop an operational inspection plan. The current plan is that the screens would require an inspection and possible external cleaning twice a year. This plan would be adjusted based on the testing program.

Following the complete due diligence survey, including its evaluations, physical field testing, and engineering and constructability investigations, the suitable slot size and material can be finalized and impacts on aquatic life can be evaluated.

4.2.7 Future Actions

Potential variations of the wedge wire screen concept could involve using different alignments, sizes, or both, for the connecting conduits. Also, further assessment of detailed engineering data and permitting requirements would be needed to establish the optimal arrangement of the wedge wire screens.

4.2.8 Permitting

The initial Phase 1 permitting assessment focused on identifying the applicable (required) permits and approvals for construction and operation of the offshore modular wedge wire screening technology. A comprehensive list was developed of potentially applicable permits and approvals at the federal, California, county, and municipal levels (as applicable). The applicability of each permit/approval to the wedge wire screen system was evaluated. Those permits and approvals that were deemed applicable were subsequently scrutinized to characterize the expected duration and complexity of the regulatory review process. Ultimately, the offshore modular wedge wire screening technology was one option selected for the Phase 2 assessment.

The subsequent permitting assessment focused on identifying the critical path (longest duration) initial preconstruction permitting processes and the associated project costs. The preconstruction permits are those approvals that directly support site mobilization, physical site access, and initial earthwork/foundations for the subject cooling system technology option. The costs include the direct permit filing, impact mitigation, and permitting application development (services) costs.

4.2.8.1 Cost and Schedule Evaluation

The cost and schedule to secure the following major applicable permits were developed based on discussions with key relevant regulatory authorities and from associated website resources:

- CEQA – Final Notice of Determination
- Section 404/10 Permit, USACE
- CPUC
- Coastal Development Permit, CCC
- Coastal Development Lease, CSLC
- NPDES Industrial Discharge Permit, CCRWQCB and SWRCB
- Letter of Authorization, National Marine Fisheries Service (NMFS)
- Dust Control Plan, SLO-APCD
- Local Approvals, SLO

Table WW-1 summarizes the key cost and schedule details and assumptions for the offshore modular wedge wire screening system. Legal costs associated managing appeal processes and related litigation have not been included. The bulk of the potential mitigation costs would be developed through negotiation process and are, consequently, not included in the cost estimate.

Table WW-1. DCPP Environmental Permit/Approval Cost Assessment:
Offshore Modular Wedge Wire Screening System

Permit/ Approval	Cost Discussion	Responsibility	Permit Review Period	Filing Costs	Remediation or Mitigation Costs	Permitting Service Costs
Section 404/10 Permit – USACE	No filing fees are associated with the Section 404 permit application, although there is a nominal fee ($10–$100) associated with preparing an EA. Labor costs for preparing an individual permit application = 3,000 hours @ $150/hr.	Owner	120 days from complete application (goal); 12 months (expected but aligned with CEQA)	$100	Undetermined	$450,000
Section 401 Water Quality Certificate – CCRWQCB	Fill & Excavation Discharges: $944 + $4,059 x disturbed area (acres) Dredging Discharges: $944 + $0.15 x cy Channel and Shoreline Discharges: $944 + $9.44 x discharge length (ft) (CCR Title 23§2200) Assumption: 2,000 ft of shoreline impacts. Labor costs: contained in Section 404/10.	Owner	Aligned with Section 404/10 Permits	$19,284	Undetermined	$0
Section 7 Consultation with USFWS, Endangered Species Act of 1973	By virtue of its Section 404/10 Permit, the project would have sufficient “federal nexus” (federal funding, federal lands) to trigger USFWS consultation. Associated costs will be inherent in the CEQA process.	Owner	May be part of CEQA review	$0	Undetermined	$0

Permit/ Approval	Cost Discussion	Responsibility	Permit Review Period	Filing Costs	Remediation or Mitigation Costs	Permitting Service Costs
CDFW Review	CDFW consultation will be conducted in parallel with the Section 7 review. CEQA document filing related fee ($2,995.50 and county clerk processing fee $50). (CDFW, 2013)	Owner	Part of CEQA Review	$3,050	Undetermined	$0
Letter of Authorization – Marine Mammal Protection Act – NMFS	Relocation of sea lion population resident in the cove may require approval from NMFS. Labor costs for preparing associated documentation and relocation = 200 hours @ $150/hr.	Owner	While review can take 8 to 18 months, approval would parallel the CEQA review process.	$30,000	Undetermined	$0
CPUC Approval	While formal CPUC review and approval may prove necessary, the primary costs of this process are associated with the CEQA review process. The CPUC could be the lead CEQA agency or share this role with another regulatory organization (e.g., CCC, SLO). These CEQA costs are addressed in the County Conditional Use Plan Approval Process.	Owner	About 20–24 months if required	$0	Undetermined	$0
Coastal Development Permit – CCC/Local Coastal Programs	The CCC indicates that the filing fee for non-residential development is $265,000 (CCC, 2008). There may be additional fees for reimbursement of reasonable expenses, including public notice costs. CEQA costs are covered in the County Condition Use Plan Approval Process. Labor costs for preparing/submitting related forms and documentation = 2,000 hours @ $150/hr.	Owner	A 3–9 month process is advertised, but it would be aligned with the CEQA review process	$265,000	Undetermined	$300,000
Coastal Development Lease – CSLC and potential CEQA Lead Agency	The Commission lease-related fees include (CSLC, 2011): Industrial Lease: $25,000 Dredge Lease Fee: $1,500 Filing Fee: $25 Labor costs for preparing/submitting related forms and documentation = 5,000 hours @ $150/hr.	Owner	Depends on duration of CEQA/EIR review process; about 2 years	$26,525	Undetermined	$750,000

Permit/ Approval	Cost Discussion	Responsibility	Permit Review Period	Filing Costs	Remediation or Mitigation Costs	Permitting Service Costs
Dust Control Plan or CAMP – SLO-APCD	While SLO-APCD does not list any specific fee for the Dust Control Plan, other CARB entities are known to charge \$300 to reimburse review costs. If the construction ozone precursor emissions (ROG + NOx) exceed the SLO-APCD quarterly significance threshold of 6.3 tons, the SLO County CEQA Handbook (SLO-APCD, 2012) defined mitigation rate is \$16,000 per ton of ozone precursor plus 15% administrative fee. The current assumption is that precursor emissions are below this threshold. Labor costs for preparing/submitting the plan = 80 hours @ \$150/hr.	Contractor	1-month plan development process	\$0	Undetermined	\$12,000
NPDES Industrial Discharge Permit – CCRWQCB and SWRCB	The operating project is incurring annual fees based on its current discharge rate, which is not expected to change appreciably with the addition of this modified intake system. Consequently, any associated fee structure is not expected to change. Labor costs for revising NPDES permit to reflect new intake structure = 500 hours @ \$150/hr.	Owner	About 6 months	\$0	Undetermined	\$75,000
Conditional Use Plan Amendment – SLO-DPB and Potential CEQA Lead Agency	As the CEQA lead agency or co-lead, the county would assess fees for development of the Initial Study, environmental coordination fees, and EIR processing fees (SLO-DPB, 2012). Initial Study Cost: \$14,603 Other fees include: CalFire Review: \$603 Health Department Review: \$600 Geological Review: \$2,671 (minimum) Resource Conservation District Review: \$375 (minimum) Labor costs for EIR consultant + 50% premium = 4,000 hours @ \$150/hr x 1.5.	Contractor	Depends on duration of CEQA review process; about 2 years	\$20,000	Undetermined	\$900,000
Notification of Waste Activity – RCRA Hazardous Waste Identification Number (Small Quantity Generator) – Construction Phase – Department of Toxic Substance Control, USEPA, SLO-EHS – California Unified Program Agency	Securing the Construction Phase Hazardous Waste ID (if necessary) does not demand a filing fee. Labor costs for preparing/submitting related forms = 4 hours @ \$150/hr.	Contractor	1–2 weeks if required	\$0	Undetermined	\$600

Permit/ Approval	Cost Discussion	Responsibility	Permit Review Period	Filing Costs	Remediation or Mitigation Costs	Permitting Service Costs
Building Permits – SLO-DPB and SLO-DPW: Grading Site Plan Reviews/Checks Mechanical, Plumbing, and Electrical Tanks Fire Inspections	SLO-DPB has a complex fee schedule (SLO-DPB, 2012). Recent SLO County experience on a significant solar PV project indicates that overall building permit and inspection fees could total $750,000. Labor costs for preparing/submitting related engineering packages = 2,000 hours @ $150/hr.	Contractor	4–6 weeks for initial permits following completion of CEQA review and conditional use permit	$750,000	Undetermined	$300,000
California Department of Transportation (Caltrans) – Oversize/Overweight Vehicles	Caltrans Transportation Annual or Repetitive Permit (oversize/overweight loads): $90 (Caltrans – FAQ, 2013) Labor costs for preparing/submitting related forms = 4 hours @ $150/hr.	Contractor	About 1 month	$90	Undetermined	$600
Caltrans Heavy Haul Report (transport and delivery of heavy and oversized loads)	No direct costs. Labor costs for preparing/submitting related forms = 16 hours @ $150/hr.	Contractor	About 1 month	$0	Undetermined	$2,400
Fire Safety Plan Approval, Certificate of Occupancy, Flammable Storage – SLO Fire Department	Revisions to the existing Fire Safety Plan are not expected to result in additional filing or direct regulatory fees. The initial filing fee of $408 would probably not apply. Labor costs for revising Fire Safety Plan = 20 hours @ $150/hr.	Contractor	1 month for plan approval	$0	Undetermined	$3,000
TOTAL				**$1,110,999**	**Undetermined**	**$2,793,600**

4.2.8.2 Summary

The list of potentially applicable federal, state, and local permits for the offshore modular wedge wire screening system reflects the potentially significant impacts to the onshore and near-shore marine environment. The efforts to conduct a successful CEQA review would be the primary critical path permitting process. The CEQA lead agency may be a shared responsibility among a number of key regulatory departments (e.g., SLO, CSLC). The requisite USACE Section 404 permit, CCC Coastal Development Permit, CSLC Lease, and NPDES permit modification would have potentially lengthy review processes but would all be essentially bounded by the critical path CEQA/EIR review process.

The CEQA review process duration varies. The shortest path appears to be a nominal 210-day (7-month) period that would include the minimum 30-day period of review to determine that the initial CEQA application is complete. This process culminates in a Negative Declaration and does not involve developing a comprehensive EIR. The wedge wire screening system review process would likely demand preparation of an EIR, which would serve to significantly extend this review process. The process—inclusive of the initial 30-day completeness review, a 1-year EIR review, and a so-called 90-day "reasonable extension" triggered by compelling circumstances recognized by both the applicant and lead agency—would then extend out to 16 months. (CEQA Flowchart)

The CEQA review process would be extended even further by conservatively adding an additional 8 months to cover "unreasonable delays" ostensibly associated with the applicant's difficulty in supplying requested information. Collectively, this longer and probably more applicable 2-year CEQA review process would likely follow a 1-year period of permit application development. The other permitting processes are assumed to proceed in parallel to the critical path CEQA review process.

The total permit filing and permitting service costs associated with this 3-year permitting process would be approximately $3.9 million. As noted earlier, this 3-year period does not reflect the impact of permit appeals, litigation, or potentially negotiated CEQA-related mitigation fees. In recognition that such complications may occur, the project execution schedule adds a 12-month appeal period following the CEQA final decision.

4.2.9 Sources

1. California Coastal Commission (CCC) Permit Application Instructions, Appendix E Filing Fee Schedule (3/17/2008).
2. California Code of Regulations (CCR) Title 23§2200 Annual Fee Schedules – Subpart a(3) Dredge and Fill Materials.
3. California State Lands Commission (CSLC), Land Management Division Application Guidelines (10/12/2011).
4. California Department of Fish and Wildlife CEQA Document Filing Fees, 2013 http://www.dfg.ca.gov/habcon/ceqa/ceqa_changes.html.
5. California State Water Resources Control Board (SWRCB) Fee Schedule 2012–2013, 2012http://www.swrcb.ca.gov/resources/fees/docs/fy12_13_fee_schedule_npdes_permit.pdf.
6. California Environmental Quality Act (CEQA) Flowchart for Local Agencies: California Code – Section 21151.5, http://www.ceres.ca.gov/planning/ceqa/flowchart.html.
7. San Luis Obispo County Air Pollution Control District (SLO-APCD) CEQA Air Quality Handbook – A Guide for Assessing the Air Quality Impacts for Projects Subject to CEQA Review, April 2012.
8. San Luis Obispo County Department of Planning and Building (SLO-DPB) – Fee Schedule 2012–2013, 2012.

4.3 Closed-Cycle Cooling Technology

The closed-cycle cooling technologies considered herein would replace only the non-safety-related portions of each unit’s existing once-through cooling system. The portion of the existing system identified as “auxiliary saltwater cooling” would remain a once-through cooling system. The following five variants of the closed-cycle cooling technology were evaluated; two use dry cooling, two use wet cooling, and one uses a combination of wet/dry cooling:

- Passive draft dry/air cooling
- Mechanical (forced) draft dry/air cooling
- Wet natural draft cooling
- Wet mechanical (forced) draft cooling
- Hybrid wet/dry cooling

Each variant would significantly reduce the quantity of water withdrawn from the ocean as summarized in Table 4.3-1.

Table 4.3-1. DCPP Intake Structure Seawater Intake Flows

	Once Through Cooling System (Existing)	Dry Cooling, Natural Draft, or Mechanical Draft	Natural Draft Wet Cooling System	Mechanical Draft Wet Cooling System	Hybird, Wet/Dry Cooling System
CW System Flow (gpm)	1,734,000	0	0	0	0
ASW Cooling System Flow (gpm)	22,000	22,000	22,000	22,000	22,000
Desalination Saltwater Supply System Flow (gpm)	0	0	77,300	77,300	69,500
Saltwater Cooling System Flow (gpm)	0	20,400	0	0	0
Total (gpm)	1,756,000	42,400	99,300	99,300	91,500
Reduction (%)	0	97.6	94.3	94.3	94.8

Plant cooling water temperatures created by the closed-cycle cooling systems would be higher than the temperature provided by the existing once-through system. Cooling water temperatures created by closed-cycle cooling systems are primarily governed by the ambient wet and dry bulb temperatures, the cooling tower surface (heat exchange area), and the air flow across the cooling tower cooling surface. Dry technologies follow dry-bulb temperatures, while wet technologies follow wet-bulb temperatures. Dry technology cooling water temperatures are higher than wet technology cooling water temperatures. The design temperatures used for DCPP are provided in Table 4.3-2.

Table 4.3-2. DCPP Design Ambient Temperatures

Parameter	Temperature (°F)
Design Wet Bulb Temperature	64.5
Design Dry Bulb Temperature	77.8
Site Maximum Wet Bulb Temperature	76.1
Site Maximum Dry Bulb Temperature	97.0
Site Minimum Wet Bulb Temperature	21.0
Site Minimum Dry Bulb Temperature	33.0

Warmer cooling water temperatures to the plant’s condensers would decrease the associated turbine generator system’s electrical power output. In addition, using mechanical (forced) draft dry/air fans in lieu of natural draft would increase the plant auxiliary (parasitical) electrical load, further reducing the facility’s electrical output usable to consumers. An analysis was performed to estimate the effect on plant electrical generation due to the various cooling system options under consideration. Local weather data (dry bulb and wet bulb temperature hourly data from the San Luis Obispo airport for 2001–2003) and oceanographic data (ocean water temperature

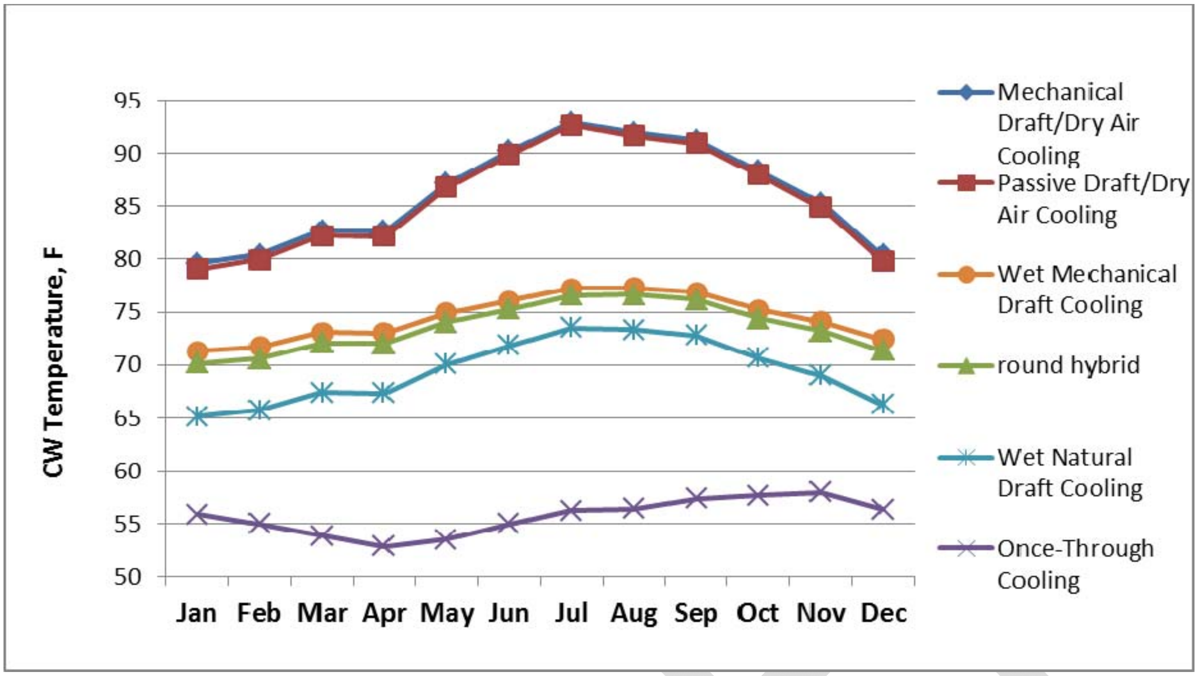


Figure 4.3-1. Average Circulating Water Temperature per Month

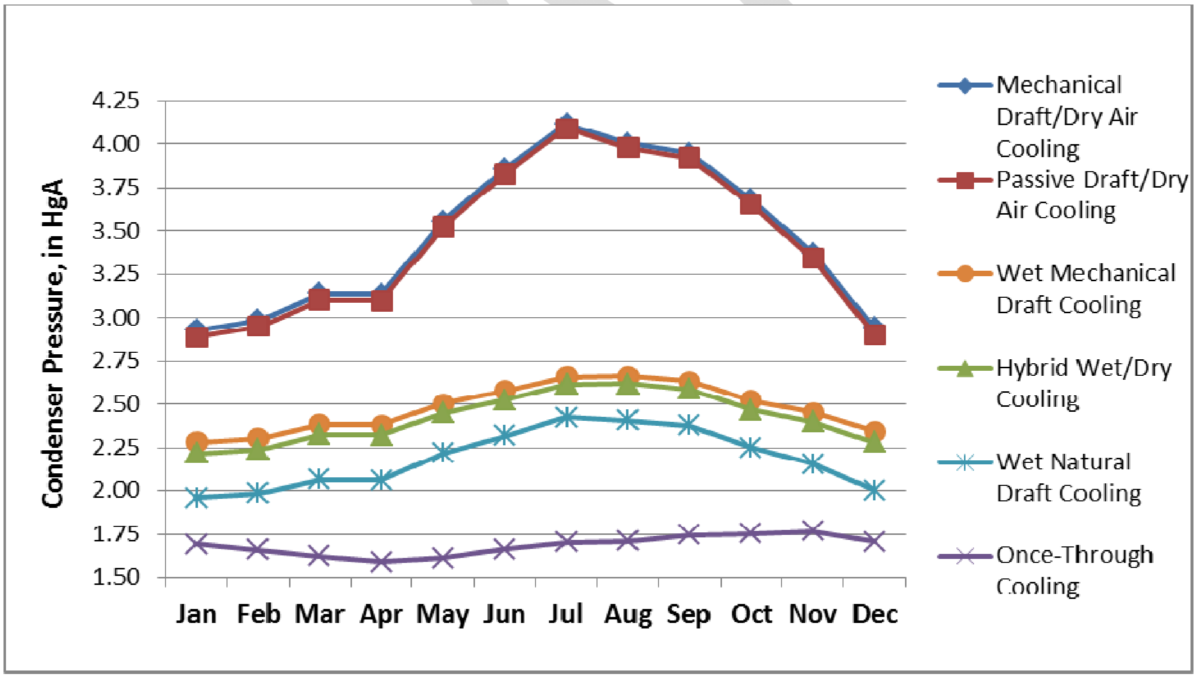


Figure 4.3-2. Average Condenser Backpressure per Month

half-hourly data obtained from the Costal Data Information Program for Station 076 for 2001–2003) were used in the analysis. For simplicity, condenser and cooling tower performance is based on 100-percent duty for all operating points. For base load operation, this is a reasonable assumption, because duty over the range of ambient temperatures would only change by a few percentage points. Figure 4.3-1 provides a graphic representation of how the monthly average cooling water temperature varies annually for the existing once-through cooling system and the various closed-cycle cooling technologies being considered. Average temperatures vary within the range of 10°F to 40°F above the existing temperature, based on the technology and time of year. Figure 4.3-2 graphically indicates the corresponding average-month condenser backpressure associated with the cooling water temperatures.

As previously stated, increased condenser pressure results in reduced turbine output. In addition, the additional auxiliary loads of some of the cooling system options (fans, additional pumping power, etc.) also lead to a reduction in plant net output. Figure 4.3-3 shows estimated loss of generation by month for the different cooling options compared to the current once-through system. The average yearly lost generation (assuming 90 percent capacity factor) is shown in Table 4.3-3.

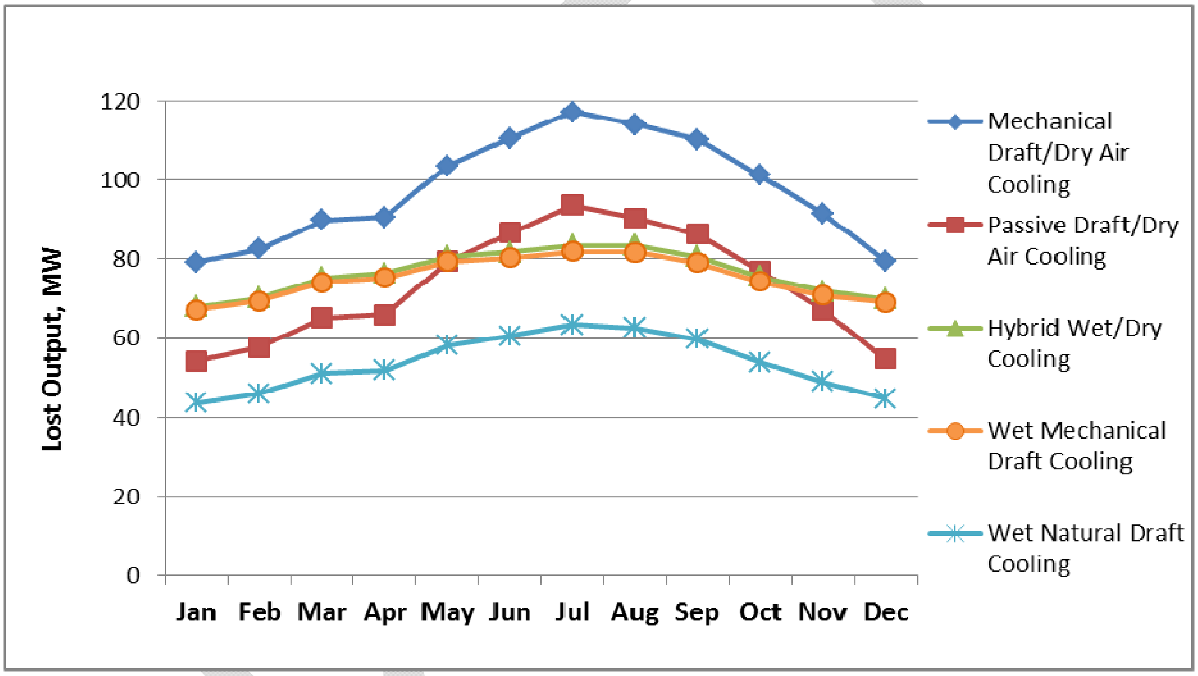


Figure 4.3-3. Average Lost Output per Month

Table 4.3-3. Average Yearly Lost Generation

Technology	Yearly Lost Generation MWh (per Unit)
Mechanical draft/dry air cooling	769,514
Passive draft/dry air cooling	578,031
Wet natural draft cooling	424,016
Wet mechanical draft cooling	593,516
Hybrid wet/dry cooling	603,086

Table 4.3-4 itemizes the sources of lost generation. The largest source of lost generation is, as expected, due to reduction in the gross output of a unit due to higher backpressure operation. However, additional auxiliary loads of the various alternative cooling technologies also contribute to lost generation.

Table 4.3-4. Average Unit MW Derating per Year

	Mechanical Draft/Dry Air Cooling	Passive Draft/Dry Air Cooling	Hybrid Wet/Dry Cooling	Wet Mechanical Draft Cooling	Wet Natural Draft Cooling
Unit Lost Gross Output	69.9	68.7	33.1	35.5	22.7
Cooling System Fan Power	23.1	0.0	14.6	8.8	0.0
Delta CW Pumping Power	4.0	4.0	3.3	3.3	3.3
Saltwater Cooling Pumps	0.2	0.2	0	0	0
Desalinization Supply Pumps	0	0	4.6	4.6	4.6
Desalination/Water Treatment	0.0	0.0	20.7	23.0	23.0
Total Generation Loss	97.3	73.0	76.4	75.2	53.6

The cost of the derated output resulting from the installation of these technologies has not been included as part of the installation cost estimate for the technologies.

Selected major equipment suppliers (cooling towers, pumps, water treatment equipment, large valves, large piping, transformers, and offshore specialty contractors) were consulted to validate technical data and cost estimates included herein.

To avoid repeating information about similar features applicable to several technologies, the variant technologies within each category (dry and wet) are discussed together.

Figure 4.3-4 is a rendering of the wet natural draft technology provided as an example of the visual effect of the installation of the closed-cycle cooling systems at DCPP. The tower pictured was supplied courtesy of SPX Cooling Technologies Inc.

4.3.1 Dry/Air Cooling Systems—Overview

4.3.1.1 Mechanical Design

Dry/air cooling systems (passive draft and mechanical [forced] draft) are primarily used when water for more traditional solutions is not available or is cost prohibitive. The cold water temperatures achievable from dry/air cooling systems are the highest of the closed-cycle cooling technologies considered and thus have the highest impact on the electrical output that can be generated. In addition, the achievable cold water temperatures do not meet the cooling requirements of secondary components at DCPP that support plant operations and are currently cooled from the CWS. It was considered impractical to redesign these secondary systems, so one much-smaller independent once-though cooling system per unit would be included to support these secondary components. Two new saltwater cooling pumps per unit would be provided, located in the existing seawater intake structure, for the new once-through cooling system. The system would be capable of providing 10,200 gpm per unit. New piping would be routed from these pumps to interface with the existing supply piping to the service water heat exchangers and component cooler. Return flow would be through the existing plant outfall.

Figure 4.3-4. Plant Site Rendering

A dry/air cooling system needs small amounts of makeup water to replace water lost due to leakage. The system requires no blowdown, nor does it have any evaporative losses. Water would be required to periodically wash the outside of the dry heat exchangers to maintain their performance. The cooling tower manufacturer recommends washing the dry heat exchangers once or twice a year. On this basis, the annual wash water requirement would be 2 to 4 million gallons. The existing plant water system would be capable of providing the initial fill of water, wash water, and leakage makeup.

Cooling towers would be located northeast of the turbine building and east of the SLO-2 archeological site. The existing portion of the mountain at this location would be lowered to an elevation of 115 feet to accommodate the towers. The 115-foot elevation was selected because it matched the elevation where the cooling water piping crossed the SLO-2 archeological site and was the highest elevation that was determined to result in an acceptable pressure for the cooling water ducts within the turbine buildings. A new pumphouse would be furnished for each unit. The Unit 1 pumphouse would be located northeast of the turbine building and south of the SLO-2 archeological site. The Unit 2 pumphouse would be located west of the Unit 1 turbine building. Refer to General Arrangement Drawing 25762-110-P1K-WK-00011 and the additional general arrangement drawings included for each closed-cycle cooling technology variant.

A hydraulic analysis of the dry/air cooling variant was performed based on providing the design coolant flow to the CWS components using the proposed configuration to validate pipe sizes and to determine required system design pressures and pumping parameters. Four 25-percent-capacity CW pumps with common suction and discharge headers would be provided per unit. As shown on the general arrangement drawings, a combination of 12-foot-in-diameter FRP piping and 16-foot-by-16-foot concrete conduits per unit would be connected to the modified condenser outlet concrete conduits and routed to the associated unit's CW pumphouse. Similar piping and concrete conduits would be routed to/from all of the cooling towers along the north and west sides of the turbine building to connect the towers to the new pumphouses and existing condensers. Refer to General Arrangement Drawing 25762-110-P1K-WL-00011 and the additional general arrangement drawings included for each closed-cycle cooling technology variant. The routing and pipe/conduit sizes would be very similar for all variant technologies except in the local area of the towers.

The ability of the steam turbine to operate at higher condenser backpressures resulting from a dry cooling system was reviewed. The DCPP-specific protection diagram provided by PG&E for the ND56R blade provides the allowable condenser pressure for load operation. This diagram indicates that, for full-load operation, the high backpressure alarm point is 9 inches HgA and the high backpressure trip point is 10.5 inches HgA. In its response to Bechtel questions regarding high backpressure operation, turbine supplier indicated that there has been an “evolution” in its protection diagrams. On a fairly recent proposal for a large nuclear project using the same ND56R last-stage blade, the turbine supplier indicated the recommended alarm setting was 6 inches HgA and the recommended trip setting was 7.5 inches HgA. Maximum backpressures with wet cooling options will not approach the alarm setting. However, based on site weather data, it is estimated that backpressures for the dry cooling options will exceed the alarm level almost 300 hours per year. Restricting plant load during these hours would result in significant lost generation (during periods of high ambient temperatures when this generation is typically needed the most). The other option would be to modify the LP section of the turbine to allow higher backpressure operation. the turbine supplier has indicated that removal of the last (L-0) stage of the turbine could be a solution; however, further work would be required to assess the feasibility of this option. For the dry cooling options, modification of the steam turbines is considered necessary.

Significant demolition/modification of the existing CW concrete conduits west of the turbine building would be required for each of the variant technologies. The extent of this demolition is shown on General Arrangement Drawing 25762-110-P1K-WL-00013. The modifications necessary on the west side of the turbine building are shown in Figure 4.3-5.

A closed-cycle cooling system would require an increase in the overall design pressure of the CWS since the towers are located at the 115-foot elevation. The tube side of the main condensers would be modified to increase the tube-side pressure design from 25 psig to 50 psig. This pressure increase would account for the system losses and the increased hydrodynamic loading that result from the modified CWS arrangement.

Access/maintenance roads would be provided. The existing fire loop would be extended to the cooling tower area. It has been assumed that the existing fire system can provide the required fire water flows and pressures required at the cooling tower area.

The existing CW pump motors and pump internals (two per unit) would be decommissioned and removed as necessary. The existing shoreline intake structure would be modified to accommodate the two new saltwater cooling pumps per unit to supply cooling water to the SCW and condensate cooler heat exchangers.

4.3.1.2 Control System Design

The philosophy used to develop the control systems approach is similar for each dry technology variant. Control systems and equipment were estimated in accordance with P&I schematics, the mechanical equipment lists, and the equipment described in the mechanical section of this report. The cooling tower control systems and equipment were estimated based on preliminary information received from cooling tower suppliers. A distributed control system (DCS) would be provided to control and monitor equipment. DCS input/output (I/O) cabinets would be located in the existing electrical building at the intake area for the new saltwater pumps, the new Unit 1 and Unit 2 cooling tower electrical buildings located in the area of the cooling towers, the new CW pump electrical building, and the new main switchgear building. It is expected that an operator workstation (OWS) human-machine interface (HMI) would be provided in each cooling tower building and in the main control room. It is assumed that there is enough space in the existing intake area electrical building to accommodate the new DCS I/O cabinet(s). The DCS would have redundant processors and communications networks. Separate and independent DCS networks would be provided for each of the two units. Hardware for the DCS would include functionally and geographically distributed I/O cabinets, I/O modules (analog and digital), OWSs, and the connective computer hardware modules. One engineering workstation (EWS) HMI and the software needed to develop control logic and graphic displays would be provided for each unit. The EWS would have the capability to upload and download configuration information and logic display changes into the OWSs and processors. The DCS would annunciate, indicate, time stamp, and track the status of critical parameters. Alarm histories would be available on the alarm summary display screen. A color laser printer would be provided to print DCS graphic displays, logic configurations, log reports, and alarm summaries.

As part of these modifications, the controls associated with the plant’s existing CW pumps would be decommissioned and removed. New CW pumps and valves would be installed at a new pumphouse to circulate the cooling water from the condenser outlet to the new cooling towers. Local instrumentation and control panels for existing CW pumps would be removed and decommissioned. This estimate includes the demolition costs for these panels and instrumentation. The estimate also includes necessary revisions to plant drawings and documents (such as logic diagrams, instrument installation details, instrument list, and instrument data sheets).

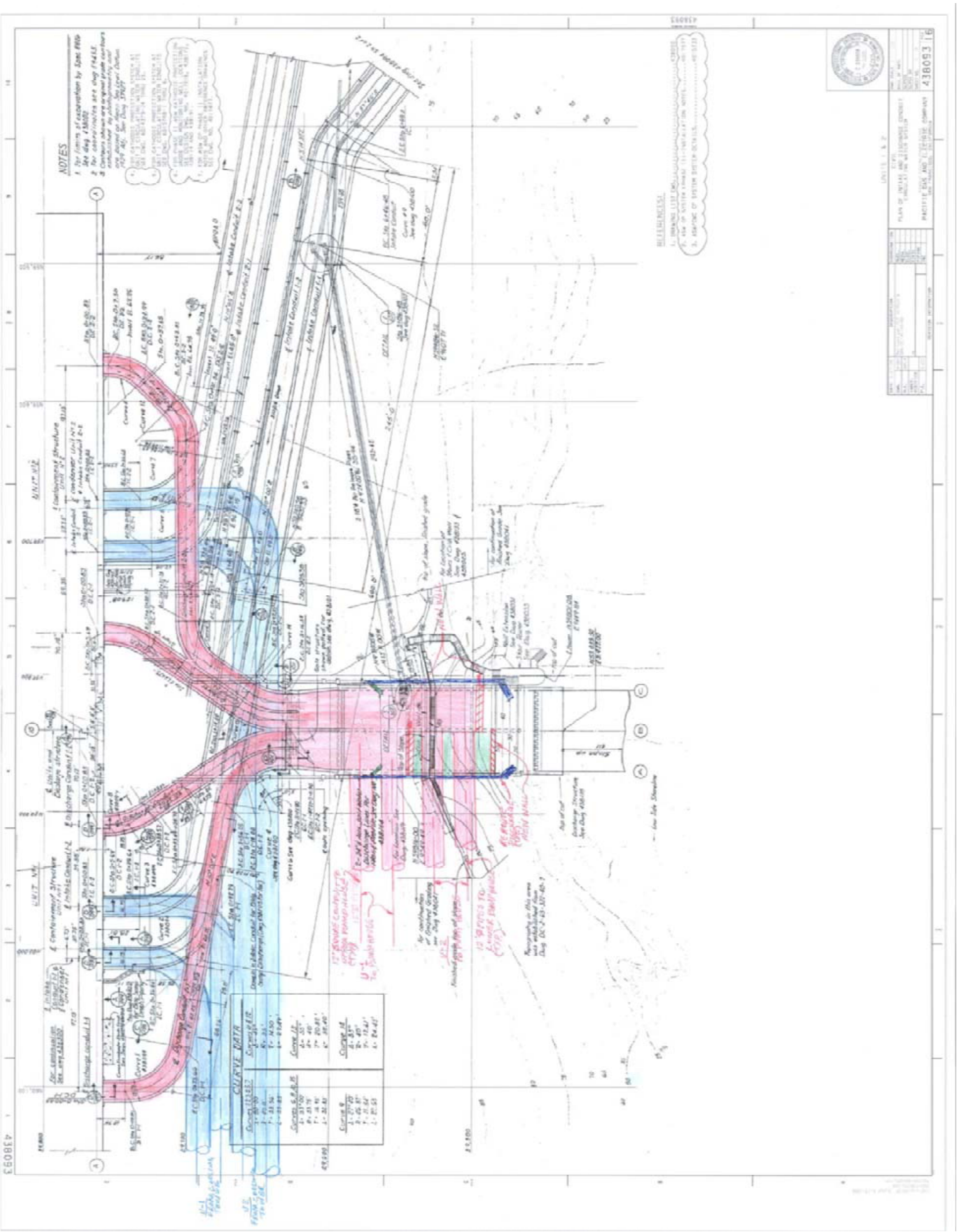


Figure 4.3-5. Circulating Water System

Custom-built DCS graphics would be provided to show overview and group or detailed information to assist the operator in any type of control action required. Other DCS features are:

- Annunciation would be predominantly in the main DCS. Major alarms and protections would be time tagged.
- Positive indications would be provided for plant status (e.g., run/stop, open/close), and these indications would be fed back to the DCS and indicated using an appropriate graphic display.
- Plant personnel would be able to modify and tune control loops, create or change displays, and make database changes without training in high-level programming languages.

The DCS network would have a redundant Ethernet data highway and Ethernet links to the medium voltage (MV) switchgear multifunction relays and to the existing plant computer system. Redundant DCS Ethernet switches and cabling would be provided for the connection between the DCS local/remote I/O cabinets and the DCS HMIs to permit data transfer. All DCS printers and HMIs, including the historian, would also be interconnected via Ethernet. All DCS communication cabling between plant buildings would be fiber optic. All DCS communication cabling within the same room would be Category V/VI copper.

The DCS would control each new MV switchgear main, tie, and load center feeder breakers. The status of each MV bus would be monitored from the DCS via data link to MV meters/relays.

4.3.1.3 Civil Design

With respect to the major civil/structural effort, the five alternative closed-cycle cooling technologies can be divided into two groups: wet (includes natural draft, mechanical [forced] draft, and hybrid variants) and dry (includes natural draft and mechanical [forced] draft variants). Preliminary civil designs were prepared to size major structures such as cooling tower foundations, new pumphouses and header boxes, storage pond, desalination and water treatment plant foundations, and mountain excavation quantities.

The wet technology options have similar general arrangements, and all include a makeup water system (storage pond, desalination plant, water treatment plant, offsite reclaimed water system, and cooling tower water basin). The dry technology options do not include the makeup water system, but have general arrangements otherwise similar to those of the wet technology variants with respect to cooling towers, pumphouses, CW piping, and box conduits. The other major difference among the five alternative technologies lies in cooling tower foundation designs, shapes, and dimensions. The preliminary cooling tower foundations were sized based on the data provided by the cooling tower suppliers (GEA and SPX) and in keeping with the historic information for similar projects previously designed by Bechtel.

It would be necessary to excavate the mountain to an elevation of 115 feet to provide the space needed to build the new cooling towers and, for the wet technologies, the makeup water storage pond. The number of cooling towers needed is technology specific. The location of the new cooling towers has been chosen carefully to provide the most economical solution and to preclude impact to the nearby archeological site. Tower locations are shown on the general arrangement drawings identified in the mechanical design sections. The preliminary drawings depicting excavation plans and sections were developed to determine the excavation quantities needed to accommodate the two-cooling-tower and four-cooling-tower general arrangement options (refer to Drawings 25762-110-7200-00001, -00002, -00003, -00004, and -00005). The leveled area required at elevation 115 feet for the two-cooling-tower arrangement is approximately 62 acres; for the four-cooling-tower arrangement, it is approximately 109 acres. The shape and elevation contours of the mountain terrain were traced from the topographic quadrangle maps available from the U.S. Geological Survey (USGS) official website. A stepped configuration as shown on the above-referenced drawings is proposed, assuming that the material excavated is strong sound rock with minimal fractures and horizontal bedding. A sloped excavation with a 2:1 angle of repose was also investigated; however, the stepped configuration is proposed because it reduces the excavation quantities and limits the disturbed area. The preliminary cut and fill excavation quantities for the two-tower and four-tower general arrangements, with 7-percent haul ramps, were determined using InRoads design software and are as shown in Table 4.3-5.

Table 4.3-5. Mountain Excavation Quantities

General Arrangement	Earthwork Quantities (cubic yards)		
	Cut		Net
Two Cooling Towers	190,000,000		190,000,000
Four Cooling Towers	316,000,000		316,000,000

The excess excavated soil would be disposed of using the proposed haul roads to the potential spoil area sites located further north as shown on Drawings 25762-110-CEK-7200-00001 and -00002. The disposal areas were selected considering their proximity to the excavation site (i.e., within 5 miles) and their capacities to accommodate excavated soil quantities. Additional information regarding mountain excavation and disposal of the excavated soil is provided in Section 5.0.

Existing plant buildings 102, 518, 519, 520, 521, 527, and 528 (refer to DCPP Drawing 512297, sheet 1) would need to be demolished to provide space for the new pumphouses, CW pipes, and conduits. The estimate considers replacement costs for buildings 102, 519, and 527.

The existing plant north perimeter security infrastructure, including several substantial structures, would have to be removed during the course of the project and either replaced in the same location or relocated with a similar configuration to an alternative location in the immediate vicinity. The integrity of the plant protected area boundary would need to be reestablished by project completion. The exact orientation and nature of this infrastructure cannot be incorporated in this report; therefore, a more detailed description of the equipment and structures involved is not provided or otherwise depicted on the provided drawings and site layouts.

Two CW pumphouses would be required (one for each unit), and two each supply and return headers would be required for each pumphouse. Preliminary engineering has been performed to provide material and excavation quantities for the two pumphouses and headers. These quantities are in addition to the mountain excavation quantities noted in Table 4.3-3. Refer to the general arrangement drawings included for each variant technology to see the configuration of the headers for that technology.

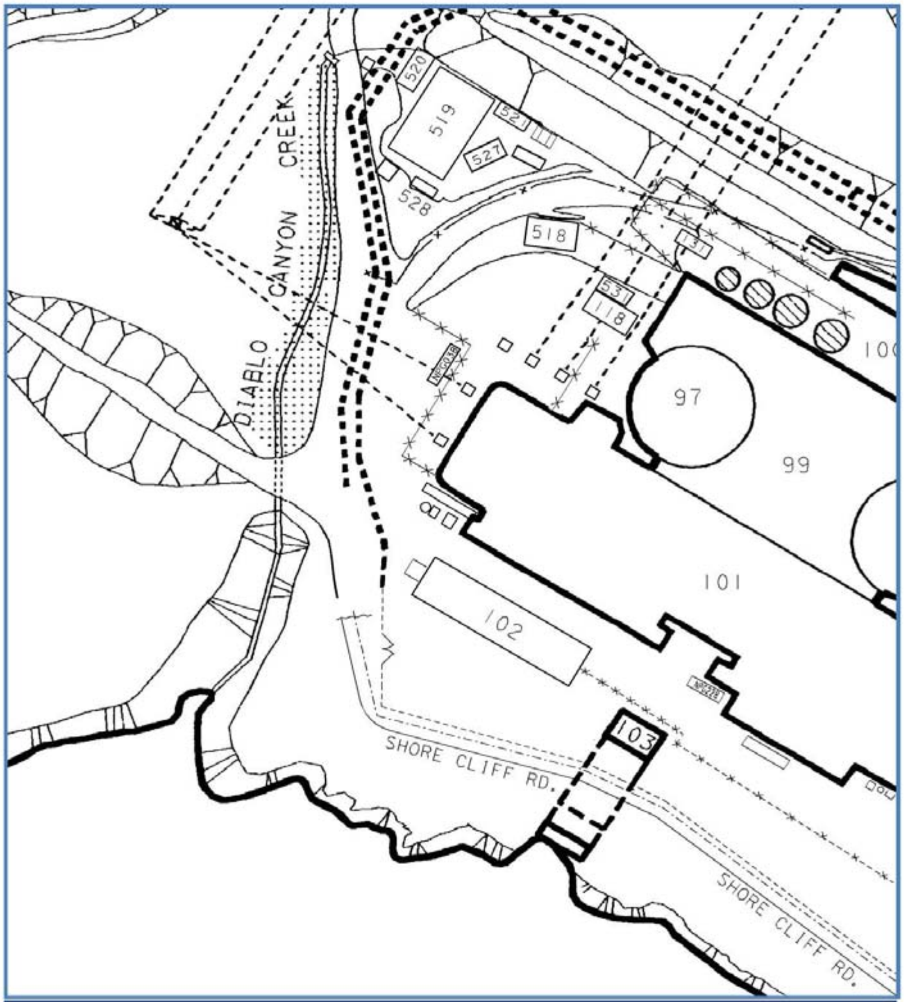
The proposed closed-cycle cooling system CW piping consists of new concrete box conduits and FRP piping to get the water to and from the condenser. Inside the power block and nearby where space is restricted, concrete box conduits that can be designed to fit the restricted space would be used to carry the CW. For the rest of the CW pipe route toward the cooling towers, where adequate space is available, FRP pipes have been proposed in this estimate. FRP piping material was selected considering its advantages (such as hydraulic characteristics, resistance to biological attack, resistance to corrosion and a seawater environment, low maintenance, ease of handling and transportation, construction productivity, and long-term reliability) over other piping material like steel and concrete. Refer to General Arrangement Drawings 25762-110-P1K-WL-00010, -00011, -00020, -00030, -00031, -00040 and -00050 for CW piping/conduit layouts and to Section A-A on General Arrangement Drawings 25762-110-P1K-WL-00010, -00020, -00030, -00040 and -00050 for FRP pipe spacing requirements. Note that the stringent requirements for quality backfill around the FRP pipes require a larger space to accommodate the installation of the multiple FRP pipes needed to supply and return the cooling water to the main condensers.

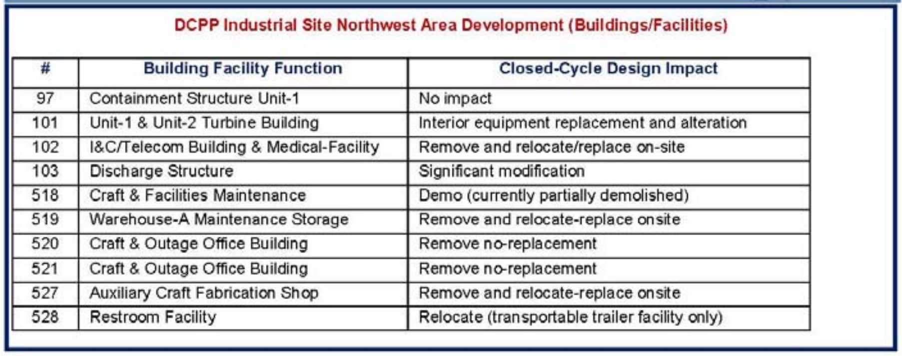
The existing concrete intake and discharge conduits outside the turbine building were evaluated for the proposed CW pipe tie-ins based on the existing plant calculated design pressure and the design pressure determined for the new system configuration. Based on the tower evaluations, it was concluded that the existing conduits outside the turbine building would not be adequate for the new design pressure; therefore, they would be demolished and replaced with new concrete conduits to meet the new design pressure requirements. The excavation is planned for the space in front of the turbine building in order to demolish and remove the existing concrete conduits and provide space for the new pumphouse, valve pits, header boxes, and concrete box conduits. Refer to General Arrangement Drawing 25782-110-P1K-WL-00013 for the extent of the proposed demolition area. The existing concrete intake and discharge conduits within the turbine building were assessed based on a comparison of their structural configurations to those of the existing conduits outside the turbine building, a comparison of the existing plant calculated normal operating and extreme design pressures to the normal operating and extreme design pressures determined for the new system configuration, and a review of the available design margins and conservatism in existing Plant Calculation No. 52.27.100.523, Rev. 0, for the existing discharge conduits outside the turbine building. Based on the assessment, the conduits within the turbine building were determined to be able to accept the new design pressure; however, their capability was one of the determining factors in selecting the tower basin elevation of 115 feet.

Each cooling tower option has specific requirements for electrical buildings to house the required electrical equipment and cable raceways. The preliminary foundation engineering for the buildings has been developed to determine excavation and concrete quantities.

New roads are planned to be 24 feet wide. The new access road layouts and lengths vary with each cooling tower option. Refer to the cooling tower and piping general arrangement drawings for the proposed road layouts.

The development plan for the plant site area is shown in Figure 4.3-6.





DCPP Industrial Site Northwest Area Development (Buildings/Facilities)

#	Building Facility Function	Closed-Cycle Design Impact
97	Containment Structure Unit-1	No impact
101	Unit-1 & Unit-2 Turbine Building	Interior equipment replacement and alteration
102	I&C/Telecom Building & Medical-Facility	Remove and relocate/replace on-site
103	Discharge Structure	Significant modification
518	Craft & Facilities Maintenance	Demo (currently partially demolished)
519	Warehouse-A Maintenance Storage	Remove and relocate-replace onsite
520	Craft & Outage Office Building	Remove no-replacement
521	Craft & Outage Office Building	Remove no-replacement
527	Auxiliary Craft Fabrication Shop	Remove and relocate-replace onsite
528	Restroom Facility	Relocate (transportable trailer facility only)

Figure 4.3-6. Site Development Plan (Plant Site Area)

The earthwork operations would affect an existing two-circuit 230 kV transmission line as well as one circuit of the 500 kV line, which are the main offsite power feeds to Units 1 and 2. In addition, more offsite power would be required to energize the proposed cooling tower equipment, so four additional circuits of 500 kV must also be factored into the design.

The available margin in the site 230 kV system is insufficient to support the loads projected for cooling tower operations. Additionally, the 230 kV system provides the primary source of emergency offsite power for the facility, a nuclear safety function. These factors led to the selection of the existing 500 kV system as the viable auxiliary power source for the closed cycle cooling alternatives.

This transmission line rerouting would be divided into two categories: (1) ***reroute*** of the two-circuit 230 kV transmission line and the single-circuit 500 kV offsite feed and (2) installation of a ***new tap*** consisting of four 500 kV circuits to supply offsite power to the proposed cooling towers.

4.3.1.3.1 230 kV Line Relocation

The existing two-circuit 230 kV line that provides the main source of offsite power for DCPP and the northernmost 500 kV circuit that transmits DCPP Units 1 and 2 electrical output offsite via the Gates transmission intertie would need to be rerouted. Three two-circuit high voltage transmission towers of the existing 230 kV line and one single-circuit high voltage tower of the existing 500 kV line would have to be moved. In accordance with DCPP Operating License Specifications, the maximum allowable outage time for the 230 kV offsite power source to accommodate the relocation work is 72 hours if either site reactor is operating in modes 1–4.

This requirement would demand a phased approach to completing the construction and re-energizing the lines in the allotted time. These three existing 230 kV double-circuit structures would need to be relocated to avoid anticipated earthwork operations that would be necessary to prepare a site for the proposed cooling towers. The relocated line would consist of four new towers, the first being just outside the 230 kV substation on the opposite side of Pecho Valley Road. The grading plan in this area would require special consideration because a small pad must be retained just outside the substation to accommodate the first structure. Other considerations that would be addressed in final design would require that the limits of work provide ample room (per the grading plan) to achieve the electrical clearances required by California General Order (GO) 95 and the National Electrical Safety Code (NESC) (both horizontal and vertical).

The westernmost circuit of the existing 500 kV offsite power line would also be affected by the grading. The first structures beyond the substation would require relocation because they are located within the proposed graded area. Currently configured as three single-phase lattice towers, the proposed replacement structures would be monopoles, and their location would be adjacent to the other 500 kV circuits located to the east.

Figure 4.3-7 depicts how the existing 230 kV and 500 kV lines would be rerouted.

Figure 4.3-7. Existing 230 kV and 500 kV Power Line Rerouting

4.3.1.3.2 New 500 kV Line Tap

To energize the required equipment for the proposed cooling towers, four new 500 kV circuits would be brought in from a new expansion on the west side of the existing 500 kV substation (see Figure 4.3-8). Four circuits would leave the substation on the north side and traverse the site on single-circuit monopole dead-end structures. This work would be sequenced at the end of the earthwork operations because cooling tower earthwork must be completed prior to structure erection and stringing. The structures immediately outside the 500 kV substations are proposed to be 150 feet tall; this height provides clearance over the rerouted 230 kV lines. All other 500 kV tap structures are assumed to be 110-foot-tall monopoles. Foundations are currently proposed as caissons because these are usually quick to install using an excavator-mounted Lo-Drill.

Figure 4.3-8. 500 kV Power Supply to the Cooling Towers

It is anticipated that construction would follow a sequence similar to the following:

- Perform grading in areas to which the existing lines would be relocated (existing lines still energized)
- Place foundations in the newly graded areas (existing lines still energized)
- Erect structures
  - 230 kV structures - erect lattice towers (existing lines still energized)
  - 500 kV structures – erect steel monopoles (existing lines de-energized due to proximity of construction)
- String conductor between dead-end towers (lines de-energized)
- After connections have been completed and checked off, re-energize lines

4.3.2 Passive Draft Dry/Air Cooling

4.3.2.1 General Design Considerations

P&I Schematic 25762-110-M6K-WL-00001 represents the piping arrangement for the CWS for the passive draft dry/air cooling arrangement as well as the piping arrangement for the new once-through saltwater cooling system. Two metal hyperbolic natural draft towers, approximately 590 feet in diameter by 590 feet high, would be required to support each unit, resulting in a total of four towers. The towers would provide a design cold water temperature of 107.9°F. Refer to General Arrangement Drawings 25762-110-P1K-WL-00010, -00011, and -00012 for tower locations, pump locations, and pipe routings.

Four new volute-style CW pumps would be provided per unit, each capable of a design CW flow of 215,700 gpm. Two vertical turbine saltwater cooling pumps would be provided per unit, each capable of a design flow rate of 10,200 gpm.

Equipment List 25762-110-M0X-YA-00001 provides specific details about the new mechanical equipment that would be furnished, and Valve List 25762-110-M6X-YA-00001 lists the new major valves that would be furnished.

4.3.2.2 Control System Design

The control system design approach for passive draft dry/air cooling is discussed in Section 4.3.1.2. The quantity of equipment required is adjusted to support the control needs of the given technology.

4.3.2.3 Civil Design

The civil design approach for passive draft dry/air cooling is discussed in Section 4.3.1.3. The quantities differ for each technology based on the size and spacing of the towers and the amount of support equipment required. The spacing and the equipment are shown on the general arrangement drawings referenced in each section. The tower foundation design for the dry natural draft tower is provided based on preliminary vendor input. Four circular steel cooling towers (two per unit) would be provided. The foundation design would consist of two concrete ring foundations, one to support the outside tower base and the other to support the tower throat (steel structure). For the cooling tower and piping general arrangement, refer to General Arrangement Drawing 25762-110-P1K-WL-00010.

4.3.2.4 Electrical Design

The electrical load for passive draft dry/air cooling is estimated to be approximately 32 MVA per unit. The load MVA numbers mentioned in this report are approximate and assume a power factor of 0.85. In each unit, two new three-winding, 40 MVA transformers would feed the auxiliary loads (new CW pumps). The existing 500 kV DCPP switchyard would be expanded by two additional bays (breaker-and-a-half scheme) to provide the four circuits for the transformers. Refer to One Line Diagram 25762-110-E1K-0000-00001.

The four CW pumps would be fed from each of the secondary windings. The new electrical distribution voltage levels would be 12 kV (in line with the existing MV level at DCPP) for the large CW motors (11.5 kV), 480 V for the cooling tower/CW pumphouse auxiliary equipment, and 120 V ac for smaller loads. There would be dedicated 125 V dc batteries (along with an associated battery charger) for critical uninterruptible power supply (UPS) loads and control power for distribution equipment. The batteries would be sized for 2-hour duration, and the charger would be sized to recharge the batteries in 8 hours.

The existing 13,000 hp condenser CW pumps fed from 12 kV Bus D and 12 kV Bus E as well as from farther upstream transformer UAT 11 would be decommissioned. The new 350 hp saltwater cooling pumps would be fed from 4.16 kV Bus D (fed from the X winding of UAT 12) and 4.16 kV Bus E (fed from the Y winding of UAT 12). There would be four saltwater cooling pumps, two fed from each unit of the plant.

Per available worst-case transformer loading data, the loading on transformer UAT 12, even after considering the load addition on its X and Y windings, is less than 80 percent, which is acceptable. Also, there is a load reduction of 26,000 hp on UAT11 and a load addition of 700 HP on UAT 12. Therefore, there is an overall load reduction in the system and the load change is acceptable.

Based on the auxiliary system single-line design for the passive draft dry/air cooling system, the quantity and sizes of electrical equipment were estimated and used to develop the associated building sizes. Based on the number and sizes of conductors from the single-line drawing, the raceway system was designed and the quantities and sizes were estimated (trays/conduits within building, interconnecting duct banks). Supplier drawings showing the layout of the passive draft dry/air cooling towers were used to develop physical design quantity estimates. Seven electrical buildings would be provided: one for the main switchgear, one at each of the four towers, and one at each of the two CW pumphouses. Refer to Raceway Layout Drawing 25762-110-ERK-WL-00010.

Figures 4.3-9 and 4.3-10 depict the layouts of the electrical buildings for the passive draft dry/air cooling option.

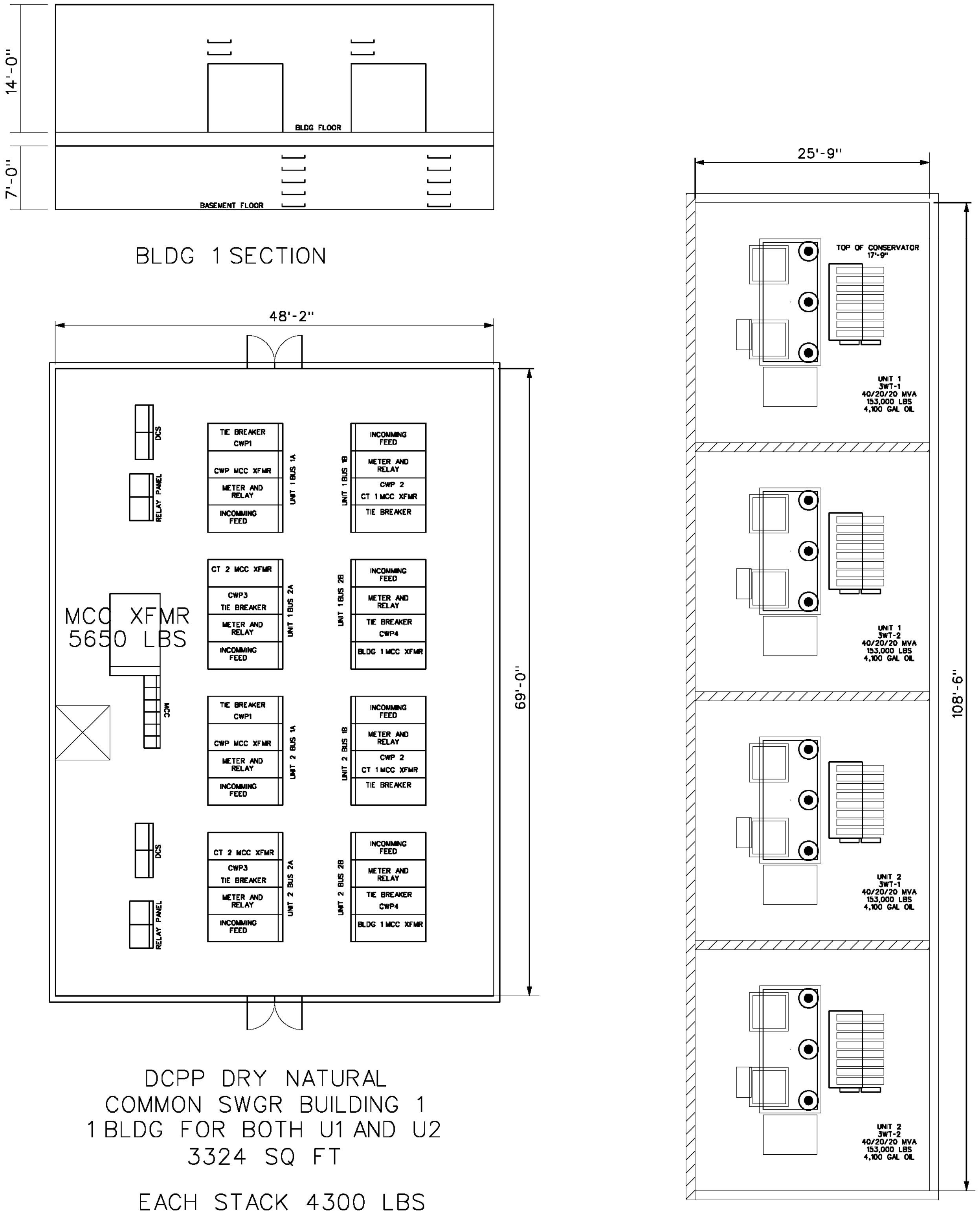
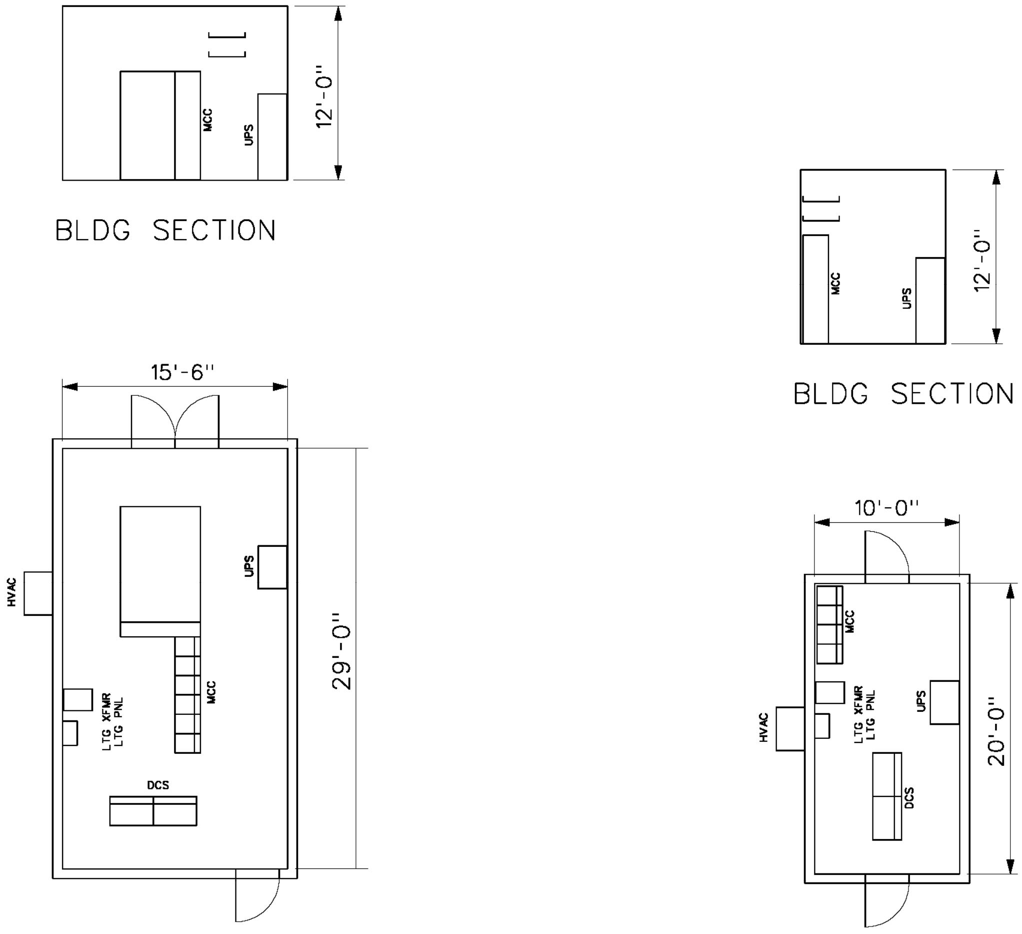


Figure 4.3-9. Passive Draft Dry/Air Cooling—Main Switchgear Electrical Building



DCPP DRY NATURAL
COOL TWR BLDGS 2, 3, 4 & 5
2 FOR U1 AND 2 FOR U2
450 SQ FT

DCPP DRY MECHANICAL
BUILDING 6 & 7
U1 & U2 CW PMPS
200 SQ FT

Figure 4.3-10. Passive Draft Dry/Air Cooling—Cooling Tower and Pumphouse Electrical Buildings

Quantity estimates were determined for the following items: tray, duct bank conduit, grounding, lighting, MV cable, nonsegregated phase bus duct, communication equipment, aboveground conduit length per circuit, and average circuit length.

4.3.3 Mechanical (Forced) Draft Dry/Air Cooling

4.3.3.1 Mechanical Design

P&I Schematic 25762-110-M6K-WL-00002 represents the CWS piping arrangement for the mechanical (forced) draft dry/air cooling arrangement as well as the piping arrangement for the new once-through saltwater cooling system. Two rectangular mechanical (forced) draft dry/air cooling towers, each approximately 1,200 feet long, 100 feet wide, and 100 feet high, would be required to support each unit, resulting in a total of four towers. Each tower would have 60 fans. Each fan would be driven by a 250 hp motor to provide the required air flow through the tower. The towers would provide a design cold water temperature of 107.9°F. Refer to General Arrangement Drawings 25762-110-P1K-WL-00020, -00011, -00012, and -00013 for tower locations, pump locations, and pipe routings.

Four new volute-style CW pumps would be provided per unit, each capable of a design CW flow of 215,700 gpm. Two vertical turbine saltwater cooling pumps would be provided per unit, each capable of a design flow rate of 10,200 gpm, to supply cooling water to the SCW and condensate cooler heat exchangers.

Equipment List 25762-110-M0X-YA-00002 provides additional details about the equipment that would be furnished, and Valve List 25762-110-M6X-YA-00002 lists the new major valves that would be furnished.

Performance, except for the additional electrical consumption, would be identical to that of the passive draft dry/air cooling towers, and the piping would be the same except in the immediate vicinity of the towers.

4.3.3.2 Control System Design

The control system design approach for mechanical (forced) draft dry/air cooling is discussed in Section 4.3.1.2. The quantity of equipment required is adjusted to support the control needs of the given technology.

4.3.3.3 Civil Design

The method used to develop quantities for the variant technologies is discussed in Section 4.3.1.3. The quantities differ for each technology based on the size and spacing of the towers and the amount of support equipment required. The spacing and the equipment are shown on the general arrangement drawings referenced in each section.

The tower foundation designs for the mechanical (forced) draft dry/air cooling tower are based on preliminary vendor input. Four rectangular, steel-framed cooling towers (two per unit) are proposed. Foundations would be a grid of multiple spread-footing foundations of two different sizes. For the cooling tower and piping general arrangement, refer to General Arrangement Drawing 25762-110-P1K-WL-00020.

4.3.3.4 Electrical Design

The electrical load for mechanical (forced) draft dry/air cooling is estimated to be approximately 61 MVA per unit. In each unit, two new three-winding, 70 MVA transformers would feed the auxiliary loads (cooling tower fans, CW pumps, etc.). The existing 500 kV DCPP switchyard would be expanded by two additional bays (breaker-and-a-half scheme) to provide the four circuits for the transformers. Refer to One Line Diagram 25762-110-E1K-0000-00002.

The four CW pumps would be fed from each of the secondary windings. The new electrical distribution voltage levels would be 12 kV (in line with the existing MV level at DCPP) for the large CW motors (11.5 kV), 480 V for the cooling tower fans and other cooling tower/CW pumphouse auxiliary equipment, and 120 V ac for smaller loads. There would be dedicated 125 V dc batteries (along with an associated battery charger) for critical UPS loads and control power for distribution equipment. The batteries would be sized for 2-hour duration, and the charger would be sized to recharge the batteries in 8 hours.

The existing 13,000 hp condenser CW pumps fed from 12 kV Bus D and 12 kV Bus E as well as from farther upstream transformer UAT 11 would be decommissioned. The new 350 hp saltwater cooling pumps would be fed from 4.16 kV Bus D (fed from the X winding of UAT 12) and 4.16 kV Bus E (fed from the Y winding of UAT 12). There would be four saltwater cooling pumps, two fed from each unit of the plant.

Per available worst-case transformer loading data, the loading on transformer UAT 12, even after considering the load addition on its X and Y windings, is less than 80 percent, which is acceptable. Also, there is a load reduction of 26,000 hp on UAT11 and a load addition of 700 hp on UAT 12. Therefore, there is an overall load reduction in the system and the load change is acceptable.

Based on the auxiliary system single-line design for the mechanical (forced) draft dry/air cooling system, the quantity and sizes of electrical equipment were estimated and used to develop the building sizes. Based on the number and sizes of conductors from the single-line drawing, the raceway system was designed and the quantities and sizes were estimated (trays/conduits within building, interconnecting duct banks). Supplier vendor drawings showing the layout of the dry mechanical cooling tower were used to develop physical design quantity estimates. Seven electrical buildings would be provided: one for the main switchgear, one at each of the four towers, and one at each of the two CW pumphouses. Refer to Raceway Layout Drawing 25762-110-ERK-WL-00020.

Quantity estimates were determined for the following items: tray, duct bank conduit, grounding, lighting, MV cable, nonsegregated phase bus duct, communication equipment, aboveground conduit length per circuit, and average circuit length.

Figures 4.3-11 and 4.3-12 depict the layouts of the electrical buildings for the mechanical (forced) draft dry/air cooling option.

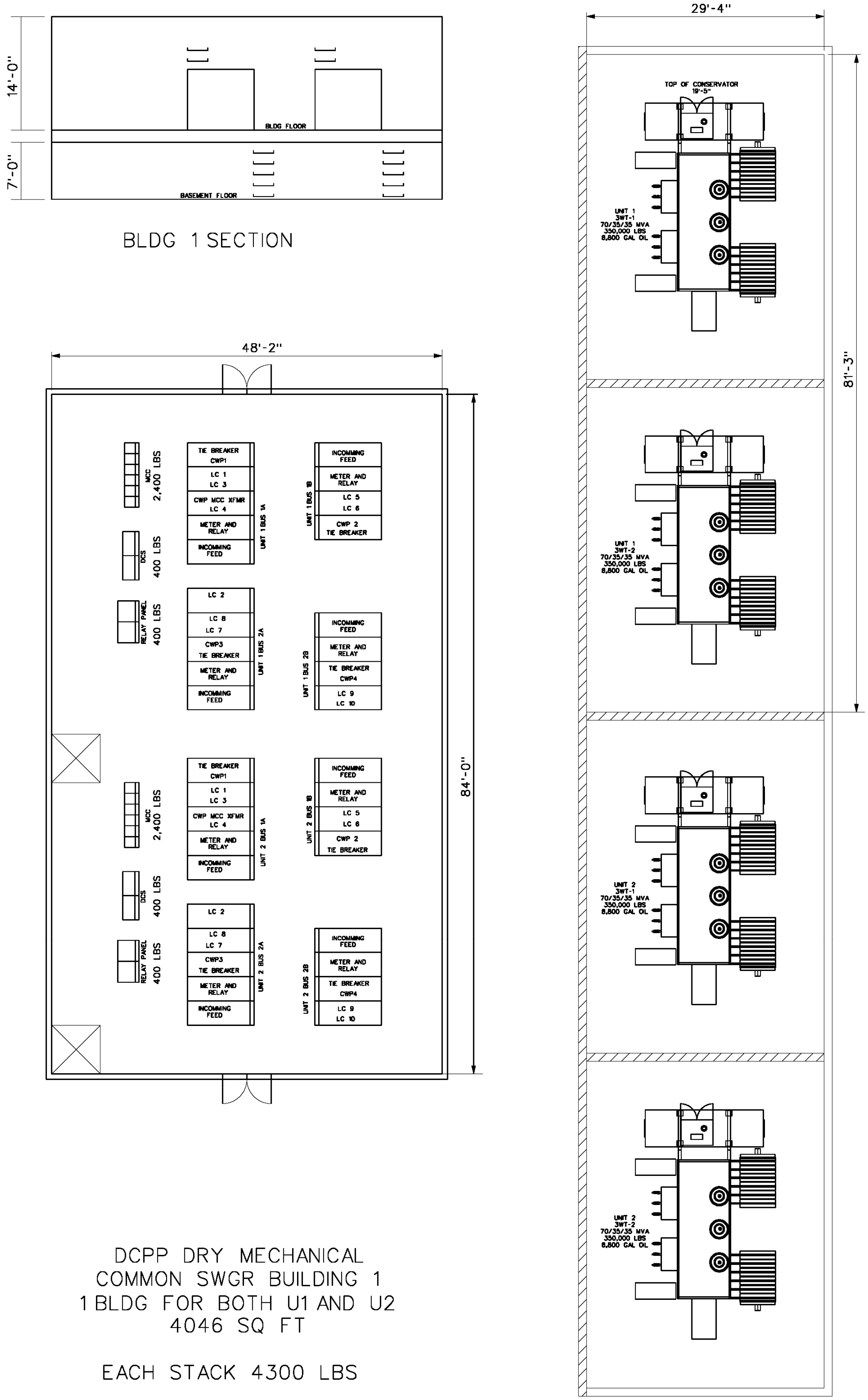


Figure 4.3-11. Mechanical (Forced) Draft Dry/Air Cooling—Main Switchgear Electrical Building

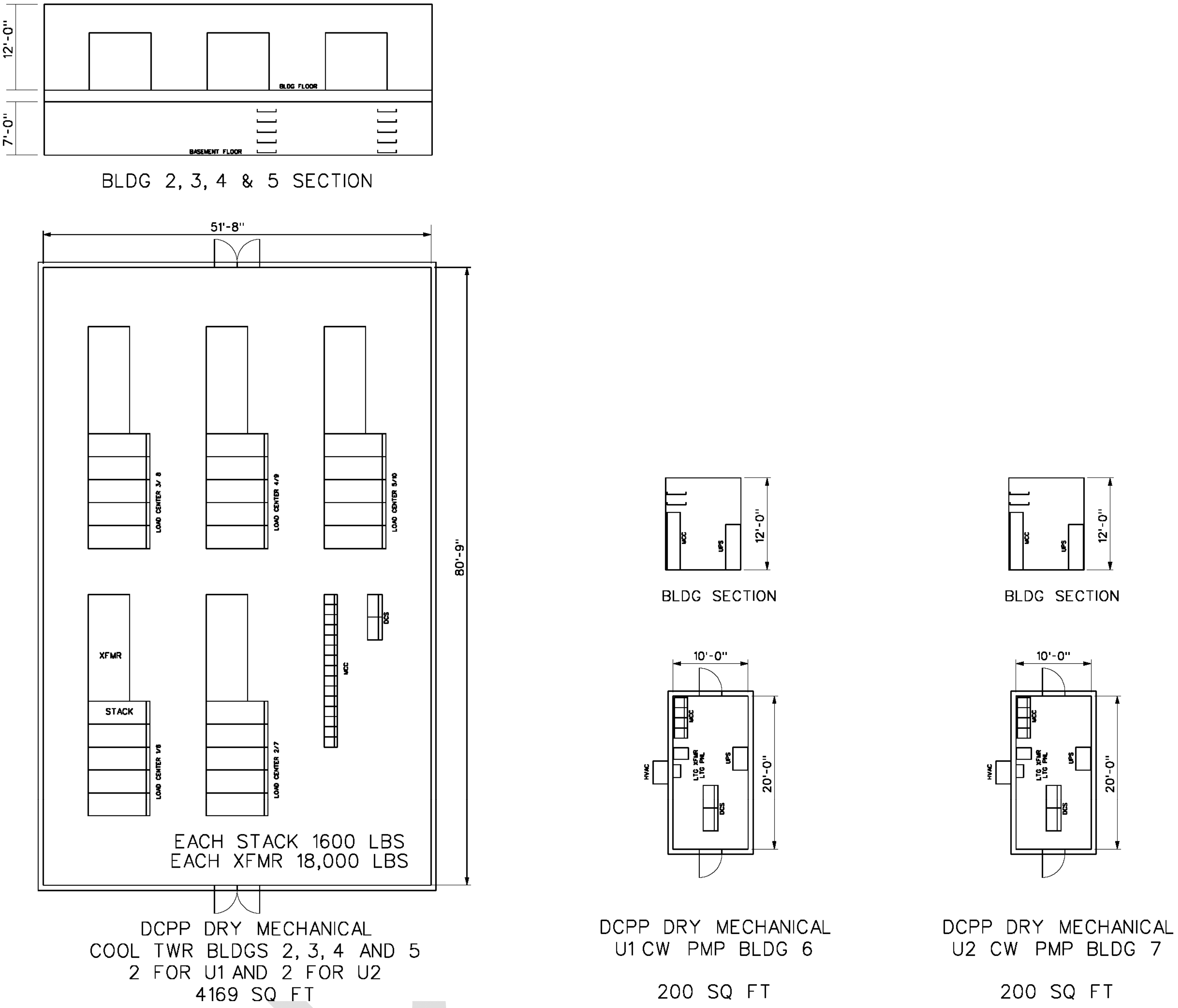


Figure 4.3-12. Mechanical (Forced) Draft Dry/Air Cooling—Cooling Tower and Pumphouse Electrical Buildings

4.3.4 Wet Cooling Technologies—Overview

4.3.4.1 Mechanical Design

The primary differences between wet cooling towers and dry cooling towers are that a wet cooling tower consumes water due to evaporation, drift, and blowdown and achieves lower cold water temperatures because of the difference between wet and dry bulb temperatures. Currently, DCPP does not have the resources to produce water of adequate quality needed for the proposed cooling towers. Therefore, water required for the towers would be obtained from a new onsite desalination plant and from processed reclaimed water obtained from the surrounding communities. A water balance was performed for the wet cooling tower variants to determine the quantity of water required (refer to Water Balance 2562-110-M5K-YA-00001). The towers for each unit would consume approximately 16,550 gpm.

It should be noted that the State Water Board is currently developing amendments to the Water Quality Control Plan for Ocean Waters of California. The amended Plan, once adopted, may include requirements for intake and/or brine discharges that could result in restrictions or additional requirements on the use of desalination at the site.

Currently, up to 2,800 gpm of reclaimed water can be obtained from the following wastewater treatment plants, both within a 20-mile radius of DCPP:

- San Luis Obispo
- Morro Bay/Cayucos

Because this quantity is insufficient to support DCPP operation, a supplementary desalinization plant has been included, designed to supply 100 percent of the required makeup water. Refer to Figure 4.3-13 for proposed reclaim water routing.

The desalination facility would be located north of the turbine building and north of the SLO-2 archeological site. Three desalination seawater supply pumps would be installed in the existing plant shoreline intake structure. Piping would be routed from the intake structure around the SLO-2 archeological site to the desalination facility (refer to General Arrangement Drawing 25762-110-P1K-WL-00032). The new proposed seawater supply piping would be routed entirely below grade except in the screen house, where it would be within the building. No piping would be exposed as it crosses the protected area. A second line would be routed from the desalination facility to discharge the brine produced by the desalination process back to near the CW discharge (refer to General Arrangement Drawing 25762-110-P1K-WL-00030) and further extended offshore to a sufficient depth and non-stagnant ambient location. A multiport diffuser would be fitted at the end of the effluent discharge to achieve the dilution needed to comply with state discharge requirements. The offshore discharge pipe would be buried and protected against current- and wave-induced erosive forces. The water produced by the desalination facility would be pumped to an approximately 5-million-gallon HDPE-lined storage pond located adjacent to the cooling towers. The storage pond size would allow 2 hours of operation of both units upon loss of both the reclaim source and the desalinization system, to allow for an orderly shutdown if the makeup source cannot be restored. Tower blowdown would be accomplished via a connection from the CW piping supply line to the condensers that would be routed to the plant outfall (refer to P&I Schematic 25762-110-M6K-WO-00001). The existing CW pump motors and pump internals (two per unit) would be decommissioned and removed from the existing shoreline intake structure, and modifications would be made to accommodate three new desalination saltwater supply pumps.

Figure 4.3-13. Proposed Reclaim Water Routing

Two offsite pump stations would be provided to pump water from the reclaimed water sources to an onsite storage tank. The reclaimed water would need to be pretreated before use in the cooling towers. Reclaim water treatment equipment would be located adjacent to the new onsite desalination facility. Treated reclaimed water would be blended with desalinated water and stored in the pond. Refer to P&I Schematic 25762-110-M6K-WR-00001.

The cooling towers would be located northeast of the turbine building and east of the SLO-2 archeological site. The existing portion of the mountain at this location would be lowered to an elevation of 115 feet to accommodate the towers as with the other closed-cycle cooling technologies. New pumphouses would be furnished for each unit. The Unit 1 pumphouse would be located northeast of the turbine building and south of the SLO-2 archeological site. The Unit 2 pumphouse would be located west of the Unit 1 turbine building. Refer to General Arrangement

General Arrangement Drawing 25762-110-P1K-WI-00031 and the additional general arrangement drawings included for each variant.

Four 25-percent-capacity CW pumps with common suction and discharge headers would be provided per unit. A combination of 12-foot-in-diameter FRP pipes and 16-foot-by-16-foot concrete conduits per unit would be connected to modified condenser outlet concrete conduits and routed to the associated unit’s CW pumphouse. Similar piping and concrete conduits would be routed to/from the cooling towers by the west side of the turbine building and connect the towers to the new pumphouses and existing condensers. Refer to General Arrangement Drawing 25762-110-P1K-WL-00031 and the additional general arrangement drawings included for each variant. The routing and pipe/conduit sizes are very similar for all closed-cycle cooling technology variants except in the local area of the towers.

Significant demolition/modification of the existing CW concrete conduits west of the turbine building would be required. Refer to General Arrangement Drawing 25762-110-P1K-00013. The modifications necessary on the west side of the turbine building are shown in Figure 4.3-5.

A closed-cycle cooling system would require an increase in the overall design pressure of the CWS. The tube side of the main condensers would be modified to increase the tube-side pressure design from 25 psig to 50 psig. This pressure increase would account for the system losses and the increased hydrodynamic loadings that result from the CWS modified arrangement.

The increase in cold water temperature from the original 76°F would require that the service water heat exchanger and component coolers be replaced with larger surface area heat exchangers to provide the same hot-side cold water temperatures as provided in the original system.

The existing fire water and potable water systems would be extended to the cooling tower and desalination plant areas. A sanitary lift station would be installed at the desalination plant and piped to the plant existing sanitary system.

Access/maintenance roads would be provided to service the cooling towers and desalination facility.

The existing CW pump motors and pump internals would be decommissioned and removed as necessary and the existing shoreline intake structure would be modified to accommodate the three desalination saltwater supply pumps.

Drift is an important consideration when siting wet cooling towers at a power station. When the cooling towers are in operation, water droplets become entrained in the air flow being induced through the tower and exiting through the tower discharge. These droplets are known as drift. The drift rate for the different wet cooling tower technologies being considered for DCPP would be limited to 0.0005 percent of the CW flow rate by using drift eliminators in the cooling towers. The sizes of the drift droplets would range from 0.1–300 µm, depending on the drift eliminator manufacturer and type being used. This range is the lowest achievable from a single layer of the most efficient drift eliminators available in the industry at this time, and it equates to a total drift loss of approximately 5 gallons per minute from all of the cooling towers collectively (per unit).

The drift droplets would be of the same water quality as the CW and would contain any water treatment chemicals being used at the site. Based on the estimated CW quality for DCPP, the 0.0005-percent drift rate would result in the emission of approximately 30 tons of solids per year from the towers. After drift droplets leave a tower and land on surrounding areas and structures, the contaminants in the droplets are deposited when the droplets evaporate. Different tower design considerations, including tower discharge height and air exit velocity, affect how far the drift droplets travel and thus the area on which the drift can land, as well as the concentration of contaminants deposited on the affected surfaces.

One concern is that the presence of salts and chemicals in the drift droplets could result in a conductive film being left on insulators if the droplets land on the switchyard. This film could cause electrical arcing and other safety and operational issues. Based on the conceptual plot plans, the wet cooling technologies would be located approximately 1,300–1,700 feet from the nearest boundary of the 500 kV switchyard. The predominant wind direction for the site is from the NW about 30–40 percent of the time. This wind direction results in tower discharge air being blown toward the switchyard. Wind directions of NNW and WNW would also drive tower discharge air in the general direction of the switchyard. A review of site wind roses indicates that consideration of all three of these directions accounts for approximately 60 percent of the year. Thus, this is considered as the length of time that tower air and drift discharges would be directed toward the switchyard This does not necessarily mean that all of the drift would deposit on the switchyard area and contaminate the insulators and other equipment; the actual volume of solids deposition on the switchyard area (in acres per month) can be quantified by using the Electric Power Research Institute’s Seasonal/Annual Cooling Tower Impact (SACTI) model or a similar program. During the detailed design and execution of the project, this type of analysis would be completed for the selected cooling tower design. Quantifying the deposition on the switchyard would help to determine appropriate equipment and maintenance requirements to minimize the potential for arcing. This includes correct selection of insulator type and planning for site personnel to wash the insulators frequently enough to avoid significant solids buildup.

4.3.4.2 Control System Design

The philosophy used to develop the control systems approach is similar for each wet technology variant. Control systems and equipment were estimated in accordance with the equipment shown on P&I schematics, the mechanical equipment lists, and the equipment described in the mechanical section of this report. The cooling tower control systems and equipment were estimated based on preliminary information received from cooling tower suppliers. Information from the water treatment suppliers was used to estimate the cost for the controls and instrumentation associated with adding the desalination plant, and a P&I schematic and preliminary information from the reclaim water treatment equipment supplier were used to estimate the cost for the controls and instrumentation associated with adding the reclaim water clarifier facility.

As with the dry technologies, a DCS would be provided to control and monitor equipment. DCS I/O cabinets would be located at the intake area (for new desalination seawater supply pump control/monitoring), in the electrical building near the new CW pumps (each unit), at each cooling tower, in the desalination plant/reclaim water treatment electrical building/room, and in the existing main control room (to house network switches to tie in new controllers to the existing network). It is assumed that an OWS HMI would be provided at each cooling tower building and that two OWSs (per unit) would be added to the main control room to control and monitor the new equipment added by each option. The desalination equipment vendor would provide PLC control and HMI with the equipment for desalination control. The reclaim water treatment equipment vendor would provide PLC control and HMI with the equipment for reclaimed water treatment. The DCS would be data-linked via Ethernet to PLCs for the desalination equipment and reclaimed water equipment to allow supervisory control and monitoring from the main control room via the DCS. It is assumed that there is enough space in the existing plant areas (intake area electrical building, control room) to accommodate these new DCS I/O cabinet(s) and HMIs.

The DCS would have redundant processors and communications networks. Separate and independent DCS networks would be provided for each of the two units. Hardware for the DCS would include functionally and geographically distributed I/O cabinets, I/O modules (analog and digital), OWSs, and the connective computer hardware modules. One EWS and the software needed to develop control logic and graphic displays would be provided for each unit. The EWS would have the capability to upload and download configuration information and logic display changes into the OWSs and processors. The DCS would annunciate, indicate, time stamp, and track the status of critical parameters. Alarm history would be available on the alarm summary display screen. A color laser printer would be provided to print DCS graphic displays, logic configurations, log reports, and alarm summaries.

As part of these modifications, controls associated with the plant's existing CW pumps would be decommissioned and removed. New CW pumps and valves would be installed at a new pumphouse to circulate the cooling water from the condenser outlet to the new cooling towers. Some of the existing traveling screens at the intake would remain in operation to be used for the new desalination plant seawater supply pumps. The costs associated with removing the unused screens' instrumentation and controls and control panels have been included in the estimate. Local instrumentation and control panels for existing CW pumps would be decommissioned and removed. The estimate includes the demolition costs for these panels and instrumentation. The estimate also includes necessary revisions to plant drawings and documents (such as logic diagrams, instrument installation details, instrument list, and instrument data sheets).

Custom-built DCS graphics would show overview and group or detailed information to assist the operator in any type of control action required. Other DCS features are:

- Annunciation would be predominantly in the main DCS. Major alarms and protections would be time tagged.
- Positive indications would be provided for plant status (e.g., run/stop, open/close), and these indications would be fed back to the DCS and indicated using an appropriate graphic display.
- Plant personnel would be able to modify and tune control loops, create or change displays, and make database changes without training in high-level programming languages.

The DCS network would have a redundant Ethernet data highway and Ethernet links to the MV switchgear multifunction relays and to the existing plant computer system. Redundant DCS Ethernet switches and cabling would be provided for the connection between the DCS local/remote I/O cabinets and the DCS HMIs to permit data transfer. All DCS printers and HMIs, including the historian, would be interconnected via Ethernet. All DCS communication cabling between plant buildings would be fiber optic. All DCS communication cabling within the same room would be Category V/VI copper.

The DCS would control each new MV switchgear main, tie, and load center feeder breaker. The status of each MV bus would be monitored from the DCS via data link to MV meters/relays.

4.3.4.3 Civil Design

The philosophy used to develop the civil design approach is similar for each wet technology variant, with the primary difference occurring at the cooling towers.

The designs for the CW main piping and pumps are virtually identical to those described for the variant dry technologies in Section 4.3.1. The major differences are the inclusion of cooling tower blowdown piping and valve, the makeup water supply systems, the storage pond, and the cooling tower foundations.

The makeup water system would only be required for the wet cooling tower variants, and it would consist of the following structures and components:

a. A desalination plant to provide treated makeup water to the CWS through the cooling tower basin. Based on cooling tower supplier data, preliminary engineering has been performed to provide foundation and excavation quantities.

b. A reclaimed water treatment plant with a 90-minute contact basin to treat grey water from off site for use as makeup to the cooling towers. Based on water treatment vendor preliminary design data, preliminary engineering has been performed to provide foundation and excavation quantities.

c. A 5,000,000-gallon-capacity storage pond to store treated water for the units. The proposed storage pond would have an HDPE liner with a layer of protective sand over it. The water would be discharged to the cooling tower basins by gravity (no need for pumps). A concrete discharge structure with screens and a discharge outfall would be provided for the gravity-fed water supply to the cooling towers.

d. Two offsite reclaimed water sources, each requiring a pumphouse, an electrical building, and buried cement-lined ductile iron pipes routed to the onsite pumphouse grey water storage tank. Preliminary engineering has been performed to provide structural and excavation quantities for these facilities.

4.3.5 Wet Natural Draft Cooling

4.3.5.1 Mechanical Design

P&I Schematic 25762-110-M6K-WL-00003 represents the piping arrangement for the CWS for the wet natural draft cooling arrangement. Two concrete hyperbolic natural draft towers approximately 590 feet in diameter by 590 feet high would be required to support each unit, resulting in a total of four towers. The towers would provide a design cold water temperature of 80.6°F. Refer to General Arrangement Drawings 25762-110-P1K-WL-00030 and -00031 for tower locations, pump locations, and pipe routings.

Two new shell-and-tube service water heat exchangers and one new condensate cooler per unit, all with increased surface areas, would be provided. Each would provide a hot-side cold water temperature of 95°F at the original design duty.

Four new volute-style CW pumps would be provided per unit, each capable of a design CW flow of 218,250 gpm. Three vertical turbine saltwater supply pumps would be provided, each capable of a design flow rate of 36,800 gpm.

Equipment List 25762-110-M0X-YA-00003 provides additional details about the new mechanical equipment that would be furnished, and Valve List 25762-110-M6X-YA-00003 lists the new major valves that would be furnished.

4.3.5.2 Control System Design

The control system design approach for the wet natural draft cooling technology is discussed in Section 4.3.2. The quantity of equipment required is adjusted to support the control needs of the given technology.

4.3.5.3 Civil Design

The method used to develop quantities for the various variant technologies is discussed in Section 4.3.2. The quantities differ for each technology based on the size and spacing of the towers and the amount of support equipment required. The spacing and equipment are shown on the general arrangement drawings referenced in each section. The tower foundations for the wet natural draft cooling tower are based on preliminary supplier input. Four hyperbolic cooling towers (two per unit) are proposed. Foundations would include one concrete ring foundation to support the tower shell, a concrete slab on grade for a water basin, and an outfall concrete structure for the makeup water. For the cooling tower and piping general arrangement, refer to General Arrangement Drawing 25762-110- P1K-WL-00040.

4.3.5.4 Electrical Design

The electrical load for this option is estimated to be approximately 64 MVA per unit. In each unit, two new three-winding, 70 MVA transformers would feed the auxiliary loads (CW pumps, desalination loads, and cooling tower instrumentation). The existing DCPP 500 kV switchyard would be expanded by two additional bays (breaker-and-a-half scheme) to provide the four circuits for the transformers (refer to One Line Diagram 25762-110-E1K-0000-00003). The four CW pumps would be fed from each of the secondary windings. The new electrical distribution voltage levels would be 12 kV (in line with the existing MV level at DCPP) for the large CW motors (11.5 kV), and desalination and water reclaim systems, 480 V for the cooling tower fans and other cooling tower/CW pumphouse auxiliary equipment, and 120 V ac for smaller loads. There would be dedicated 125 V dc batteries (along with an associated battery charger) for critical UPS loads and control power for distribution equipment. The batteries would be sized for a 2-hour duration, and the charger would be sized to recharge them in 8 hours.

The existing 13,000 hp condenser CW pumps fed from 12 kV Bus D and 12 kV Bus E as well as from farther upstream transformer UAT 11 would be decommissioned and new 6,800 hp desalination seawater supply pumps would be fed from the same 12 kV Bus D and 12 kV Bus E, respectively. In all, there would be three desalination seawater supply pumps, two fed from one unit from the buses mentioned above and the third from the second unit. Because there is a net load reduction on upstream transformer UAT11, the load change is acceptable.

Based on the auxiliary system single-line design for the wet natural draft cooling system, the quantity and sizes of electrical equipment were estimated and used to develop the building sizes. Based on the number and size of conductors from the single-line drawing, the raceway system was designed and the quantities were estimated (trays/conduits within building, interconnecting duct banks). Supplier vendor drawings showing the layout of the wet natural cooling tower were used as appropriate for physical design quantity estimates. Eight electrical buildings would be provided: one for the main switchgear, one at each of the four towers, one at each of the two CW pumphouses, and one at the desalination plant. Refer to Raceway Layout Drawing 25762-110-ERK-WL-00040.

The desalination and water reclaim vendors have provided estimates for the electrical equipment required for power distribution for their supplied equipment. The desalination vendor provided a typical single-line diagram showing the electrical equipment configuration. The desalination/reclaim area electrical building size, tray quantity, and duct bank quantity were estimated from the desalination vendor typical single-line diagram, mechanical equipment lists, and vendor-supplied conceptual plant general arrangement drawings.

Quantity estimates were determined for the following items: tray, duct bank conduit, grounding, lighting, MV cable, nonsegregated phase bus duct, communication equipment, aboveground conduit length per circuit, and average circuit length.

Figures 4.3-14 through 4.3-16 depict the layouts of the electrical buildings for the wet natural draft cooling option.

Figure 4.3-14. Wet Natural Draft Cooling—Main Switchgear Electrical Building

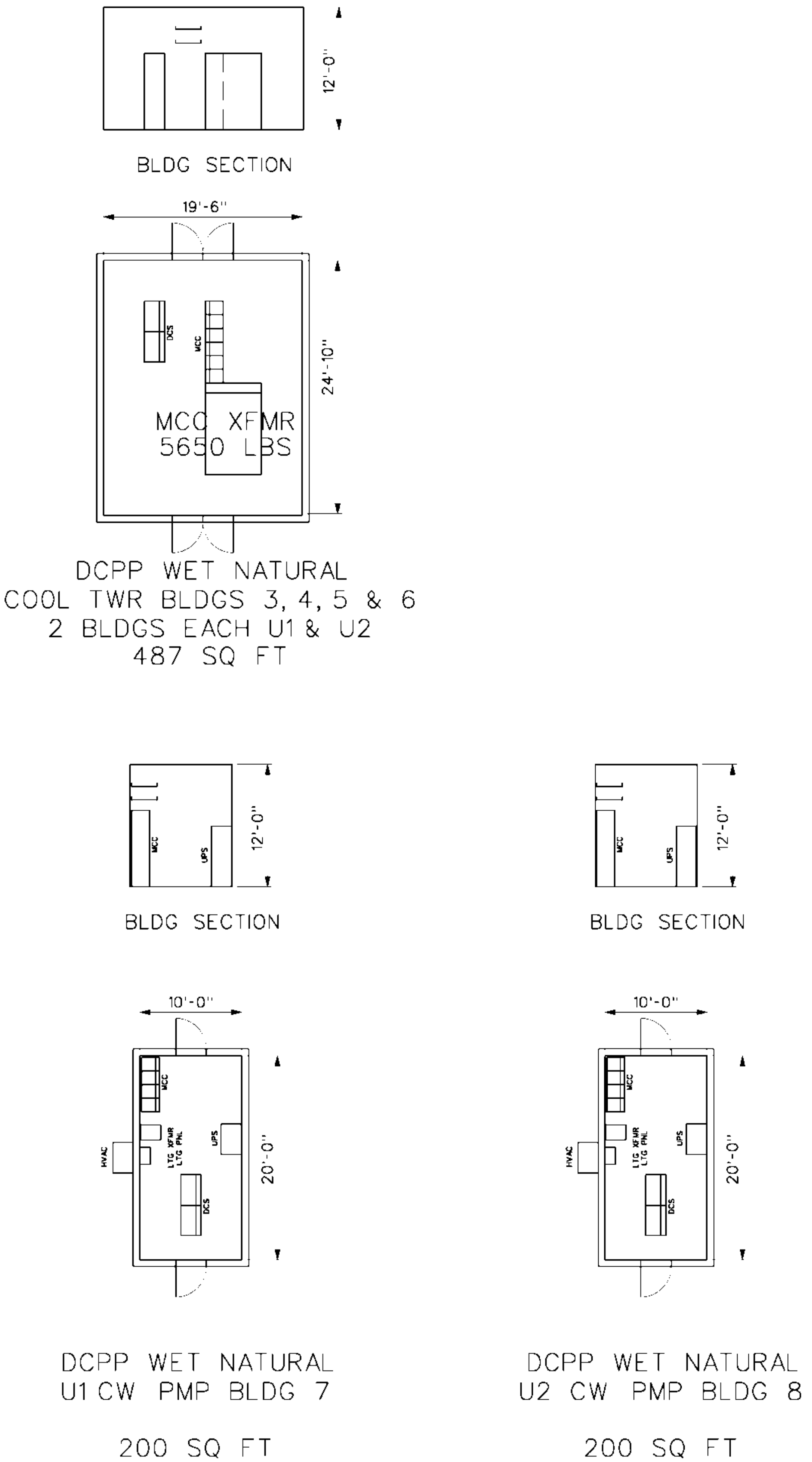


Figure 4.3-15. Wet Natural Draft Cooling—Cooling Tower and Pumphouse Electrical Buildings

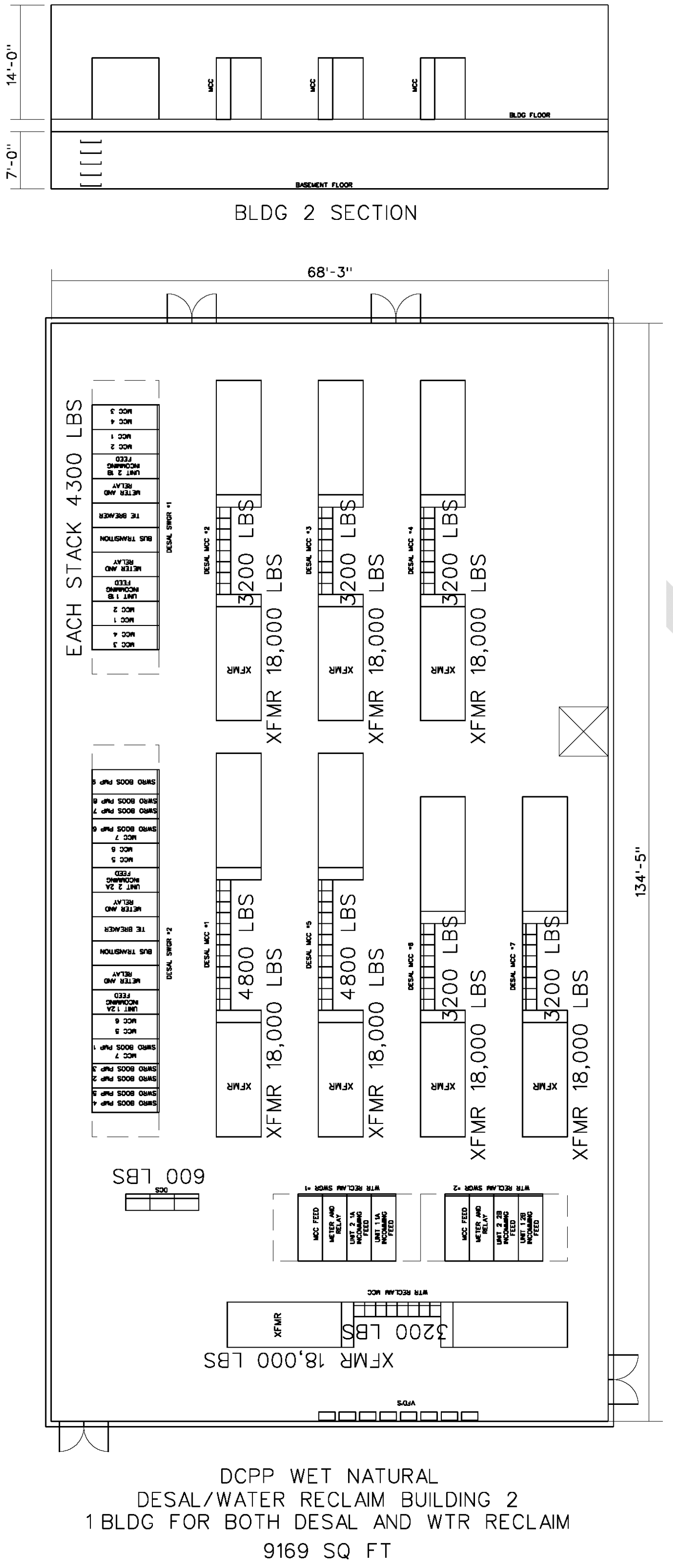


Figure 4.3-16. Wet Natural Draft Cooling—Desalination/Water Reclaim Electrical Building

4.3.6 Wet Mechanical (Forced) Draft Cooling

P&I Schematic 25762-110-M6K-WL-00004 represents the CWS piping arrangement for the wet natural draft cooling arrangement. One circular concrete mechanical (forced) draft dry/air cooling tower 542 feet in diameter by 180 feet high would be required for each unit, for a total of two towers. Each tower would have 40 fans, each driven by a 300 hp motor, to provide the required air flow through the tower (refer to General Arrangement Drawing 25762-110-P1K-WL-00050). The towers would be capable of maintaining a design cold CW temperature of 80.6°F. Refer to General Arrangement Drawings 25762-110-P1K-WL-00013, -00030, and -00031 for tower locations, pump locations, and pipe routings.

Two new shell-and-tube service water heat exchangers and one new condensate cooler per unit, all with increased surface areas, would be provided. Each would provide a hot-side cold water temperature of 95°F at the original design duty.

Four new volute-style CW pumps would be provided per unit, each capable of a design CW flow of 218,250 gpm. Three vertical turbine saltwater supply pumps would be provided, each capable of a design flow rate of 36,800 gpm.

Equipment List 25762-110-M0X-YA-00004 provides additional details about the new mechanical equipment that would be furnished, and Valve List 25762-110-M6X-YA-00004 lists the new major valves that would be furnished.

4.3.6.1 Control System Design

The control system design approach for the wet mechanical (forced) draft cooling technology is discussed Section 4.3.2. The quantity of equipment required is adjusted to support the control needs of the given technology.

4.3.6.2 Civil Design

The method used to develop quantities for the variant technologies is discussed in Section 4.3.2. The quantities differ for each variant based on the size and spacing of the towers and the amount of support equipment required. The spacing and equipment are shown on the general arrangement drawings referenced in each section. The tower foundations for the wet mechanical (forced) draft tower are based on preliminary supplier input. Two concrete, circular cooling towers (one per unit) are proposed. Per the preliminary foundation design, there would be one concrete ring foundation to support the tower shell, a concrete slab on grade for a water basin, and an outfall concrete structure for the makeup water. For the cooling towers and piping general arrangement, refer to General Arrangement Drawing 25762-110-P1K-WL-00050.

4.3.6.3 Electrical Design

The electrical load for this option is estimated to be approximately 74 MVA per unit. In each unit, two new three-winding, 80 MVA transformers would feed the auxiliary loads (cooling tower fans, CW pumps, and desalination loads). The existing DCPP 500 kV switchyard would be expanded by two additional bays (breaker-and-a-half scheme) to provide the four circuits for the transformers. Refer to One Line Diagram 25762-110-E1K-0000-00004.

The four CW pumps would be fed from each of the secondary windings. The new electrical distribution voltage levels would be 12 kV (in line with the existing MV level at DCPP) for the large CW motors (11.5 kV) and the desalination and water reclaim systems, 480 V for the cooling tower fans and other cooling tower/CW pumphouse auxiliary equipment, and 120 V ac for smaller loads. There would be dedicated 125 V dc batteries (along with an associated battery charger) for critical UPS loads and control power for distribution equipment. The batteries would be sized for a 2-hour duration, and the charger would be sized to recharge them in 8 hours.

The existing 13,000 hp condenser CW pumps fed from 12 kV Bus D and 12 kV Bus E as well as from farther upstream transformer UAT 11 would be decommissioned and new 6,800 hp desalination seawater supply pumps would be fed from the same 12 kV Bus D and 12 kV Bus E, respectively. In all, there would be three desalination seawater supply pumps, two fed from one unit from the buses mentioned above and the third from the second unit. Because there is a net load reduction on upstream transformer UAT11, the load change is acceptable.

Based on the auxiliary system single-line design for the wet mechanical (forced) draft cooling system, the number and size of electrical equipment were estimated and used to develop building sizes. Based on the number and size of conductors from the single-line drawing, the raceway system was designed and the quantities were estimated (trays/conduits within building, interconnecting duct banks). Supplier vendor drawings showing the layout of the wet mechanical cooling tower were used as appropriate for physical design quantity estimates. Five electrical buildings would be provided: one for the main switchgear and a cooling tower, one at the second cooling tower, one at each of the two CW pumphouses, and one at the desalination plant. Refer to Raceway Layout Drawing 25762-110-ERK-WL-00050.

The desalination and water reclaim vendors have provided estimates for the electrical equipment required for power distribution for their supplied equipment. The desalination vendor provided a typical single-line diagram showing the electrical equipment configuration. The desalination/reclaim area electrical building size, tray quantity, and duct bank quantity were estimated from the desalination vendor typical single-line diagram, mechanical equipment lists, and vendor-supplied conceptual plant general arrangement drawings.

Quantity estimates were determined for the following items: tray, duct bank conduit, grounding, lighting, MV cable, nonsegregated phase bus duct, communication equipment, aboveground conduit length per circuit, and average circuit length.

Figures 4.3-17 through 4.3-19 depict the layouts of the electrical buildings for the wet mechanical (forced) draft cooling option.

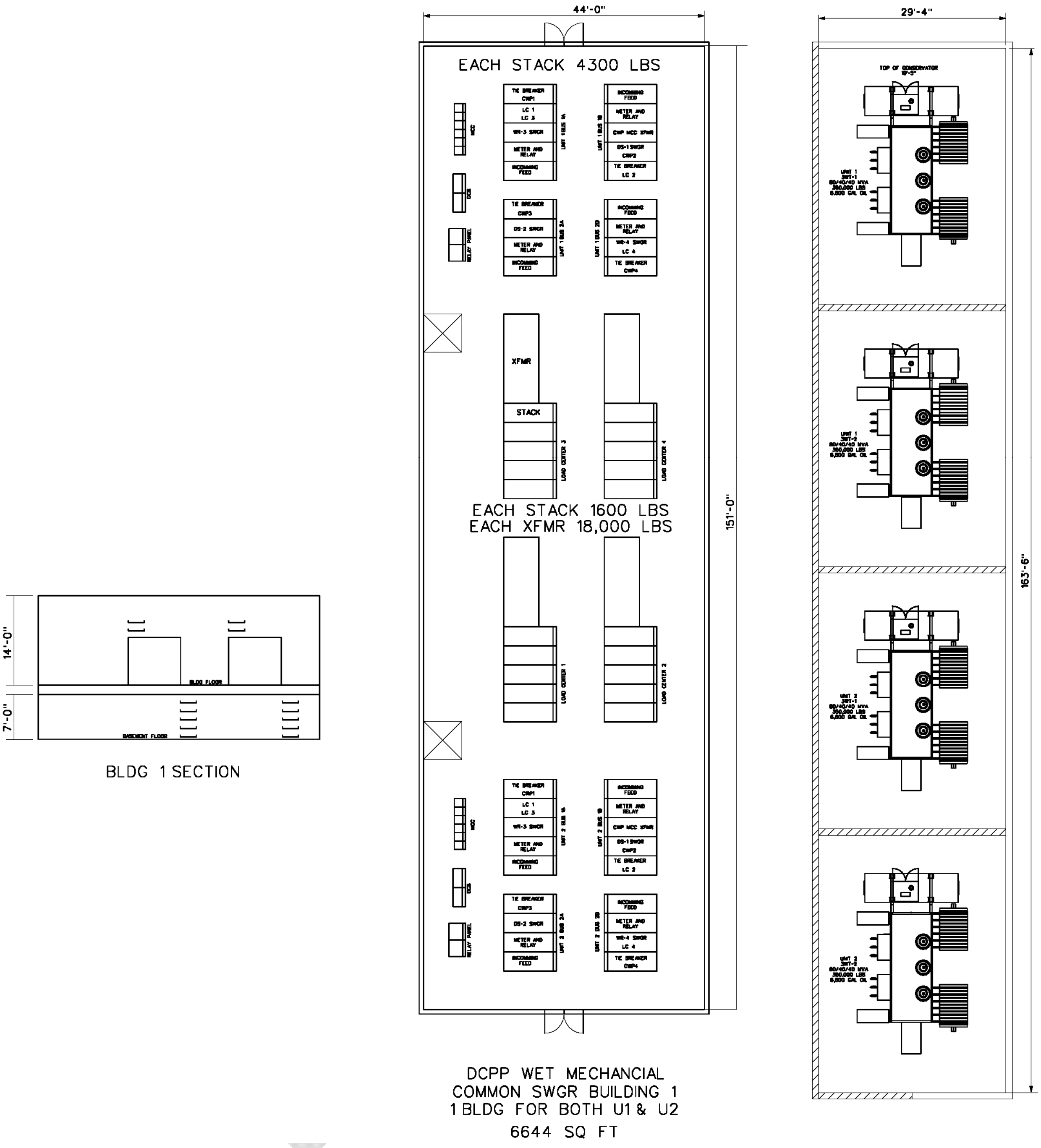


Figure 4.3-17. Wet Mechanical (Forced) Draft Cooling—Main Switchgear Electrical Building

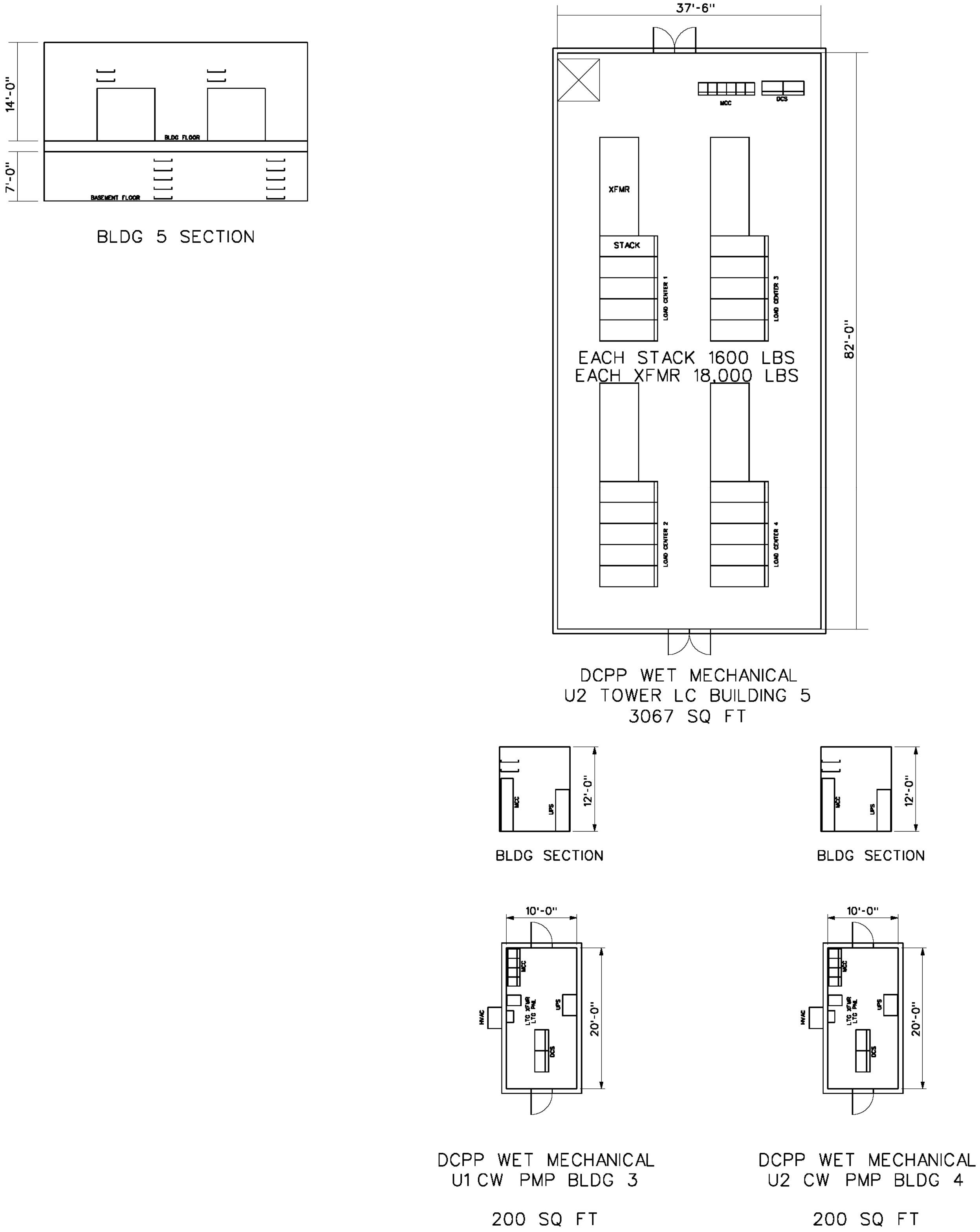


Figure 4.3-18. Wet Mechanical (Forced) Draft Cooling—Cooling Tower and Pumphouse Electrical Buildings

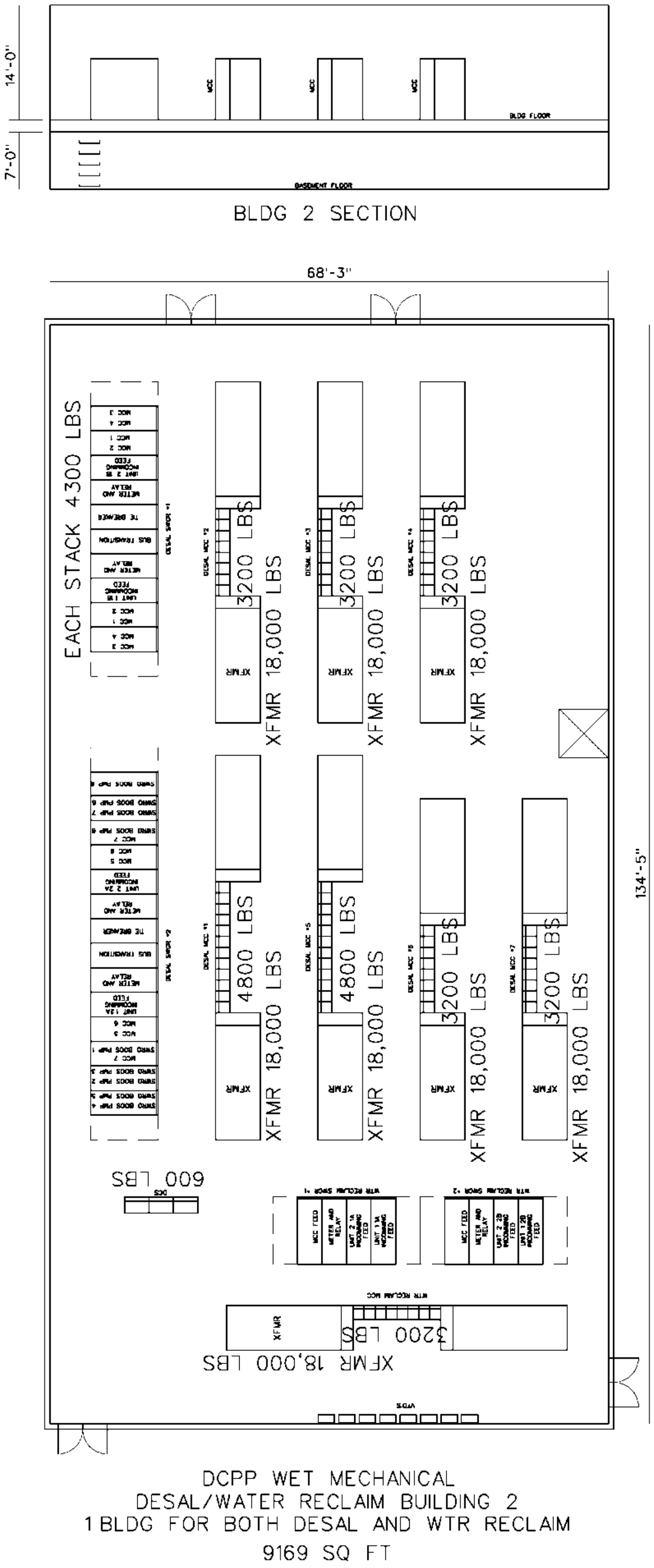


Figure 4.3-19. Wet Mechanical (Forced) Draft Cooling—Desalination/Water Reclaim Electrical Building

4.3.7 Hybrid Wet/Dry Cooling

P&I Schematic 25762-110-M6K-WL-00005 represents the CW piping arrangement for the hybrid wet/dry cooling arrangement. The hybrid wet/dry cooling variant is identical to the wet mechanical (forced) draft cooling variant except for the tower design. The tower would be fitted with an additional set of fans that would draw ambient air through fin-tube heat exchangers located above the cooling tower fill section to change the state of the air exiting the tower to minimize/eliminate the tower plume. One circular concrete hybrid wet/dry cooling tower 576 feet in diameter by 180 feet high would be required for each unit, resulting in a total of two towers. To provide the required air flow through the tower, each would have 40 fans associated with the wet section, each driven by a 300 hp motor, and 40 fans associated with the dry section, each driven by a 200 hp motor. The towers would be capable of maintaining a design cold CW temperature of 80.3°F. Refer to General Arrangement Drawings 25762-110-P1K-WL-00013, -00030, and -00031 for tower locations, pump locations, and pipe routings.

Two new shell-and-tube service water heat exchangers and one new condensate cooler per unit, all with increased surface area, would be provided. Each would provide a hot-side cold water temperature of 95°F at the original design duty.

Four new volute-style CW pumps would be provided per unit, each capable of a design CW flow of 218,250 gpm. Three vertical turbine saltwater supply pumps would be provided, each capable of a design flow rate of 36,800 gpm.

Equipment List 25762-110-M0X-YA-00005 provides additional details on the new mechanical equipment that would be furnished, and Valve List 25762-110-M6X-YA-00005 lists the new major valves that would be furnished.

4.3.7.1 Control System Design

The control system design approach for the hybrid wet/dry cooling technology is discussed in Section 4.3.2. The quantity of equipment required is adjusted to support the control needs of the given technology.

4.3.7.2 Civil Design

The method used to develop quantities for the variant technologies is discussed in Section 4.3.2. The quantities differ for each variant based on the size and spacing of the towers and the amount of support equipment required. The spacing and the equipment are shown on the general arrangement drawings referenced in each section. The tower foundations for the hybrid wet/dry cooling tower are based on preliminary supplier input. Two circular concrete cooling towers are proposed. The foundation design would consist of one concrete ring foundation to support the tower shell, a concrete slab on grade for a water basin, and an outfall concrete structure for the makeup water. For the cooling tower and piping general arrangement, refer to General Arrangement Drawing 25762-110-P1K-WL-00030.

4.3.7.3 Electrical Design

The electrical load for this option is estimated to be approximately 86 MVA per unit. In each unit, two new three-winding, 90 MVA transformers would feed the auxiliary loads (cooling tower fans, CW pumps, and desalination loads). The existing DCPP 500 kV switchyard would be expanded by two additional bays (breaker-and-a-half scheme) to provide the four circuits for the transformers. Refer to One Line Diagram 25762-110-E1K-0000-00005.

The four CW pumps would be fed from each of the secondary windings. The new electrical distribution voltage levels would be 12 kV (in line with the existing MV level at DCPP) for the large CW motors (11.5 kV) and the desalination and water reclaim systems, 480 V for the cooling tower fans and other cooling tower/CW pumphouse auxiliary equipment, and 120 V ac for smaller loads. There would be dedicated 125 V dc batteries (along with an associated battery charger) for critical UPS loads and control power for distribution equipment. The batteries would be sized for a 2-hour duration, and the charger would be sized to recharge them in 8 hours.

Mechanical equipment lists depicting the pumphouse power requirements, P&I schematics depicting the system components for the various options, general arrangement drawings depicting the plant design, and instrumentation list and quantities (by control system) were primarily the inputs for electrical design.

The existing 13,000 hp condenser CW pumps fed from 12 kV Bus D and 12 kV Bus E as well as from farther upstream transformer UAT 11 would be decommissioned and new 6,800 hp desalination seawater supply pumps would be fed from the same 12 kV Bus D and 12 kV Bus E, respectively. In all, there would be three desalination seawater supply pumps, two fed from one unit from the buses mentioned above and the third from the second unit. Because there is a net load reduction on upstream transformer UAT11, the load change is acceptable.

Based on the auxiliary system single-line design for hybrid wet/dry cooling, the number and size of electrical equipment were estimated and used to develop building sizes. Based on the number and size of conductors from the single-line drawing, the raceway system was designed and the quantities were estimated (trays/conduits within building, interconnecting duct banks). Supplier vendor drawings showing the layout of the hybrid cooling tower were used as appropriate for physical design quantity estimates. Five electrical buildings would be provided: one for the main switchgear and a cooling tower, one at the second cooling tower, one at each of the two CW pumphouses, and one at the desalination plant. Refer to Raceway Layout Drawing 25762-110-ERK-WL-00030.

The desalination and water reclaim vendors have provided estimates for the electrical equipment required for power distribution for their equipment. The desalination vendor provided a typical single-line diagram showing its electrical equipment configuration. The desalination/reclaim area electrical building size, tray quantity, and duct bank quantity were estimated from the desalination vendor typical single-line diagram, mechanical equipment lists, and vendor-supplied conceptual plant general arrangement drawings.

Quantity estimates were determined for the following items: tray, duct bank conduit, grounding, lighting, MV cable, nonsegregated phase bus duct, communication equipment, aboveground conduit length per circuit, and average circuit length.

Figures 4.3-20 through 4.3-22 depict the layouts of the electrical buildings for the wet natural draft cooling option.

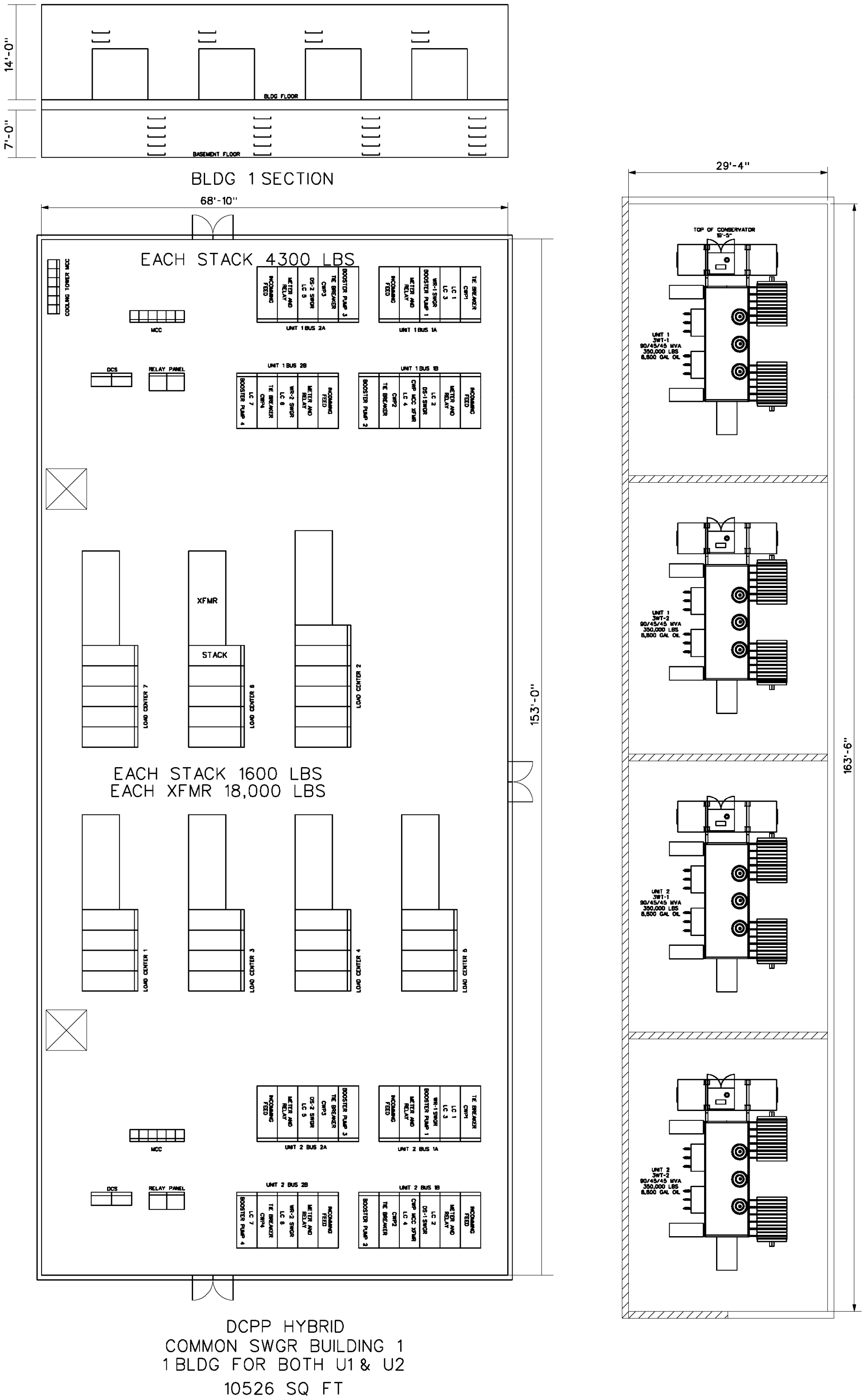


Figure 4.3-20. Hybrid Wet/Dry Cooling—Main Switchgear Electrical Building

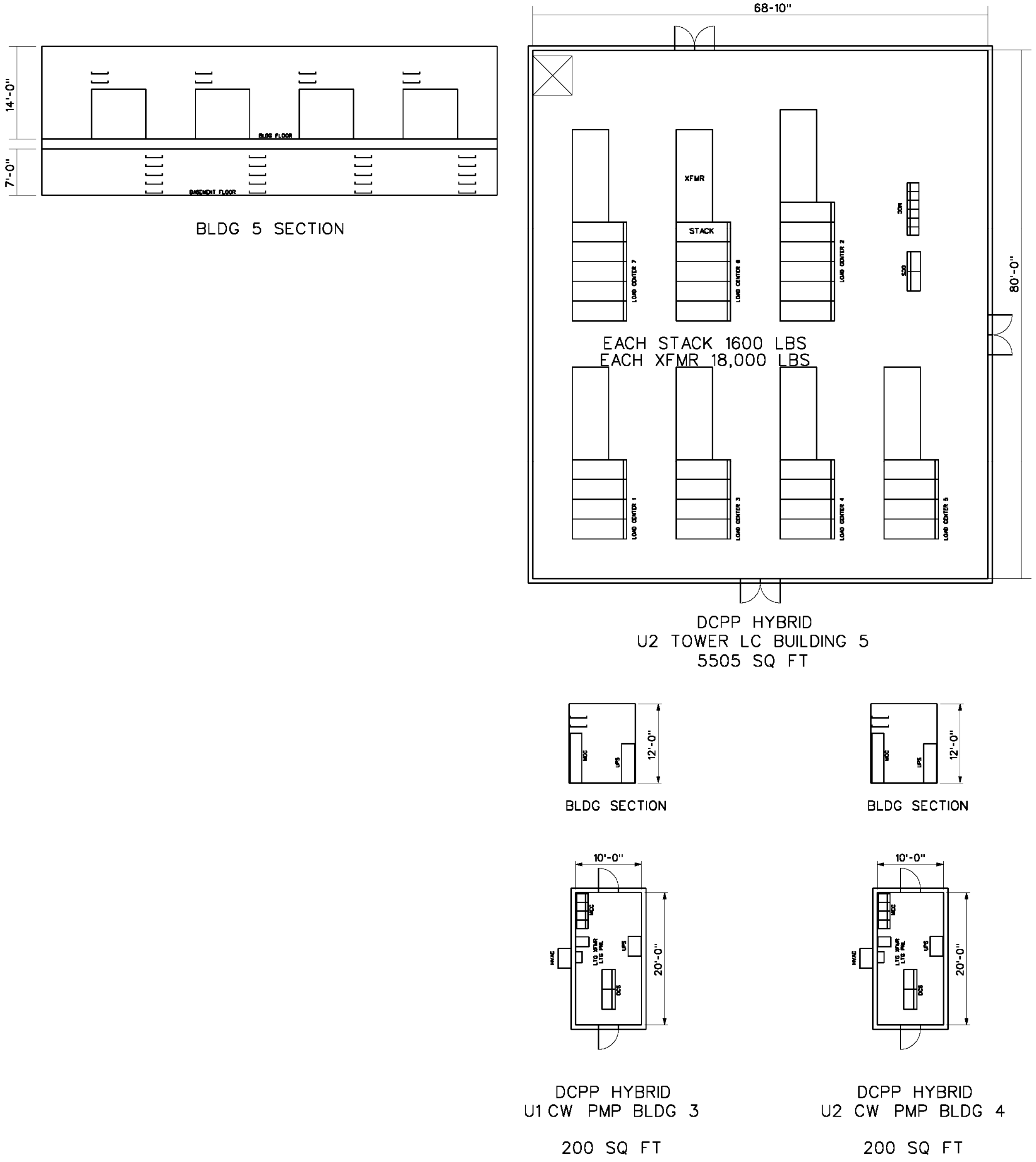


Figure 4.3-21. Hybrid Wet/Dry Cooling—Cooling Tower and Pumphouse Electrical Buildings

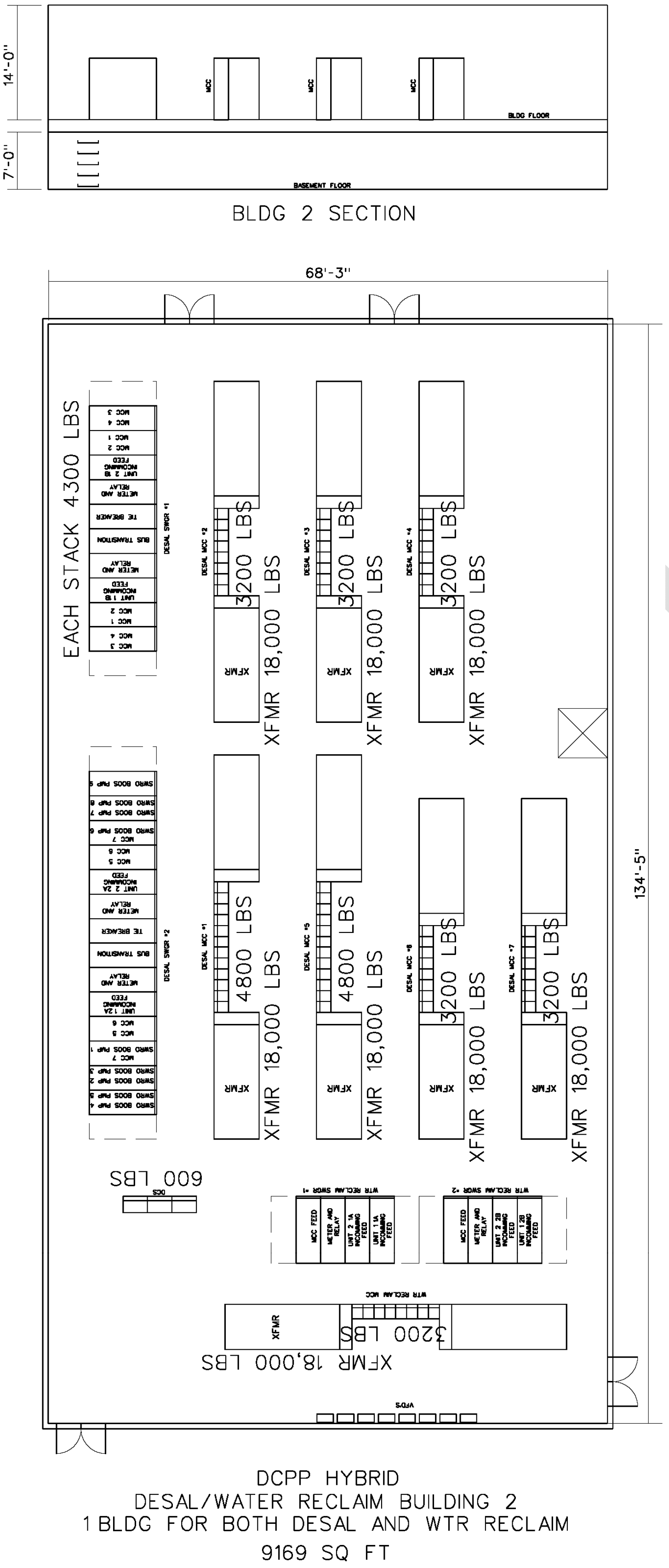


Figure 4.3-22. Hybrid Wet/Dry Cooling—Desalination/Water Reclaim Electrical Building

4.3.8 Permitting

The initial Phase 1 permitting assessment focused on identifying the applicable (required) permits and approvals for constructing and operating the various closed-cycle cooling technology options (passive draft dry/air, mechanical [forced] draft dry/air, wet natural draft, wet mechanical [forced] draft, and hybrid wet/dry). A comprehensive list of potentially applicable permits and approvals at the federal, California, county, and municipal levels (as applicable) was developed for each technology. The applicability of each permit/approval to the various options was evaluated. Those permits and approvals deemed applicable were subsequently scrutinized to characterize the expected duration and complexity of the regulatory review process. Ultimately, most of the closed-cycle cooling system options (except the saltwater-based systems) were selected for the Phase 2 assessment.

The subsequent permitting assessment focused on identifying the critical path (longest duration) initial preconstruction permitting processes and the associated project costs. The preconstruction permits are those approvals that directly support site mobilization, physical site access, and initial earthwork/foundations for the subject cooling system technology. The costs include direct permit filing, impact mitigation, and permitting application development (services).

4.3.8.1 Cost and Schedule Evaluation

The cost and schedule to secure the following major applicable permits were developed based on discussions with key relevant regulatory authorities and from associated website resources:

- CEQA – Final Notice of Determination
- Nationwide or Section 404/10 Permit, USACE
- Determination of No Hazard to Air Navigation, Federal Aviation Administration (FAA)
- CPUC
- Coastal Development Permit, CCC
- Coastal Development Lease, CSLC
- Notice of Intent, General Permit for Stormwater Discharges Associated with Construction Activity, CCRWQCB
- NPDES Industrial Discharge Permit, CCRWQCB and SWRCB
- 2081 Permit for California Endangered Species Act of 1984, CDFW
- Lake and Streambed Alteration (LSA) Agreement, CDFW
- Waste Discharge Requirements, CCRWQCB
- Dust Control Plan, SLO-APCD
- Road Crossing or Encroachment Permit, Caltrans
- Local Approvals, SLO

Tables CC-1 and CC-2 summarize the key cost and schedule details and assumptions for the selected closed-cycle cooling system options. Legal costs associated with managing appeal processes and related litigation have not been included. The bulk of the potential mitigation costs would be developed through negotiation and are consequently not included in the cost estimate.

Table CC-1. DCPP Environmental Permit/Approval Cost Assessment:
Dry/Air Cooling Technologies—Passive Draft and Mechanical (Forced) Draft

Permit/Approval	Cost Discussion	Responsibility	Permit Review Period	Filing Costs	Remediation or Mitigation Costs	Permitting Service Costs
Nationwide Permit – USACE	If applicable. There are no filing fees for the USACE permits and no EA document fees for nationwide form of the permit, which generally is not associated with a formal EA. Labor costs for preparing/submitting related forms = 20 hours @ $150/hr.	Owner	1–3 months if required	$0	Undetermined	$3,000
Section 7 Consultation with USFWS, Endangered Species Act of 1973	The USACE permit would provide sufficient “federal nexus” (federal funding, federal lands) to trigger USFWS consultation. Associated costs are inherent in the CEQA process.	Owner	May be part of CEQA review	$0	Undetermined	$0
CDFW Review	CDFW consultation will be conducted in parallel with the Section 7 review. CEQA document filing related fee ($2,995.50 and county clerk processing fee $50). (CDFW, 2013)	Owner	Part of CEQA Review	$3,050	Undetermined	$0
For Passive Draft Dry/Air Cooling only: Notice of Determination of No Hazard to Air Navigation – FAA	There are no formal filing fees associated with this Notice. Labor costs for preparing/submitting related forms = 4 hours @ $150/hr.	Owner	1–2 months	$0	Undetermined	$600
For Passive Draft Dry/Air Cooling only: Notice of Determination of No Hazard to Air Navigation – FAA, Temporary Construction Facilities	There are no formal filing fees associated with this Notice. Labor costs for preparing/submitting related forms = 4 hours @ $150/hr.	Contractor	1–2 months	$0	Undetermined	$600
CPUC Approval	While formal CPUC review and approval may prove necessary, the primary costs of this process are associated with the CEQA review process. The CPUC could be the lead CEQA agency or share this role with another regulatory organization (e.g., SLO). These CEQA costs are addressed in the County Conditional Use Plan Approval Process.	Owner	About 20–24 months if required	$0	Undetermined	$0

Permit/Approval	Cost Discussion	Responsibility	Permit Review Period	Filing Costs	Remediation or Mitigation Costs	Permitting Service Costs
Coastal Development Permit – CCC/Local Coastal Programs	The CCC indicates that the filing fee for non-residential development is $265,000 (CCC, 2008). There may be additional fees for reimbursement of reasonable expenses, including public notice costs. CEQA costs are covered in the County Condition Use Plan Approval Process. Labor costs for preparing/submitting related forms and documentation = 2,000 hours @ $150/hr.	Owner	A 3–9 month process is advertised, but it would be aligned with the CEQA review process	$265,000	Undetermined	$300,000
Coastal Development Lease – CSLC and potential CEQA Lead Agency	The Commission lease-related fees include (CSLC, 2011): Industrial Lease: $25,000 Dredge Lease Fee: $1,500 Filing Fee: $25 Labor costs for preparing/submitting related forms and documentation = 2,000 hours @ $150/hr.	Owner	Depends on duration of CEQA/EIR process; about 2 years	$26,525	Undetermined	$300,000
Dust Control Plan or CAMP – SLO-APCD	While SLO-APCD does not list any specific fee for the Dust Control Plan, other CARB entities are known to charge $300 to reimburse review costs. If the construction ozone precursor emissions (ROG + NO_X) exceed the SLO-APCD quarterly significance threshold of 6.3 tons, the SLO County CEQA Handbook (SLO-APCD, 2012) defined mitigation rate is $16,000 per ton of ozone precursor plus 15% administrative fee. The current assumption is that precursor emissions are below this threshold. Labor costs for preparing/submitting the plan = 80 hours @ $150/hr.	Contractor	1-month plan development process	$0	Undetermined	$12,000

Permit/Approval	Cost Discussion	Responsibility	Permit Review Period	Filing Costs	Remediation or Mitigation Costs	Permitting Service Costs
NPDES Industrial Discharge Permit – CCRWQCB and SWRCB	The operating project is incurring annual fees based on its current discharge process. Fee structure: $1,606 + $2,840 x flow (mgd) Maximum fee: $410,568 + surcharges ($5,000 to $15,000) (SWRCB, 2012) The fee would drop dramatically with the removal of the current substantial once–through discharge rate (about $400,000 savings). Labor costs for preparing/submitting related permit forms = 1,000 hours @ $150/hr.	Owner	About 6 months	–$400,000	Undetermined	$150,000
Notice of Intent – NPDES General Permit for Storm Water Discharges Associated with Construction Activity – CCRWQCB	Construction stormwater fee for disturbed areas > 100 acres is $2,618 + 21% fee ($550). Labor costs for preparing/submitting related forms = 40 hours @ $150/hr.	Owner	1 week – electronic submittal	$3,192	Undetermined	$6,000
Storm Water Pollution Prevention Plan (SWPPP) – NPDES General Permit for Storm Water Discharges Associated with Construction Activity – CCRWQCB	There are no direct filing fees or regulatory charges associated with the SWPPP. Labor costs for preparing plan = 120 hours @ $150/hr.	Contractor	3 months for SWPPP development process	$0	Undetermined	$18,000
2081 Permit for California Endangered Species Act of 1984 – CDFW	While there does not appear to be a direct filing fee for this permit, there are related CEQA review services: Negative or Mitigated Negative: $2,156.25 Environmental Impact Review: $2,995.25 Certified Regulatory Program Fee: $1,018.50 County Clerk Processing Fee: $50 (CDFW–CEQA, 2013) Labor costs for preparing/submitting related forms, documentation, and field work = 500 hours @ $150/hr.	Owner	Potentially part of CEQA review	$3,049.50	Undetermined	$75,000

Permit/Approval	Cost Discussion	Responsibility	Permit Review Period	Filing Costs	Remediation or Mitigation Costs	Permitting Service Costs
LSA Agreement – CDFW	If project costs > $500,000, then fees are $4,482.75 + $2,689.50. If there is a separate Master Agreement, the supplemental fees could total $33,620 + $2,801.50 + $280.25. (CDFW-LSA, 2013) Labor costs for preparing/submitting related forms, documentation, and field work = 500 hours @ $150/hr.	Owner	1–2 months (if application complete) Could extend to 4–6 months	$44,000	Undetermined	$75,000
Waste Discharge Requirements – CCRWQCB	Fill & Excavation Discharges: $944 + $4,059 x disturbed area (acres) Dredging Discharges: $944 + $0.15 x cy Channel and Shoreline Discharges: $944 + Discharge Length (ft) x $9.44 – not to exceed $59,000 + surcharges (CCR Title 23§2200) Assumed 100 acres of jurisdictional lands (state waters) are affected – triggers maximum fee (no extra surcharges). Labor costs for preparing/submitting related forms, documentation, and field work = 120 hours @ $150/hr.	Owner	4–6 months	$944	$59,000	$18,000
California Office of Historic Preservation (OHP) Review	OHP review is part of the CEQA process and does not demand any additional fees or pose direct regulatory costs. Labor costs are captured in CEQA discussion.	Owner	Integral to CEQA review process	$0	Undetermined	$0
Notification of Waste Activity – RCRA Hazardous Waste Identification Number (Small Quantity Generator) – Construction Phase – Department of Toxic Substance Control, USEPA, SLO-EHS – California Unified Program Agency	Securing the Construction Phase Hazardous Waste ID (if necessary) does not demand a filing fee. Labor costs for preparing/submitting related forms = 4 hours @ $150/hr.	Contractor	1–2 weeks if required	$0	Undetermined	$600

Permit/Approval	Cost Discussion	Responsibility	Permit Review Period	Filing Costs	Remediation or Mitigation Costs	Permitting Service Costs
Spill Prevention, Control, and Countermeasure (SPCC) Plan – 40 CFR 112 and Aboveground Petroleum Storage Act – SLO-EHS – California Unified Program Agency and USEPA	SPCC modification process would not demand any additional filing fees. Aboveground storage tank annual renewal fee ($288/facility) should remain unchanged – no new fee. (SLO-EHS, 2013) Labor costs for preparing/submitting related plan = 120 hours @ $150/hr.	Owner	1–2 months for plan revision	$0	Undetermined	$18,000
Underground Storage Tank Permit – SLO-EHS – California Unified Program Agency and SWRCB	The new cooling tower system could force the relocation of underground tanks, mandating new permits from the county and a revised inspection program. The associated fees may apply, primarily facility modification fee ($1,725/facility) and closure fee ($2,216/facility) (SLO-EHS, 2013). The maintenance fee ($0.14/gallon of oil) should remain unchanged (California Board of Equalization [CBOE], 2011). Labor costs for securing underground tank permits (modification/closure) = 40 hours @ $150/hr.	Owner	1–2 months	$3,941	Undetermined	$6,000
Conditional Use Plan Amendment – SLO-DPB and Potential CEQA Lead Agency	As the CEQA lead agency or co-lead, the county would assess fees for development of the Initial Study, environmental coordination fees, and EIR processing fees (SLO-DPB, 2012). Initial Study Cost: $14,603 Other fees include: CalFire Review: $603 Health Department Review: $600 Geological Review: $2,671 (minimum) Resource Conservation District Review: $375 (minimum) Labor costs for EIR consultant + 50% premium = 4,000 hours @ 150/hr x 1.5.	Owner	Depends on duration of CEQA review process; about 2 years	$20,000	Undetermined	$900,000
Erosion and Sediment Control Plan (Rain Event Action Plan) – SLO-DPW	No filing fee for this plan. Development costs are included in the SWPPP section.	Contractor	Parallel to SWPPP development 3 months	$0	Undetermined	$0

Permit/Approval	Cost Discussion	Responsibility	Permit Review Period	Filing Costs	Remediation or Mitigation Costs	Permitting Service Costs
Building Permits – SLO-DPB and SLO-DPW: Grading Site Plan Reviews/Checks Mechanical, Plumbing, and Electrical Tanks Roads Septic Systems Fences Fire inspections	SLO-DPB has a complex fee schedule (SLO-DPB, 2012). Recent SLO County experience on a significant solar PV project indicates that overall building permit and inspection fees could total $750,000. Labor costs for preparing/submitting related engineering packages = 2,000 hours @ $150/hr.	Contractor	4–6 weeks for initial permits following completion of CEQA and conditional use permit	$750,000	Undetermined	$300,000
Fire Safety Plan Approval, Certificate of Occupancy, Flammable Storage – SLO Fire Department	Revisions to the existing Fire Safety Plan are not expected to result in additional filing or direct regulatory fees. The initial filing fee of $408 would probably not apply. Labor costs for revising Fire Safety Plan = 20 hours @ $150/hr.	Contractor	1 month for plan approval	$0	Undetermined	$3,000
Road Crossing or Encroachment Permit – Caltrans, SLO	If needed. Caltrans fees vary by type of encroachment and are based on $82/hr review-and-approval fee. County encroachment permits are: Driveway review and encroachment: $607 General encroachment: $338 Utility non-franchise: $597 (Caltrans Encroachment, 2013) (Caltrans FAQ, 2013) Labor costs for preparing/submitting related engineering information and forms = 40 hours @ $150/hr.	Owner	1–3 months	$5,000	Undetermined	$6,000
SLO Well Water Permit – SLO-EHS	If needed. New well installation: $433 Abandonment of existing wells: $121 (SLO-EHS, 2013) Well-related costs assumed to be $1,000. Labor costs for preparing/submitting well packages = 8 hours @ $150/hr.	Contractor	1–2 weeks if required	$1,000	Undetermined	$1,200
Passive Draft Dry/Air TOTAL				**$722,651.50**	**$59,000.00**	**$2,193,000.00**
Mechanical (Forced) Draft Dry/Air TOTAL				**$722,651.50**	**$59,000.00**	**$2,191,800.00**

Table CC-2. DCPP Environmental Permit/Approval Cost Assessment:
Wet Cooling Technologies—Natural Draft, Mechanical (Forced) Draft, and Hybrid Wet/Dry (Fresh and Reclaimed Water)

Permit/Approval	Cost Discussion	Responsibility	Permit Review Period	Filing Costs	Remediation or Mitigation Costs	Permitting Service Costs
Nationwide Permit –USACE	If applicable. There are no filing fees for the USACE permits and no EA document fees for nationwide form of the permit, which generally is not associated with a formal EA. Labor costs for preparing/submitting related forms – 20 hours @ $150/hr.	Owner	1–3 months if required	$0	Undetermined	$3,000
Section 7 Consultation with USFWS, Endangered Species Act of 1973	The USACE permit would provide sufficient “federal nexus” (federal funding, federal lands) to trigger USFWS consultation. Associated costs are inherent in the CEQA process.	Owner	May be part of CEQA review	$0	Undetermined	$0
For Wet Natural Draft Cooling Towers only: Notice of Determination of No Hazard to Air Navigation – FAA	There are no formal filing fees associated with this Notice. Labor costs for preparing/submitting related forms = 4 hours @ $150/hr.	Owner	1–2 months	$0	Undetermined	$600
For Wet Natural Draft Cooling Towers only: Notice of Determination of No Hazard to Air Navigation – FAA, Temporary Construction Facilities	There are no formal filing fees associated with this Notice. Labor costs for preparing/submitting related forms = 4 hours @ $150/hr.	Owner	1–2 months	$0	Undetermined	$600
CPUC Commission Approval	While formal CPUC review and approval may prove necessary, the primary costs of this process are associated with the CEQA review process. The CPUC could be the lead CEQA agency or share this role with another regulatory organization (e.g., CCC, SLO). These CEQA costs are addressed in the County Conditional Use Plan Approval Process.	Owner	About 20–24 months if required	$0	Undetermined	$0

Permit/Approval	Cost Discussion	Responsibility	Permit Review Period	Filing Costs	Remediation or Mitigation Costs	Permitting Service Costs
Coastal Development Permit – CCC/Local Coastal Programs	The CCC indicates that the filing fee for non-residential development is $265,000 (CCC, 2008). There may be additional fees for reimbursement of reasonable expenses, including public notice costs. CEQA costs are covered in the County Condition Use Plan Approval Process. Labor costs for preparing/submitting related forms and documentation = 2,000 hours @ $150/hr.	Owner	A 3–9 month process is advertised, but it would be aligned with CEQA review process	$265,000	Undetermined	$300,000
Coastal Development Lease – CSLC and potential CEQA Lead Agency	The Commission lease related fees include (CSLC-2011): Industrial Lease: $25,000 Dredge Lease Fee: $1,500 Filing Fee: $25 Labor costs for preparing/submitting related forms and documentation = 2,000 hours @ $150/hr.	Owner	Depends on duration of CEQA/EIR process; about 2 years	$26,525	Undetermined	$300,000
Regional Pollution Control District Permit to Construct (ATC) – SLO-APCD	The SLO-APCD standard filing fee ($195) is somewhat incidental (SLO-APCD, 2011). The evaluation fee is on a time-and-materials basis and can be in the order of $20,000 to $30,000 ($115/hr). Additionally, the fees associated with securing the necessary PM-10 credits have a recent average price of $20,000/ton in the Santa Barbara APCD (CARB, 2011). Cooling tower PM 10 emissions are estimated to total about 30 tons annually, which is less than the current local 31-ton emission offset bank. There have not been any recent PM-10 ERC sales in SLO-APCD. Labor costs for preparing/submitting related forms and documentation = 500 hours @ $150/hr.	Owner	6–12 months	$31,000	$480,000	$75,000

Permit/Approval	Cost Discussion	Responsibility	Permit Review Period	Filing Costs	Remediation or Mitigation Costs	Permitting Service Costs
Regional Control District Permit to Operate (PTC) – SLO-APCD	The SLO-APCD standard filing fee ($195) is somewhat incidental (SLO-APCD, 2011). The evaluation fee is on a time-and-materials basis and can be in the order of $20,000 to $30,000 (115/hr). The emission reduction credits fees associated with PM-10 are paid in the ATC phase of air permitting. Labor costs for preparing/submitting related forms and documentation = 200 hours @ $150/hr.	Owner	Not preconstruction permit	$31,000	Undetermined	$30,000
Title V Federal Operating Permit – SLO-APCD and USEPA	Assuming 7,000 mg/l TDS from freshwater application, the total particulate emissions (132 tpy) exceed 100 tpy, which makes this a major source if one conservatively assumes all PM is PM-10. Federal Presumptive Fee: $46.73/ton for Title V permits Labor costs for preparing/submitting related forms and documentation = 200 hours @ $150/hr.	Owner	Not preconstruction permit	$6,170	Undetermined	$30,000
Dust Control Plan or CAMP – SLO-APCD	While SLO-APCD does not list any specific fee for the Dust Control Plan, other CARB entities are known to charge $300 to reimburse review costs. If the construction ozone precursor emissions (ROG + NO_x) exceed the SLO-APCD quarterly significance threshold of 6.3 tons, the SLO County CEQA Handbook (SLO-APCD, 2012) defined mitigation rate is $16,000 per ton of ozone precursor, plus 15% administrative fee. The current assumption is that precursor emissions are below this threshold. Labor costs for preparing/submitting the plan = 80 hours @ $150/hr.	Contractor	1-month plan development process	$0	Undetermined	$12,000

Permit/Approval	Cost Discussion	Responsibility	Permit Review Period	Filing Costs	Remediation or Mitigation Costs	Permitting Service Costs
NPDES Industrial Discharge Permit – CCRWQCB and SWRCB	The operating project is incurring annual fees based on its current discharge process. Fee structure: $1,606 + $2,840 x flow (mgd) Maximum fee: $410,568 + surcharges ($5,000 to $15,000) (SWRCB, 2012) The fee would drop dramatically with the removal of the current substantial once–through discharge rate (about $400,000 savings). Labor costs for preparing/submitting related permit forms = 1,000 hours @ $150/hr.	Owner	About 6 months	–$400,000	Undetermined	$150,000
Notice of Intent – NPDES General Permit for Storm Water Discharges Associated with Construction Activity – CCRWQCB	Construction stormwater fees for disturbed areas > 100 acres is $2,618 + 21% fee ($550). Labor costs for preparing/submitting related forms = 40 hours @ $150/hr.	Owner	1 week – electronic submittal	$3,192	Undetermined	$6,000
SWPPP – NPDES General Permit for Storm Water Discharges Associated with Construction Activity – CCRWQCB	There are no direct filing fees or regulatory charges associated with the SWPPP. Labor costs for preparing plan = 120 hours @ $150/hr.	Contractor	3 months for SWPPP development process	$0	Undetermined	$18,000
2081 Permit for California Endangered Species Act of 1984 – CDFW	While there does not appear to be a direct filing fee for this permit, there are related CEQA review services: Negative or Mitigated Negative: $2,156.25 Environmental Impact Review: $2,995.25 Certified Regulatory Program Fee: $1,018.50 County Clerk Processing Fee: $50 (CDFW–CEQA, 2013) Labor costs for preparing/submitting related forms, documentation, and field work = 500 hours @ $150/hr.	Owner	Potentially part of CEQA review	$3,049.50	Undetermined	$75,000

Permit/Approval	Cost Discussion	Responsibility	Permit Review Period	Filing Costs	Remediation or Mitigation Costs	Permitting Service Costs
LSA Agreement – CDFW	If project costs > $500,000, then fees are $4,482.75 + $2,689.50. If a separate Master Agreement, the supplemental fees could total $33,620 + $2,801.50 + $280.25. (CDFW, 2013) Labor costs for preparing/submitting related forms, documentation, and field work = 500 hours @ $150/hr.	Owner	1–2 months (if application complete) Could extend to 4–6 months	$44,000	Undetermined	$75,000
Waste Discharge Requirements – CCRWQCB	Fill & Excavation Discharges: $944 + $4,059 x disturbed area (acres) Dredging Discharges: $944 + $0.15 x cy Channel and Shoreline Discharges: $944 + Discharge Length (ft) x $9.44 – not to exceed $59,000 + surcharges (CCR Title 23§2200) Assumed 100 acres of jurisdictional lands (state waters) are affected – triggers maximum fee (no extra surcharges). Labor costs for preparing/submitting related forms, documentation, and field work = 120 hours @ $150/hr.	Owner	4–6 months	$944	$59,000	$18,000
California OHP Review	OHP review is part of the CEQA process and does not demand any additional fees or pose direct regulatory costs. Labor costs are captured in CEQA discussion.	Owner	Integral to CEQA review process	$0	Undetermined	$0
Notification of Waste Activity – RCRA Hazardous Waste Identification Number (Small Quantity Generator) – Construction Phase – Department of Toxic Substance Control, USEPA, SLO-EHS – California Unified Program Agency	Securing the Construction Phase Hazardous Waste ID (if necessary) does not demand a filing fee. Labor costs for preparing/submitting related forms = 4 hours @ $150/hr.	Contractor	1–2 weeks if required	$0	Undetermined	$600

Permit/Approval	Cost Discussion	Responsibility	Permit Review Period	Filing Costs	Remediation or Mitigation Costs	Permitting Service Costs
SPCC Plan – 40 CFR 112 and Aboveground Petroleum Storage Act – SLO-EHS – California Unified Program Agency and USEPA	SPCC modification process would not demand any additional filing fees. Aboveground storage tank annual renewal fee ($288/facility) should remain unchanged – no new fee. (SLO-EHS, 2013) Labor costs for preparing/submitting related plan = 120 hours @ $150/hr.	Owner	1–2 months for plan revision	$0	Undetermined	$18,000
Underground Storage Tank Permit – SLO-EHS – California Unified Program Agency and SWRCB	The new cooling tower system could force the relocation of underground tanks, mandating new permits from the county and a revised inspection program. The associated fees may apply, primarily the facility modification fee ($1,725/facility) and closure fee ($2,216 per facility) may apply (SLO-EHS, 2013). The maintenance fee ($0.14/gallon of oil) should remain unchanged (CBOE, 2011). Labor costs for securing underground tank permits (modification/closure) = 40 hours @ $150/hr.	Owner	1–2 months	$3,941	Undetermined	$6,000
Conditional Use Plan Amendment – SLO-DPB and Potential CEQA Lead Agency	As the CEQA lead agency or co-lead, the county would assess fees for development of the Initial Study, environmental coordination fees, and EIR processing fees (SLO-DPB, 2012). Initial Study Cost: $14,603 Other fees include: CalFire Review: $600 Health Department Review: $600 Geological Review: $2,671 (minimum) Resource Conservation District Review: $375 (minimum) Labor costs for EIR consultant + 50% premium = 4,000 hours @ $150/hr x 1.5.	Owner	Depends on duration of CEQA review process; about 2 years	$20,000	Undetermined	$900,000
Erosion and Sediment Control Plan (Rain Event Action Plan) – SLO-DPW	No filing fee for this plan. Development costs are included in the SWPPP section.	Contractor	Parallel to SWPPP development 3 months	$0	Undetermined	$0

Permit/Approval	Cost Discussion	Responsibility	Permit Review Period	Filing Costs	Remediation or Mitigation Costs	Permitting Service Costs
Building Permits – SLO-DPB and SLO-DPW: Grading Site Plan Reviews/Checks Mechanical, Plumbing, and Electrical Tanks Roads Septic Systems Fences Fire inspections	SLO-DPB has a complex fee schedule (SLO-DPB, 2012). Recent SLO County experience on a significant solar PV project indicates that overall building permit and inspection fees could total $750,000 for onsite work. Offsite fresh or reclaimed water pipeline building permits would add substantial costs (about $500,000). Labor costs for preparing/submitting related engineering packages = 3,000 hours @ $150/hr.	Contractor	6 months for initial permits following completion of CEQA and conditional use permit	$1,250,000	Undetermined	$450,000
Fire Safety Plan Approval, Certificate of Occupancy, Flammable Storage – SLO Fire Department	Revisions to the existing Fire Safety Plan are not expected to result in additional filing or direct regulatory fees. The initial filing fee of $408 would probably not apply. Labor costs for revising Fire Safety Plan = 20 hours @ $150/hr.	Contractor	1 month for plan approval	$0	Undetermined	$3,000
Road Crossing or Encroachment Permit (Caltrans, SLO)	If needed. Caltrans fees vary by type of encroachment and are based on $82/hr review-and-approval fee. County encroachment permits are: Driveway review and encroachment: $607 General encroachment: $338 Utility non-franchise: $597 (Caltrans Encroachment, 2013) (Caltrans FAQ, 2013) Labor costs for preparing/submitting related engineering information and forms = 40 hours @ $150/hr.	Owner	1–3 months	$5,000	Undetermined	$6,000
SLO Well Water Permit – SLO-EHS	If needed. New well installation: $433 Abandonment of existing wells: $121 (SLO-EHS, 2013) Well related costs assumed to be $1,000. Labor costs for preparing/submitting well packages = 8 hours @ $150/hr.	Contractor	1–2 weeks if required	$1,000	Undetermined	$1,200

Permit/Approval	Cost Discussion	Responsibility	Permit Review Period	Filing Costs	Remediation or Mitigation Costs	Permitting Service Costs
Wet Natural Draft TOTAL				**$1,290,821.50**	**$539,000.00**	**$2,478,000.00**
Wet Mechanical (Forced) Draft TOTAL				**$1,290,821.50**	**$539,000.00**	**$2,476,800.00**
Hybrid Wet/Dry TOTAL				**$1,290,821.50**	**$539,000.00**	**$2,476,800.00**

4.3.8.2 Summary

The list of potentially applicable federal, state, and local permits for the closed-cycle cooling system options reflects the expected significant impacts to the onshore and near-shore environment. The efforts to conduct a successful CEQA review would be the primary critical path permitting process. The CEQA lead agency may be a shared responsibility among a number of key regulatory departments (e.g., SLO, CSLC). The requisite USACE Section 404 permit, CCC Coastal Development Permit, CSLC Lease, and NPDES permit modification would have potentially lengthy review processes but would all be essentially bounded by the critical path CEQA/EIR review process.

The CEQA review process duration varies. The shortest path appears to be a nominal 210-day (7-month) period that would include the minimum 30-day review period to determine that the initial CEQA application is complete. This process culminates in a Negative Declaration and does not involve developing a comprehensive EIR. However, all of the closed-cycle cooling processes under consideration would likely demand preparation of an EIR, which would further extend this review process. The process—inclusive of the initial 30-day completeness review, a 1-year EIR review, and a so-called 90-day “reasonable extension” triggered by compelling circumstances recognized by both the applicant and lead agency—would then extend out to 16 months. (CEQA Flowchart)

The CEQA review process would be extended even further by conservatively adding an additional 8 months to cover “unreasonable delays” ostensibly associated with the applicant’s difficulty in supplying requested information. Collectively, this longer and probably more applicable 2-year CEQA review process would likely follow a 1-year period of permit application development. The other permitting processes are assumed to proceed in parallel to the critical path CEQA review process. While there could be some variation on the permitting timeline for the various closed-cycle cooling systems under consideration, such variation would be effectively enveloped by the lengthened CEQA review process.

The total permit filing and permitting service costs associated with the various closed-cycle cooling system options does vary. The permitting costs for the dry cooling options total about $3.0 million. The permitting costs for the wet cooling options increase to $4.3 million in response to the additional costs associated with the offsite reclaimed water pipelines. As noted earlier, the overall 3-year permitting process and associated costs do not reflect the impact of permit appeals, litigation, or potentially negotiated CEQA-related mitigation fees. In recognition that such complications may occur, the project execution schedule includes a 1-year appeal period following the CEQA final decision.

4.3.8.3 Sources

1. California Air Resources Board (CARB) Emission Reduction Offset Transaction Costs Summary Report for 2011.

2. California Board of Equalization (CBOE) Underground Storage Tank Maintenance Fee – as of June 30, 2011 (http://www.boe.ca.gov/info/fact_sheets/underground_strg_tank_maint.htm).

3. California Coastal Commission (CCC) Permit Application Instructions, Appendix E Filing Fee Schedule (3/17/2008).

4. California Department of Fish and Wildlife CEQA Document Filing Fees, 2013 http://www.dfg.ca.gov/habcon/ceqa/ceqa_changes.html.

5. California Code of Regulations (CCR) Title 23§2200 Annual Fee Schedules - Subpart a(3) Dredge and Fill Materials.

6. California Department of Fish and Wildlife (CDFW) Document Filing Fees (www.dfg.ca.gov/habcon/ceqa/ceqa_changes.html), April 3, 2013.

7. California Department of Fish and Wildlife (CDFW) Lake and Streambed Alteration Agreements and Fees (http://www.nrm.dfg.ca.gov/FileHandler.ashx?DocumentID37872), April 3, 2013.

8. California Department of Transportation (Caltrans) Encroachment Permits (www.dot.ca.gov/hq/traffops/developserv/permits), April 3, 2013.

9. California Department of Transportation (Caltrans) FAQ #2 (www.dot.ca.gov/hq/traffops/permits/faq.htm). April 3, 2013.

10. California State Lands Commission (CSLC), Land Management Division Application Guidelines (10/12/2011).

11. California State Water Resources Control Board (SWRCB) Fee Schedule 2012–2013, 2012 http://www.swrcb.ca.gov/resources/fees/docs/fy12_13_fee_schedule_npdes_permit.pdf.

12. California Environmental Quality Act (CEQA) Flowchart for Local Agencies: California Code - Section 21151.5, http://www.ceres.ca.gov/planning/ceqa/flowchart.html.

13. San Luis Obispo County Air Pollution Control District (SLO-APCD) CEQA Air Quality Handbook – A Guide For Assessing the Air Quality Impacts for Projects Subject to CEQA Review, April 2012.

14. San Luis Obispo County Air Pollution Control District (SLO-APCD) Rule 302 Schedule of Fees, July 27, 2011.

15. San Luis Obispo County Department of Planning and Building (SLO-DPB) – Fee Schedule 2012–2013, 2012.

16. San Luis Obispo County Environmental Health Services (SLO-EHS) Fees – Aboveground and Underground Storage Tanks (http://www.slocounty.ca.gov/Assets/AD/Fees/12-13+Fees/Schedule+B+Fees/160+PH+-+Environmental+Hlt+fee+workbook+FY12-13.pdf), April, 3 2013.

5 Construction Approach

The general construction approach for the onshore mechanical fine mesh screen and closed cooling technologies is to perform as much construction work as possible during nonoutage periods. The nonoutage work schedule is estimated to be two shifts working 5 days per week, 10 hours per day. During outage periods, the work schedule would be adjusted to working 24 hours per day, 7 days per week to minimize outage durations while adhering to regulatory fatigue rules in performing work on or near safety-related SSCs.

In the case of the modular wedge wire/tunnel technology installation, unit outages would not be required, and marine construction work hours would be adjusted in response to weather conditions.

5.1 Onshore Mechanical (Active) Intake Fine Mesh Screening Technology

The primary construction work components of this technology option are the modifications to the existing DCPP once-through cooling system screens, which consist of the following:

- Replacement of six of the existing once-through traveling screens associated with Unit 1 and six of the screens associated with Unit 2 with larger dual-flow traveling screens
- Addition of one additional screen wash pump for each unit, below the concrete deck to support the increased screen wash and fish wash return flows associated with the traveling screen replacement
- Replacement of the existing Units 1 and 2 traveling screen control panel with seven new panels for each unit (one for each new traveling screen and one for the remaining once-through traveling screen)
- Replacement of the existing screen wash pump control panels for Units 1 and 2 by adding new panels to control the new pumps
- Addition of one automatic backwash strainer on the screen wash supply line to the Unit 1 screen, and one on the Unit 2 screens
- Addition of a new trash trough on top of concrete deck for Unit 1 and Unit 2 to collect the trash from the screens and transport it to the existing trash grinder located in the intake structure between the Units 1 and 2 traveling screens
- Addition of fish return trough above the concrete deck to direct the fish return flow from the new Units 1 and 2 dual-flow screens to the north-end intake structure
- Installation of the Units 1 and 2 fish return systems to north of the plant intake cove through a single pipe/trough
- Removal and disposal of the existing traveling screens
- Concrete cutting and structural modification of the existing intake deck at the new traveling fine mesh screen locations to fit the larger screens
- Modification of the existing screen wash piping
- Removal and reinstallation/relocation of existing forebay level sensors

The construction approach for the onshore mechanical (active) intake fine mesh screening technology would be to complete the installation work on the new systems for Units 1 and 2 during nonoutage periods. The partial unit outages would consist of reducing the output of one unit to between 50% and 60% power and taking one CW pump out of service at a time, installing three screens in three dewatered bays, starting up the three screens and CW pump, then moving to the next pump and three bays and installing and starting up the next three screens. Unit 1 would be completed first, followed by Unit 2.

5.1.1 Fish Recovery System

The nonoutage construction work operations would begin with the installation of fish recovery system conduit that is approximately 1,020 feet long from the intake structure to the end of the new discharge point, with an invert elevation of -12 feet below water level. From the intake structure, a 36-inch-diameter, aboveground FRP pipe, setting on foundations and pipe supports every 20 feet, would be routed approximately 360 feet north to a 5-foot-diameter 20-foot-deep drop shaft. From the bottom of the drop shaft (See Drawing 25762-110-P1K-WL-00071), a 5-foot-diameter tunnel would be bored and lined to the discharge point consisting of a headwall and reinforced concrete pipe covered with armor stone. The headwall and concrete pipe would be set by divers, and the armor stone would be set from a barge. The drop shaft and concrete tunnel conduit would be lined with an HDPE liner. The fish recovery piping on the intake structure would be supported a minimum of 4 feet above the concrete deck on hangers and begin at Unit 2 with 28-inch diameter FRP pipe to provide 3,600 gpm flow and transition to a 36-inch-diameter pipe to provide 7,200 gpm flow. A large portion of the 176 electrical circuits, including conduit, wire, and grounding are necessary for the installation of seven control panels for each unit. Piping commodities for the new system and the screen wash system would be installed during nonoutage periods and terminated during the outage. Construction work would also include the addition of a new concrete trash trough on top of the existing intake deck to collect trash from the screens, which transport the trash to the existing trash grinder located in the intake structure between the Units 1 and 2 traveling screens. The trash trough would be formed and concrete would be placed during nonoutage periods.

5.1.2 Dual-Flow Traveling Screens

The existing single-flow traveling screen deck opening size is 5 feet 4 inches x 11 feet 3 inches with the longer length running north and south. The new dual-flow traveling screen requires an 8-foot 6-inch x 15-foot 6-inch opening size in the 2-foot-thick concrete deck slab with the longer length running east and west. The construction approach would be to wire saw cut and lift sections of the reinforced concrete deck to enlarge the openings. This work would be performed during nonoutage periods.

The construction approach for the installation of the six new dual-flow screens in each unit would be to schedule partial unit outages to complete the balance of the installations. The partial unit outages would consist of bringing Unit 1 to between 50% and 60% power and taking one CW pump out of service at a time. The partial outage work would begin by taking CW pump 1-2 out of service first, since this will facilitate the installation of the new screen wash pump for Unit 1. Installation of stop logs and sealing off the ocean intake flow in three bays are necessary to dewater one half of the unit’s intake structure. Three screens would be installed in three dewatered bays, the three screens and CW pump would be started up, and then, moving to the next pump and three bays, the next three screens would be installed and started up. Unit 1 would be completed first, followed by Unit 2.

Once the intake is dewatered, the existing traveling screens would be removed and disposed of. The intake well interior would then be cleaned via hydro lasers, and resulting marine growth would be vacuumed and disposed of. Concrete would be formed and placed in the void areas left from the old screen locations. The new screen support mounts and anchors would be installed, the frames erected, the screens mounted, and the connecting piping and differential level control mounting brackets and instruments installed. The electrical terminations would then be made to the control panels and integrated with the existing CW pump controls.

To facilitate the installation of the new screen wash pumps, a 30-inch-diameter slab penetration will be core drilled in the deck at elevation -2.1’ in the Unit 1 pumphouse and then subsequently in Unit 2. The pump foundation base will be placed, the new pump shaft suction will be extended to elevation -13’, and the new pumps will be assembled. The pump wash piping will be piped in series to the existing screen wash system and the backwash strainers will be installed. Once the new system is operable, the existing traveling screen control panels would be removed and existing screen wash pump controls abandoned in place on the existing panels.

5.2 Offshore Modular Wedge Wire Screening Technology

The major modular wedge wire screening technology construction work components consist of:

- Geophysical subsurface investigation borings and bathometric survey
- Installation of the drop shaft cofferdam in the intake cove
- Installation of the main tunnel drop and construction access shafts by sequential excavation, drilling and shooting, shaft wall forming, and concrete placements to the tunnel invert elevation of -220’
- Installation of the top heading crown, first and second bench, and starter tunnel by drilling, shooting, excavation, and material removal
- Installation of the concrete wall liner in the starter tunnel
- Installation of tunnel boring machine rails
- Assembly of tunnel boring machine (TBM) and conveyor system
- Installation of auxiliary air and pumping systems
- Boring of the 30-foot-diameter tunnel approximately 1,000 feet
- Disposal of excavated material off site
- Installation of rock bolts and ceiling reinforcement supports
- Lining of tunnel as necessary
- Disassembly and removal of conveyor, TBM, and rail system
- Installation of the six 12-foot-diameter offshore intake drop shafts
- Installation of connection piping laterals to intake drop shafts
- Installation of wedge wire screens and armor protection of piping
- Modification and flood-up of main drop shaft

- Installation of cofferdam for emergency backup water supply
- Installation of reinforced concrete emergency water structure
- Installation of the enclosed shoreline breakwater
- Installation of interior breakwater seal liner

The construction approach for the installation offshore modular wedge wire screening technology would be to complete the entire marine construction installation without a unit outage.

5.2.1 Installation of Main Intake Tunnel Drop Shaft

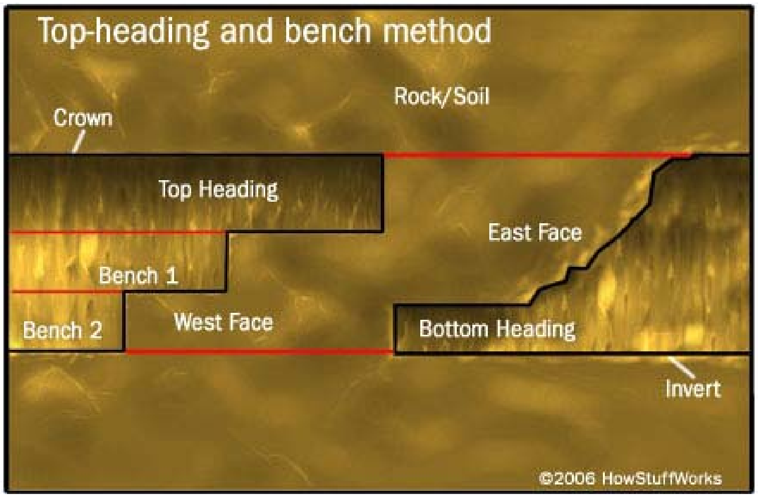
Upon completion of the geotechnical borings, subsurface investigations, detailed design, and issuance of permits, work would begin with the installation of the main drop shaft in the intake cove. This work would entail road improvements south of the plant out to the south breakwater jetty to facilitate material handling. Work on the drop shaft installation would begin with the +30-foot-diameter riser shaft cofferdam caisson in the intake cove:

Excavation would continue into the rock via drilling and shooting/excavation in sequential steps or lifts downward, with the forming and wall concrete placements in lifts. The work operation would be repeated down to tunnel invert elevation of about -220':

5.2.2 Installation of Main Intake Tunnel Starter Tunnel

Once the tunnel drop shaft is at invert elevation of -220’, horizontal drilling and shooting would commence to form the top heading crown, followed by the first and second benches:

The starter tunnel operation consists of the installation of auxiliary air, pumps, drilling and shooting, excavation, material removal, and rock bolt and ceiling reinforcement with safety netting installation, and progresses until the starter tunnel is long enough to facilitate the TBM:



5.2.3 Installation of Main Intake Tunnel Starter Tunnel Liner

Installation of the concrete wall liner in the starter tunnel is the next sequential work activity, with the installation of bottom rail system, formwork placement on the crown and walls, and concrete pump placement of 1-to-2-feet-thick concrete wall. This is followed by formwork removal in preparation for TBM assembly:

5.2.4 Installation of the Main Intake Tunnel

Installation of the main intake tunnel would begin with the assembly of the TBM, which would be lowered piece by piece down the drop shaft and assembled:

Once the TBM is assembled, the conveyor system would then be erected:

The TBM would begin boring operations, with the excavated material conveyed behind and vertically up the drop shaft to another horizontal conveyor belt, where it would be trucked away from the intake area:

5.2.5 Installation of Rock Bolts and Ceiling Reinforcement Supports

As the tunneling progresses, inspections would be performed and requirements for ceiling reinforcements would be identified and installed along with any required concrete tunnel liners for unstable rock areas:

5.2.6 Installation of Auxiliary Air and Pumping Systems

As the tunnel progresses forward, additional conveyor system sections would be added. Air quality would be continuously monitored, and auxiliary air ducting would be added. The intake flows from water seeping into the tunnel through fisher cracks would be monitored and the water diverted to sumps and pumped to the surface.

5.2.7 Disassembly and Removal of Conveyor, TBM Disposition, and Rail System Removal

Upon completion of the tunnel boring, the conveyor system would be dismantled and transported to the surface.

There are two options for dispositioning the TBM once the boring is complete. Depending on the cost, age, and usefulness of the TBM, it can be disassembled piece by piece and brought to the surface and shipped off site to be used for future boring work.

The second option is to extend the length of the tunnel boring and abandon the TBM under the sea by placing a concrete wall in the end of the tunnel, as was done with the boring machines on the Chunnel Tunnel between France and England. Upon completion of the conveyor system and TBM, the rail system supporting the TBM operations would be removed and taken to the surface.

5.2.8 Installation of Offshore Intake Drop Shafts

The installation of the six 12-foot-diameter offshore intake drop shafts would begin with a drilling platform supported from and anchored to the sea bed floor, over the main tunnel in about 70–75 feet of water (about 630 feet off shore). The top of the platform would sit substantially above the water level.

The sequence is to first install an 18-foot-diameter conductor casing from the top of the platform down into the sea bed and then auger down to rock:

The next step is to insert a 16-foot-diameter auger bit and drill through the sea bed soil and into the rock: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A 15-foot-diameter drill casing is then lowered inside the 18-foot conductor casing and reaches from the top of the sea bed down into the rock to form a seal.

Once the drill casing is set, a 14-foot-diameter rock socket is drilled to a depth just above the 30-foot-diameter tunnel. A 12-foot-diameter steel drop shaft intake liner is then inserted into the 14-foot-diameter rock socket boring, and grout is placed between the liner and the rock socket from the bottom of the boring up to the sea bed elevation. The liner has interior steel diaphragm plates in the bottom and top of the liner (see Figure 5.2-1).

The sea bed is excavated around the top section of the drop shaft and the top manifold section and 10-foot-diameter manifold pipes (as shown in Figures 4.2-6, 4.2.7, 4.2-8, and 4.2-9) are bolted on by divers to the upper-section liner containing the upper diaphragm. The manifold piping is backfilled and covered with armor stone, and the wedge wire screens (as shown in Figure 4.2-19) are bolted onto the manifold piping (see Figure 5.2-2).

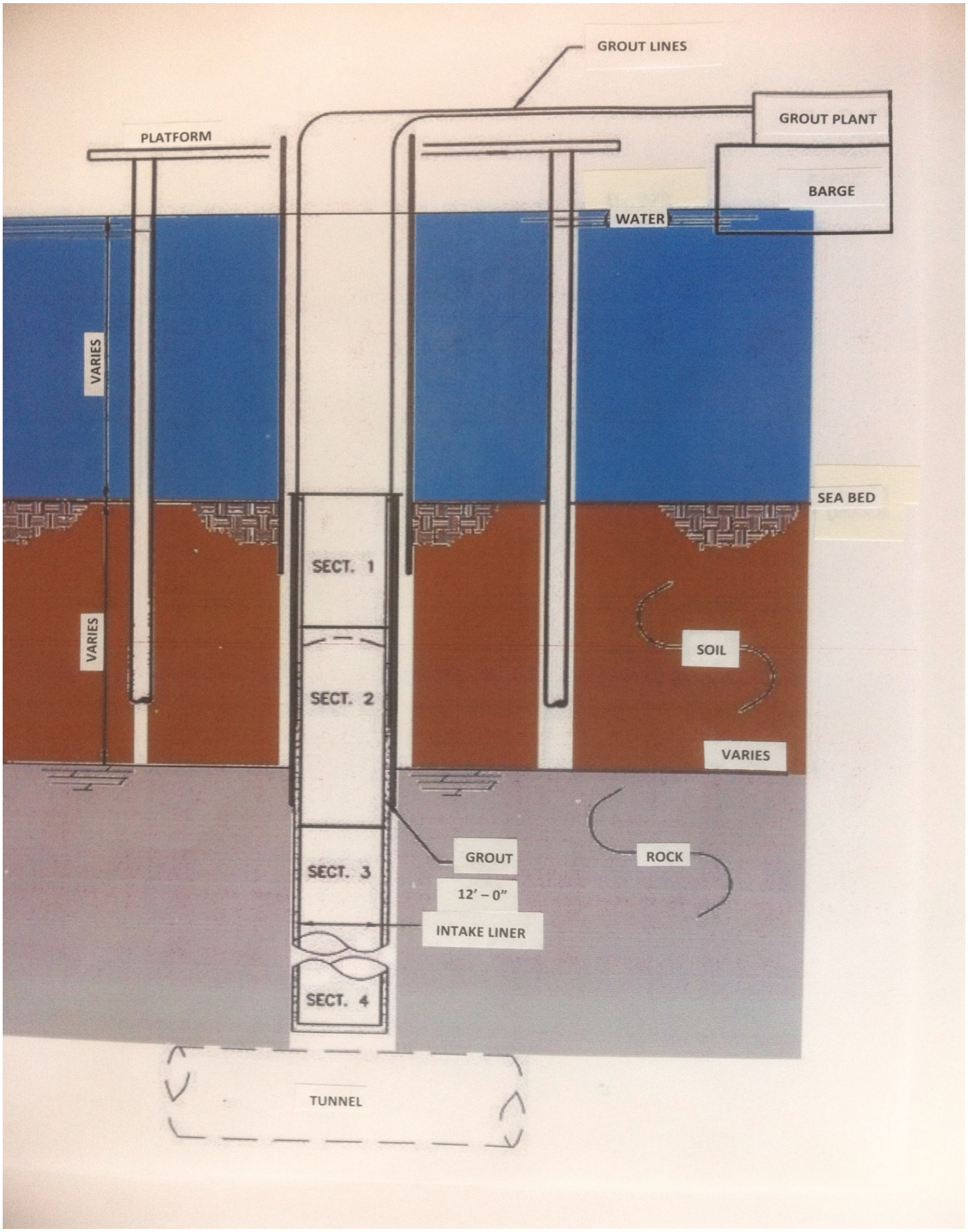


Figure 5.2-1. Installation of Offshore Intake Drop Shafts

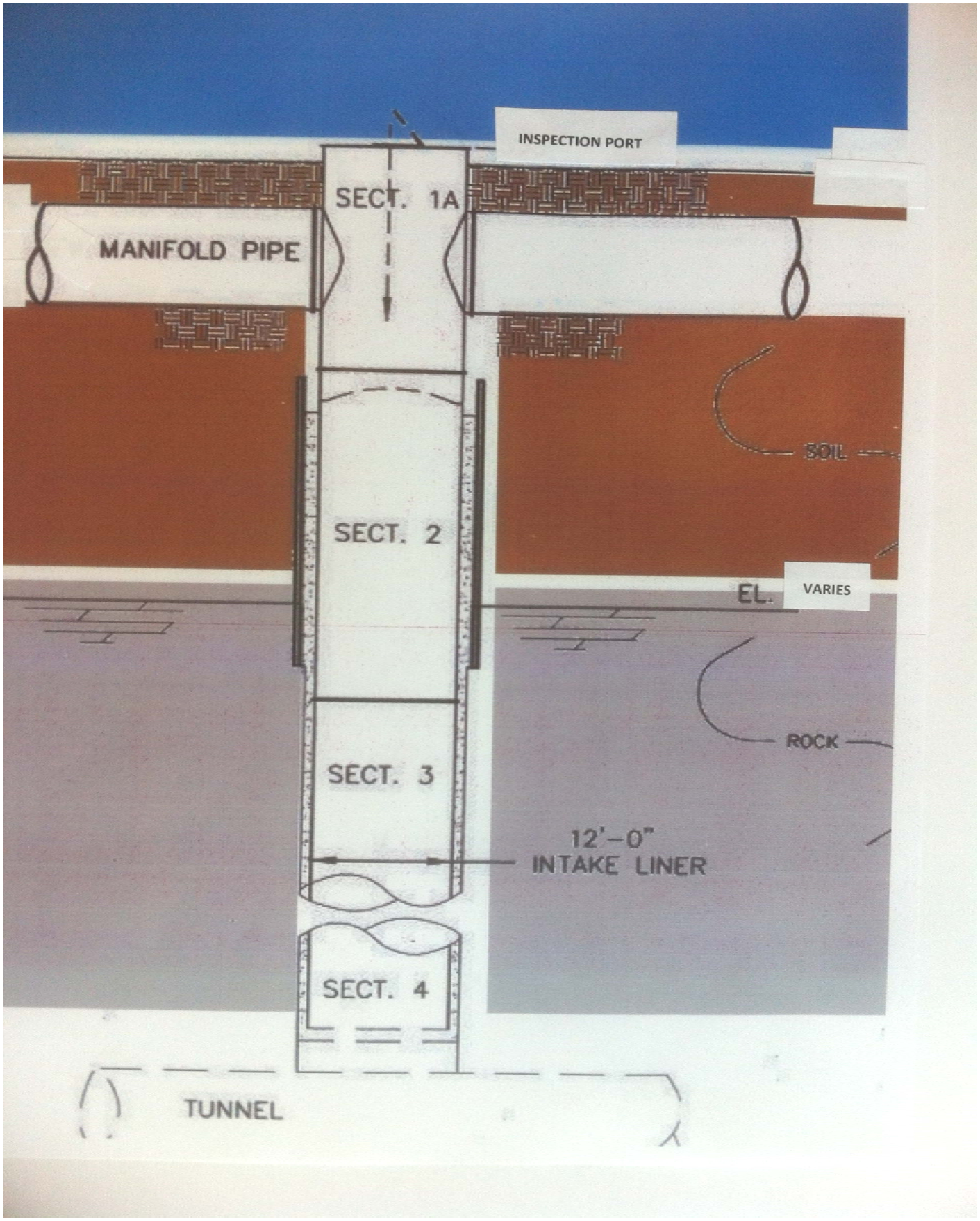


Figure 5.2-2. Installation of Offshore Intake Manifold Piping

Inside the tunnel, an overhead excavation is made upward from the tunnel ceiling to the offshore drop shafts, and the lower diaphragm seal is removed.

This operation is then moved to the next drop shaft location about 50 feet further out to sea, and the operation is repeated until all six drop shafts have been installed. When the tunnel has been cleaned of all debris and pumps, and the air ventilation system has been removed, the tunnel is ready for flood-up and removal of the upper diaphragm seal. Once the tunnel is flooded, divers will enter through the access inspection port located in the top section of the manifold piping and remove the upper diaphragm seal.

5.2.9 Main Drop Shaft Modification

The main drop shaft modification operation entails removing the riser shaft cofferdam caisson section and is performed during flood-up operations. The cofferdam whalers and sheet piling above the cove bottom are extracted and lifted out of the water.

5.2.10 Installation of Cofferdam for Emergency Backup Water Supply

The construction approach for the installation of the emergency cooling intake structure located inside the new breakwater as shown in Figure 4.2-3 will require a narrow cofferdam to be installed. The cofferdam will be installed and the interior will be excavated and dewatered. A dewatering system will be installed inside the cofferdam, and the resulting inflow will be pumped to silt screened discharge back to the sea.

5.2.11 Installation of Reinforced Concrete Emergency Water Structure

Construction of the structure entails installation of two poured-in-place concrete box culverts with 5-x-7-foot openings with dual stop log closures in each of the culverts (see Figure 4.2-10). The top of the structure will coincide with the top of the breakwater.

5.2.12 Installation of the Enclosed Shoreline Breakwater

The construction approach for the extension of the south breakwater jetty would be to complete the wedge wire screens and tunnel work and put the system into operation. The next step would be to complete the installation of the emergency backup water intake structure, then close off the cove. Once the emergency water intake structure is in place and the cofferdam is removed, work would begin on the breakwater with the stone setting and backfilling operations from north and south ends of the breakwater to the structure.

5.2.13 Installation of the Interior Breakwater Seal Liner

The construction approach to the interior breakwater seal liner would be to complete the new break water with concrete cap, and then roll out and fasten the fabric liner from the concrete cap down to the cove bottom. The fabric liner would then be grout filled, creating an impervious barrier.

5.3 Closed-Cycle Cooling, Passive Draft Dry Air; Mechanical Draft Dry Air; Wet Natural Draft; Wet Mechanical Draft; and Hybrid Wet/Dry Cooling

The major construction work components of the closed-cycle cooling technologies are:

- Relocation of the 230 kV offsite power feed
- Expansion of the 500 kV switchyard and installation of six additional breakers
- Subsurface investigation and excavation for the cooling tower footprint
- Erection of the cooling towers
- Installation of CW pipe and duct to the new pumphouses
- Installation of four new transformers near the cooling towers
- Building and powering of the two new pumphouses with four pumps each; switchgear and ductbank
- Demolition of five existing buildings within the CW duct excavation footprint and rebuilding of buildings 102, 519, and 527 outside the footprint
- Installation of the underground piping and valves, concrete duct work
- Demolition and relocation of underground interferences west of the turbine buildings
- Demolition of the existing CW ducts and decommissioning of existing intake pumps and abandonment of the power feed from the plant
- Demolition of the low pressure condenser interiors and retubing with new tube sheets in each unit
- Rebuilding of the low pressure turbines in each unit

For the wet cooling technology options only, the following are additional construction work components:

- Addition of a desalination plant
- Addition of a water treatment plant, recycle water tank, and fresh water storage pond
- Installation of pipelines and pumping stations from the San Luis Obispo and Morro Bay wastewater treatment facilities to the plant site new water treatment facility
- Installation of a new service cooling water and condensate cooler heat exchangers

For the dry cooling technology options only, the following are additional construction work components:

- New saltwater cooling system pumps and piping from the intake structure to the new plant service water cooling heat exchangers and condensate coolers.

For the mechanical draft wet and dry technology options only, the following is an additional construction work component:

- Powering the mechanical draft fans

The construction approach for the closed cooling system options are all very similar in that the cooling tower grade elevation for the five different technologies is set at elevation 115' and is located north of the plant. All cooling tower layout location footprints avoid the Indian burial grounds.

The 12-foot-diameter CW pipe routing from the cooling towers across the Diablo Creek to the new pumphouses are all very similar for each option. The construction of the new pumphouses for each unit, the power and control routing, and the concrete conduit duct from the turbine buildings to the pumphouses are the same for all options, as well as the demolition of the existing buildings, excavation, interference removal, and demolition of the current CW system ducting west of the turbine buildings. The rebuilding of the condensers and low pressure turbines for each option is the same.

The sequence of the construction activities and installations for each of the closed-cycle cooling options is shown on the individual Level 2 schedules.

5.3.1 230 kV Power Transmission Line Rerouting

To accommodate the mountain excavation activities, the first construction activity would be relocated about a mile of the existing 230 kV offsite power transmission line from Morro Bay-Mesa Line, which would be rerouted outside the excavation footprint to the east. This would entail the installation of new foundations and transmission towers further east, restringing new two-conductor three-phase cable and grounding/communications wire, and scheduling a minor outage to perform the de-terminations of the existing lines and re-termination of the new lines. Removal of the existing transmission towers and installation of temporary barriers to protect the existing switchyard area during excavation would follow.

5.3.2 500 kV Switchyard Expansion

To power the closed cooling options, the expansion of the existing 500 kV switchyard would be necessary, which would entail installation of six additional breakers (two bays). The area west of the existing 500 kV switchyard would be graded to the same elevation and new breakers would be installed and interconnected to the new transformers via monopole towers to feed the new transformers near the cooling towers.

5.3.3 Excavation Activities

Of the five options, there are two different footprints to accommodate the number of cooling towers in each tower array. The wet mechanical and hybrid technologies have two tower (one per unit) arrays, while the dry mechanical, dry natural, and wet natural technologies have four tower (two per unit) arrays, which drive the excavation quantities required for each of the two footprints. The flat platform area for the two cooling towers is approximately 62 acres, and the flat platform area for the four cooling towers is approximately 109 acres.

The excavation quantity required to accommodate the two-tower footprint is approximately 190 million cubic yards, while the four-tower footprint requires approximately 316 million cubic yards of excavation. Excavation work would be very similar to the excavation performed for the new Qinshan Nuclear Units 2 and 3, which is located next to the operating Unit 1 in a mountainous area on the East China Sea south of Shanghai, China. The construction approach would be to use drilling and shooting, large shovel excavators (22 cubic yard buckets) and large off-road trucks (100-ton payload) to haul excavated material approximately 5 miles away to the spoils areas. Two potential spoils areas have been identified that could hold the largest quantity of excavated material (see Drawings 25762-110-CEK-7200-00001, 00002, 00003, 00004, and 00005). The 264-acre spoils area that has a current low point at approximately elevation 600’ could be filled to an approximate elevation of 1,000 to 1,200’ (400’ to 600’) depth. The second 46-acre spoils area starts at approximately elevation 680’ and could be filled to an approximate elevation of 1,000’ (320’ depth).

The excavation duration for the two-tower configuration would be approximately 25 months, and the four-tower duration would be approximately 41 months, with about 3 months’ mobilization time. The mobilization will facilitate environmental controls, stormwater management, erosion control, fugitive dust controls, equipment assembly, and infrastructure facilities setup.

With regard to the excavation of rock for the cooling tower footprints, a stepped configuration (50-foot vertical and 100-foot horizontal steps from elevation 115’ [grade] up to elevation 900’ or 1,100’) as shown on Drawings 25762-110-CEK-7200-00001, 00002, 00003, 00004, and 00005 assumes that the excavated material is strong, sound rock with minimal fractures and horizontal bedding. If the rock is fractured or jointed, or has bedding planes that slope into the excavation, then additional measures will have to be taken (such as rock bolts) to ensure excavation stability (these measures have not been included in the estimate). Geotechnical borings and subsurface investigations would be made prior to the final detailed design of the excavation, and environmental impact studies would be conducted to facilitate the permitting process.

Subsurface areas would be excavated for foundations, pumphouses, duct, and pipe during a nonoutage period, while the existing circulating system, diesel fuel storage tanks, and the balance of duct and pipe installations west of the turbine buildings would be demolished during a dual unit outage period.

5.3.4 Circulating Water Piping and Duct Excavation

The eight 12-foot-diameter FRP CW pipes from the cooling tower array would be routed to the new Unit 1 pumphouse area and cross Diablo Creek, requiring an approximately 150-foot-wide and 25-foot deep excavation and the existing Diablo Creek buried duct to be extended east of the excavation footprint.

The piping would be installed in 40-foot lengths on a bed of sand with laminated restrained wrapped ridged joints without thrust blocks (see Section A_A on Drawings 25762-110-P1K-WL-00010, 00020, 00030, 00040 and 00050).

A 344,000 cubic yard excavation from the new Unit 1 pumphouse area to the new Unit 2 pumphouse and to the turbine buildings is required to facilitate the installation of 40,000 cubic yards of poured-in-place reinforced concrete duct. The area north of the Unit 1 turbine excavated during nonoutage periods. The area to the west of the turbine buildings would be excavated during the outage period. The two belowground, 50,000-gallon emergency diesel fuel oil storage tanks would be removed. The existing concrete CW intake and discharge ducts (12,514 cubic yards) would be demolished and removed as part of the excavation during the dual-unit plant outage period. Drawing 25762-P1K-WL-00013 illustrates the area of demolition. The eight existing CW duct ends (intake and discharge) outside the excavation would be sealed with concrete closures and abandoned in place.

An excavation for the new saltwater cooling lines for the dry cooling tower options would be routed from the intake structure parallel to the existing 1-1 conduit to the new excavation west of the Units 1 and 2 turbine buildings (see Drawings 25762-P1K-WL-00011 and 12), and then to the plant service cooling water heat exchangers and condensate coolers.

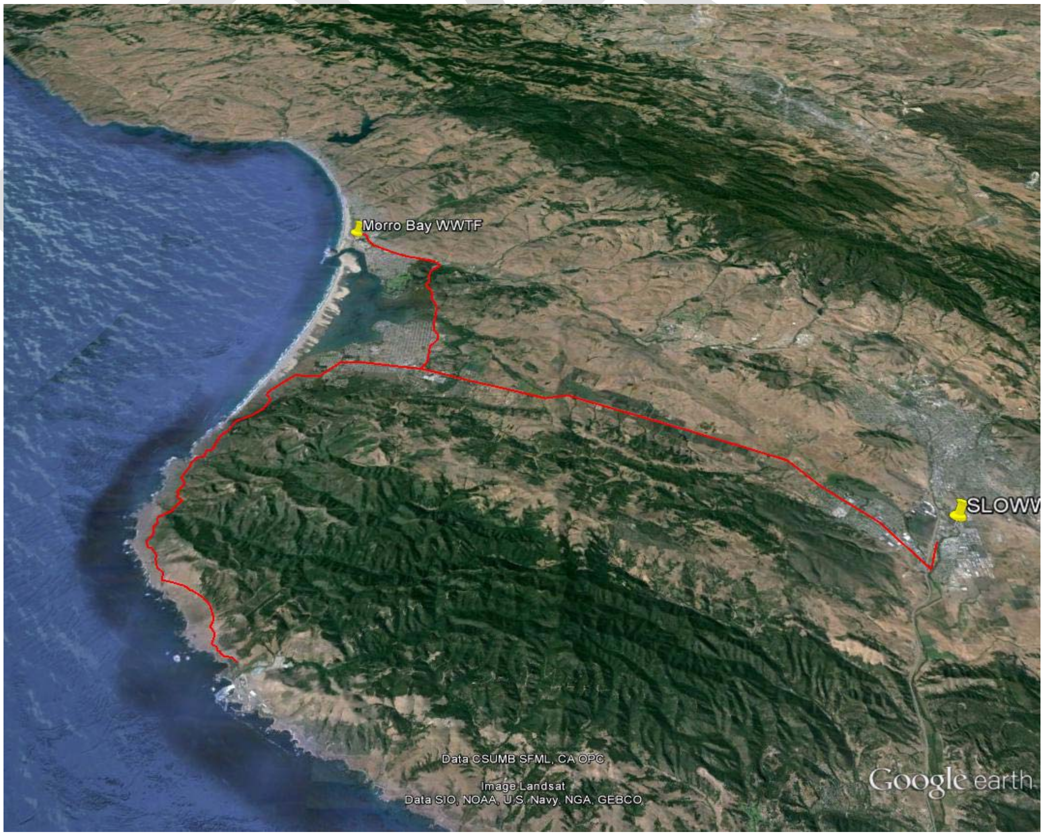
Buildings 102 (30,200 sq ft), 519 (9,600 sq ft), 520 (1,600 sq ft), 521 (2,880 sq ft), and 527 (1,250 sq ft), which are located within the excavation area, would be demolished. The cost to replace these buildings with new buildings has been included in the estimate.

5.3.5 Cooling Tower Erection

The dry natural draft, wet natural draft, wet mechanical draft, and hybrid wet/dry cooling towers are pour-in-place, reinforced concrete structures erected on mass concrete foundations requiring foundation excavation. Substructure foundations are typically excavated, formed and placed via concrete pumps, while the superstructure is formed in lifts and concrete is placed via a bucket using a tower crane in the interior of the structures. Once the civil construction is complete, the mechanical/piping equipment is installed. For the wet mechanical and hybrid towers, the electrical commodities to power the forced draft fans are installed.

Mechanical draft dry air cooling towers are relatively low-profile towers that sit on many small pier foundations poured in place, with a concrete slab under each four-tower array. The mechanical draft fin-fan dry air towers arrive on site in modular sections, which are essentially bolted together, anchored to the foundation, and connected to the 12-foot-diameter circulating water supply and return piping. The electrical commodities are then installed and terminated to power the forced draft fans.

While the two dry cooling technologies do not have water treatment packages, the three wet cooling technologies have standard desalination and water treatment packages with an excavated and lined 5-million-gallon fresh water storage pond on site and gravity feed to the cooling towers. In addition to the desalination plant for the wet technologies, recycle water pump stations will be built at the San Luis Obispo Waste Water Treatment Facility (WWTF) located at 879 Morrow Street and the Morro Bay Waste Water Treatment Facility located at 955 Shasta Ave:



Open cut and buried ductile iron recycled water pipeline (14-inch diameter) would be routed from the San Luis Obispo WWTF south along Highway 101, about 0.6 miles to Los Osos Valley Road boring under the highway, and follow Los Osos Valley Road 9.8 miles to South Bay Boulevard at Los Osos, where the Morro Bay supply tie-in point would be reached, for a total of 10.4 miles. From the Morro Bay WWTF to the tie-in point, buried ductile iron pipe (10 inch diameter) routing would follow along Atascadero Road at the plant to Route 1 into Quintana Road to South Bay Road, to the tie-in point at South Bay Road and Los Osos Valley Road, which is 6.43 miles. From the tie in point to the site, the pipe diameter will increase to 18-inch diameter ductile iron pipe and the routing would follow Los Osos Valley Road to Pecho Valley Road to the site, which is another 10.8 miles, to the 100,000 gallon field-erected recycled water storage tank at the onsite recycle water treatment plant. The belowground piping would be ductile iron while the aboveground piping at the water treatment plants would be FRP pipe.

Buried saltwater intake piping to feed the desalination plant would be routed from the new saltwater pumps installed at the existing intake structure to the desalination plant, and the brine discharge piping would be routed back to the ocean at the station discharge structure.

The dry technology tower arrays and piping routing are illustrated in Drawings 25762–P1K-WL-00010, and 20. The wet technology tower arrays and piping are illustrated in Drawings 25762-P1K-WL-00030, 40, and 50.

5.3.6 Pumphouses

The pumphouses for all the closed cooling options are located in the same manner. Each unit will have a separate pumphouse consisting of a vertical pump concrete structure with four vertical circulating water pumps with 108-inch butterfly valves, concrete intake and discharge header boxes, and a concrete valve pit with four 108-inch isolation butterfly valves. The pumphouses have an electrical building for switchgear and underground duct banks for power and control electrical installations. Construction of the pumphouses and appurtenances calls for excavation, installation of reinforced concrete structures, with foundations; walls and slabs with embedded items; and subsequent backfilling operations. Following the civil work, the installation of mechanical equipment and piping and electrical equipment, conduit, tray, wire, and electrical terminations will follow.

5.3.7 Concrete Production

The closed-cycle cooling technology calls for large quantities of concrete for the construction of the cooling towers, pumphouses, and circulating water duct. To ease traffic congestion, and to provide a quality and least cost approach to concrete supply, concrete batch plant(s) would be erected on site, and the cement, aggregate, and admixtures shipped to the site. Onsite concrete mixer trucks would deliver the concrete from the batch plant to the points of placement.

5.3.8 Structural Backfill

To accommodate the structural backfill requirements, a crushing/screening/blending plant would be located at the excavation spoils area to manufacture the necessary backfill material from the excavated spoils.

5.3.9 Parking

To accommodate the construction workforce parking requirements and ease traffic on the plant access road, it is expected that the construction workforce will park in remote parking areas off site and be bused to the work locations on site.

5.3.10 Construction Workforce Populations

To accommodate the three different technologies, the construction workforce population on site will vary during the course of installation activities. The approximate construction workforce populations required to accomplish the various schedule durations would be as follows:

For the closed-cycle cooling options the construction population would consist of approximately 500 personnel (per shift) would work two shifts, 5 days per week, 10 hours per day during the mountain excavation. Following the excavation, the nonoutage schedule would continue and the workforce population would increase to approximately 675 personnel per shift to accomplish the cooling tower erection and piping, underground, and pumphouse installations. During the dual-unit outage period, the work schedule would be adjusted to working 24 hours per day, 7 days per week to minimize outage duration and would require approximately 440 persons per shift performing the outage scope of work.

For the onshore mechanical fine mesh screen option, a construction population consisting of approximately 75 personnel per shift (would work two shifts, 5 days per week, 10 hours per day during the 6-monthy preoutage period (excluding work on the intake structure bar rack cleaning system). During the 12 months of partial unit outages, a construction workforce consisting of approximately 85 personnel per shift would work 24 hours, per day, 7 days per week, to minimize outage durations.

The onshore mechanical wedge wire/tunnel technology option will not require unit outages and marine construction work hours would be two shifts, 5 days per week, 10 hours per day and would periodically adjusted in response to weather conditions. The total workforce population over the 41-month construction period would consist of approximately 120 personnel between the two shifts.

6 Schedule Development

6.1 Summary

Phase 2 evaluated three general classifications of technologies: closed-cycle cooling systems, onshore mechanical fine mesh system technology, and offshore modular wedge wire systems technology. The closed-cycle cooling technologies include dry natural draft, a wet natural draft cooling, a dry mechanical draft, a wet mechanical draft and hybrid technologies. All of these closed-cycle cooling technologies incorporate the use of a separate cooling tower structure and circulating water system and employ a single combined outage for each unit. The onshore mechanical fine mesh and modular wedge wire technologies do not require plant outages to implement. The closed cooling technologies require overall schedule durations ranging from 8 to 9 years after Notice to Proceed (NTP), while the onshore mechanical (active) fine mesh screening technology and the offshore modular wedge wire screening system technology offer overall schedule durations of approximately 4 years and 5 years after NTP, respectively. Schedule specifics for each of these seven approaches are detailed below. For each of the technologies, NTP occurs following permit approval for implementation, which is typically approximately a 5-year period.

Each of the technologies was evaluated and a schedule developed to cover the design, construction, and commissioning of that technology. The philosophy underpinning the schedule development process was to 1) minimize PG&E’s outlay of funds until such time as the permitting process was nearing completion, 2) determine the most efficient design and construction sequence, and 3) design and construct the project so that the time one or both of the units are offline is kept to an absolute minimum. The process used to develop the schedule for each technology is discussed in detail below.

6.2 Base Key Schedule Durations

The timescale of the milestone schedules in this report is shown in an “ordinal calendar” format to depict amount of time after Notice to Proceed (NTP). It is shown in years (not in months).

Milestone Description (years from NTP)	Wet Natural Draft Cooling	Wet Mechanical (Forced) Draft Cooling	Hybrid Wet/Dry Cooling	Passive Draft Dry/Air Cooling	Mechanical (Forced) Draft Dry/Air Cooling	Onshore Mechanical (Active) Intake Fine Mesh Screening Systems	Offshore Modular Wedge Wire Screening Systems
CEQA Permit Approval	-5.0	-5.0	-5.0	-5.0	-5.0	-4.3	-5.0
Notice to Proceed	0	0	0	0	0	0	0
Pre-Outage Construction Complete	7.3	7.1	6.1	5.9	6.5	n/a	n/a
Outage Complete and T/O to Operations	8.8	8.6	7.6	7.4	8.0	3.3 *	4.4 *
Total Duration (approximate)	14	14	13	13	13	8	10

* No outages required

6.3 General Schedule Qualifications and Assumptions

- There is a standard approach to secure required permitting and leases that is valid and used for all of the technologies evaluated.
- Permitting durations are based on recent California related power plant permitting experience and the individual regulatory agency guidance on review periods.
- Considering related permits and their respective processes, the CEQA permit will require the most time during the permitting process.

6.4 Closed-Cycle Cooling Technologies

The closed-cycle cooling technology solution consists of five distinct approaches, with a separate schedule developed for each approach. The project team initially collaborated to identify individual tasks/milestones and the appropriate sequence in which the work needed to proceed. Engineering, permitting, construction, and startup task durations were evaluated, based on their complexity, physical location, effect on station operation, and past performance on previous Bechtel projects. Procurement, vendor, and subcontract durations were confirmed with potential suppliers or supported with past performance metrics on Bechtel projects. The project team then worked to optimize each schedule, focusing on minimizing outage duration, permitting risk, and impacts to plant operations.

The basic structure is the same for each of the closed-cycle cooling technologies schedules; however, the dry mechanical and dry natural options do not consider the desalination plant/water or reclaim water, since it is not required. The primary variability of these schedules is due to the different durations for mountain excavation and cooling tower configurations. The wet natural draft cooling requires a larger amount of excavation due to the number of cooling towers and the fact that makeup water is required. The summary level project implementation schedule developed for each of the five closed cooling options is provided in Figures 6.4-1 through 6.4-5. The dry natural draft option is forecasted to be the shortest closed cooling schedule duration, completing in approximately 8 years; while the wet natural option is forecasted to be the longest duration, completing in approximately 9 years. Each of these schedules includes an initial 5-year period prior to NTP that is dedicated solely to submitting and acquiring permit approvals.

It is important to note that for all of the closed-cycle cooling options, construction activities are independently scheduled to focus on the area outside the current plant protected area, separate from the construction activities inside the protected area. This approach was used to maximize productivity and minimize impact on the operating plants.

6.5 Closed-Cycle Schedule Qualifications and Assumptions

Closed-cycle schedule qualifications and assumptions are identified below:

- Procurement/construction work will not begin until after permit approval is received, except for the bid preparation to relocate the 230 kV power line. The engineering specifications bid and evaluation process would be completed, but a purchase order issue was assumed to not take place until the permitting process is completed.

- Limited equipment award, especially for equipment design activities, may be a source of schedule improvement to be considered during implementation. It would be a PG&E decision to assume some risk in this area based on confidence gained during the permitting process and may be deemed reasonable and acceptable.

- Mountain excavation duration based on the estimated volume of material to be excavated is a major segment of the overall schedule duration (estimated volumes are 316 million cubic yards for the dry natural, wet natural and dry mechanical options, and 190 million cubic yards for the wet mechanical and hybrid options).

- For each closed-cycle cooling technology, the construction approach is to complete as much of the scope as possible for the cooling towers prior to the plant outages, leaving the circulating water pipe removal and installation tie-ins and hookups, to minimize outage time.

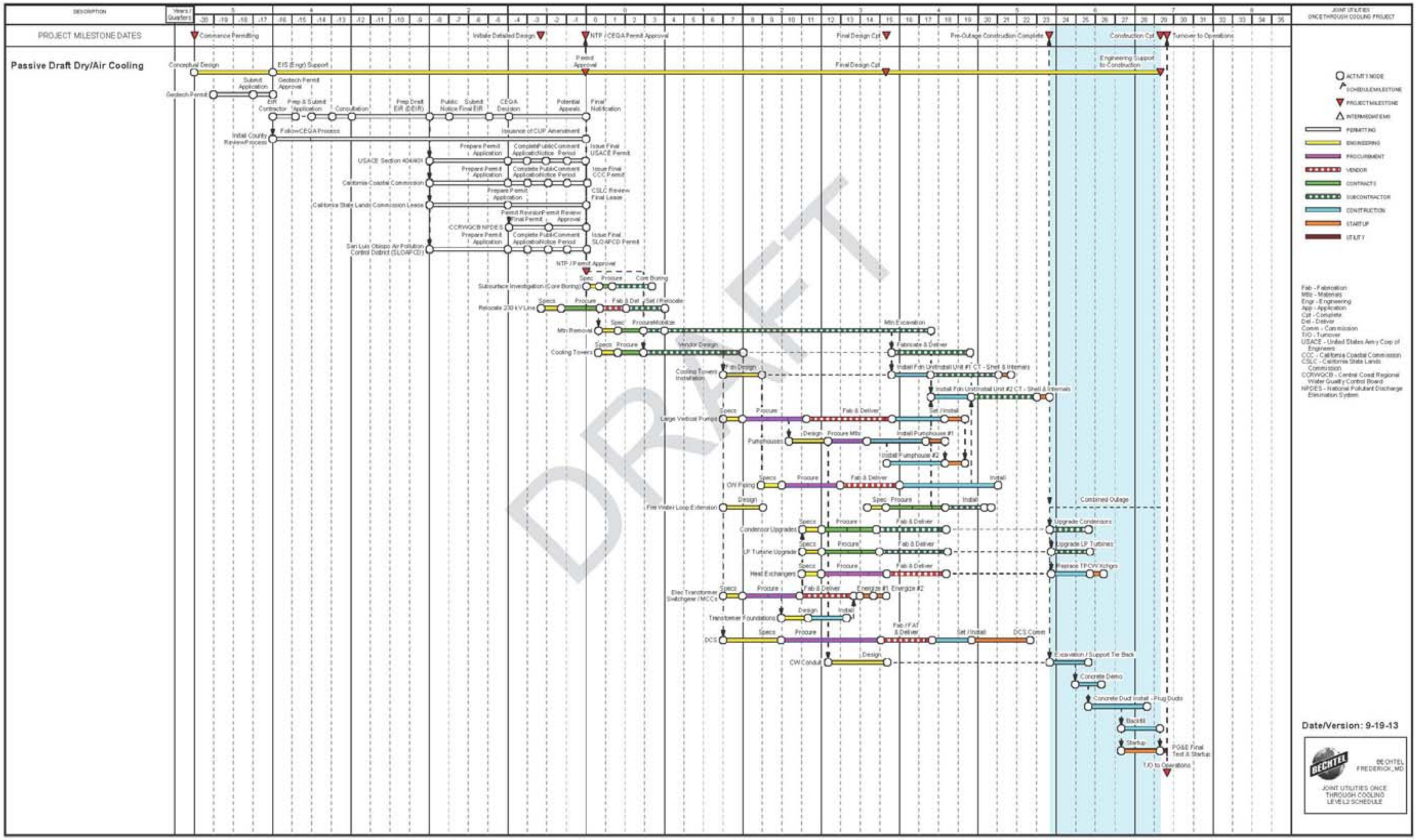


Figure 6.4-1. DCPP Closed Cycle–Passive Draft Dry/Air Dry Natural Cooling

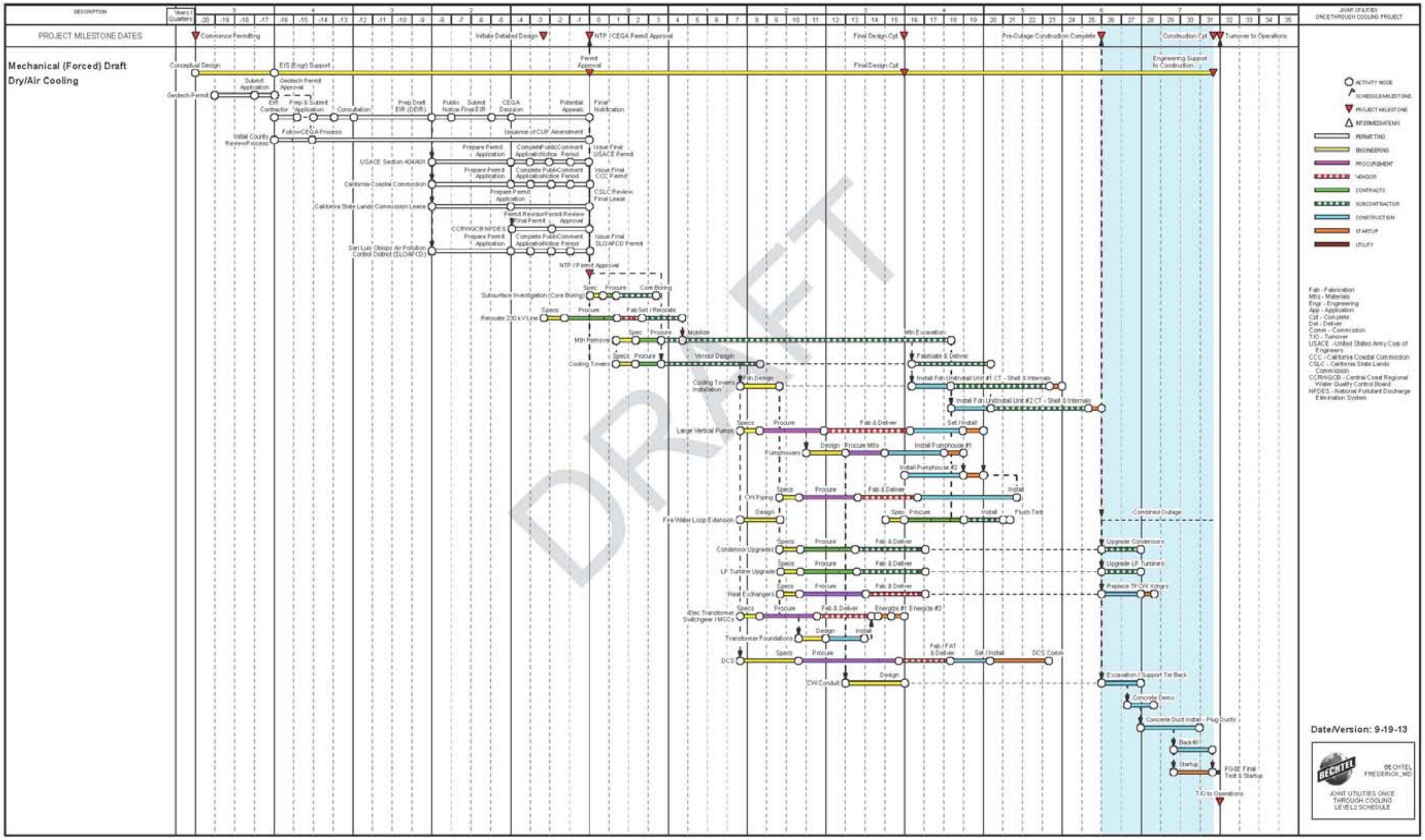


Figure 6.4-2. DCPP Closed Cycle–Mechanical (Forced) Draft Dry/Air Cooling

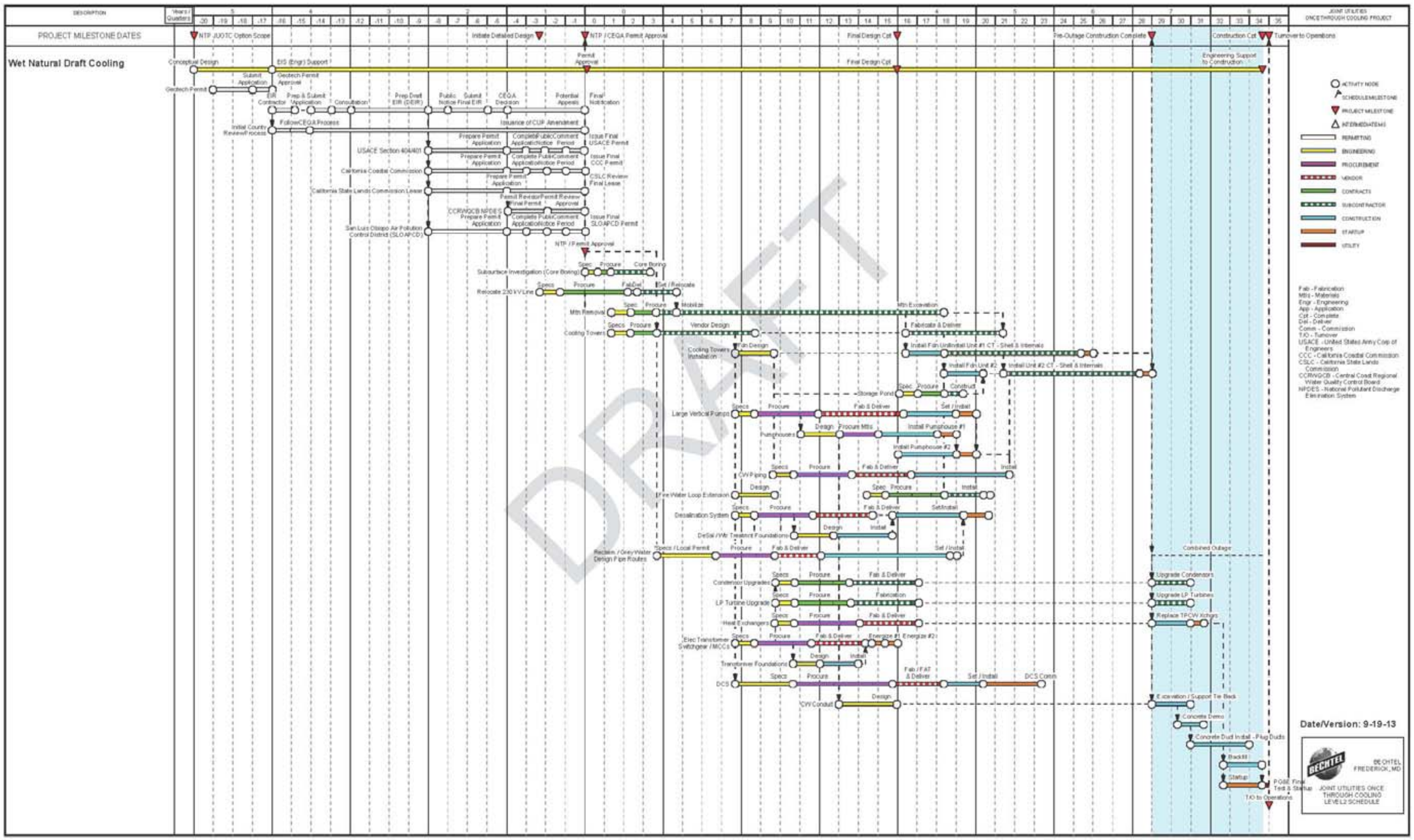


Figure 6.4-3. DCPP Closed Cycle–Wet Natural Draft Cooling

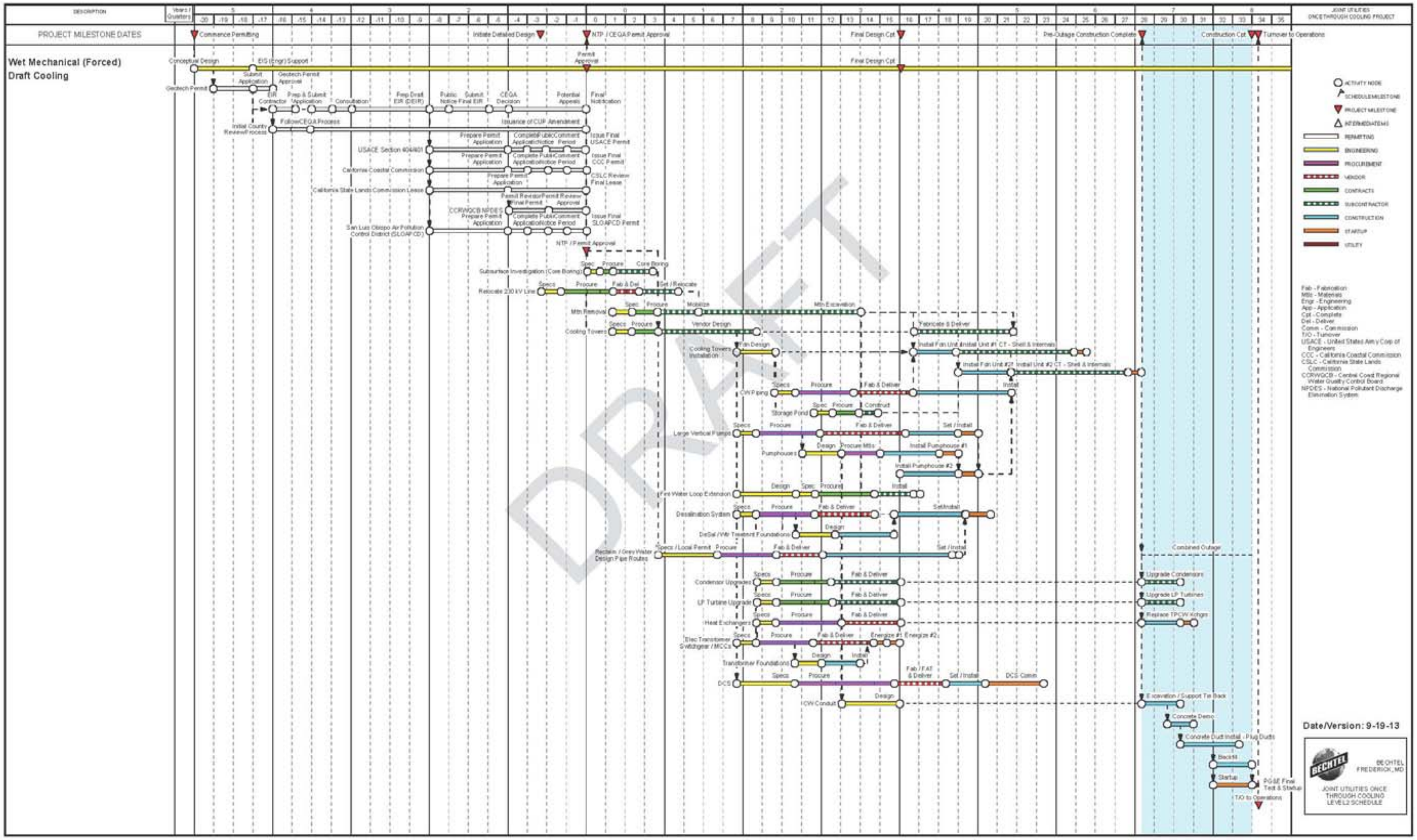


Figure 6.4-4. DCPP Closed Cycle–Wet Mechanical (Forced) Draft Cooling

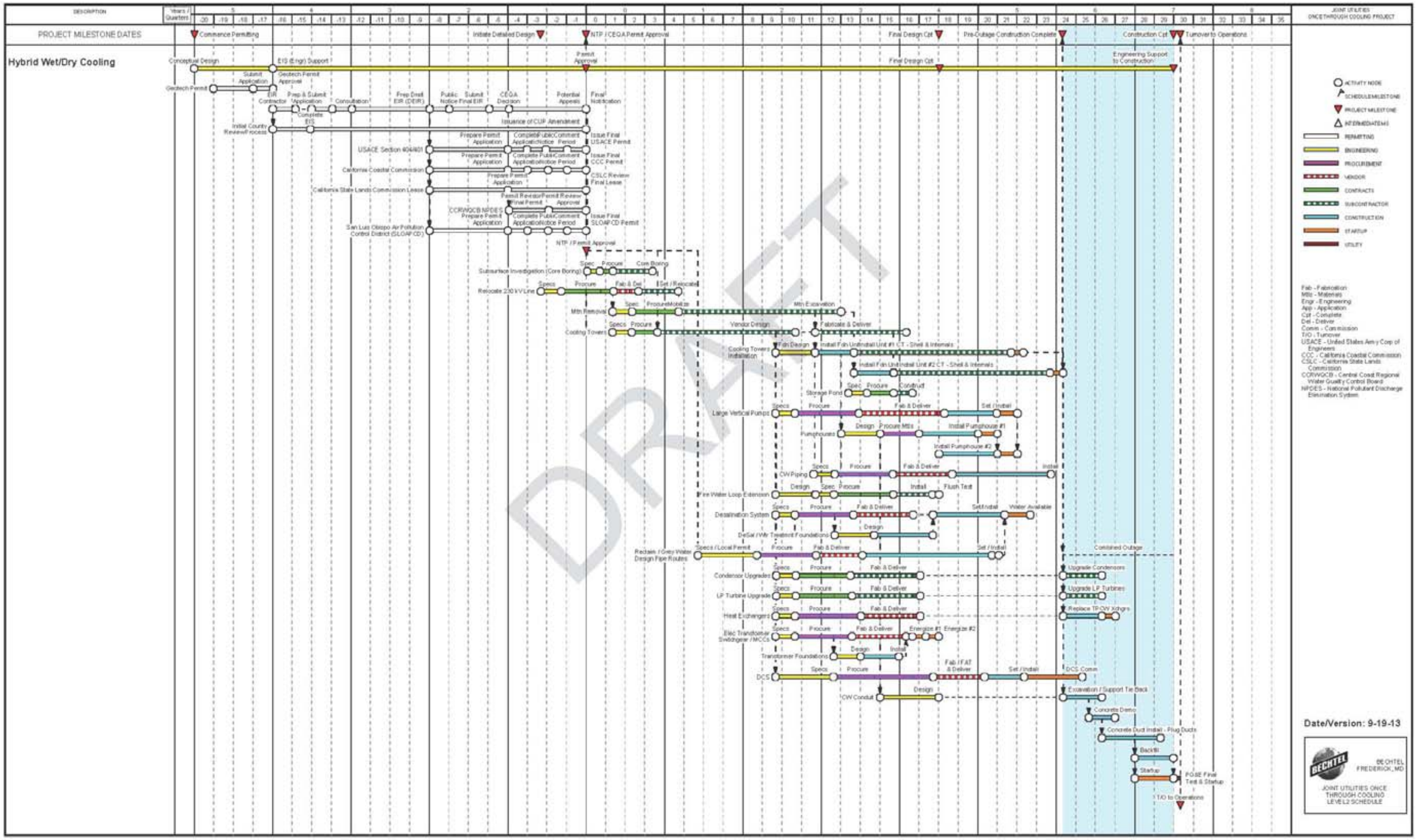


Figure 6.4-5. DCPP Closed Cycle–Hybrid Wet/Dry Cooling

- The closed-cycle options are expected to require a single combined outage to perform final installation and tie-in work. Significant underground piping work is required west of the turbine building.

- Several work fronts (including the heat exchanger replacement, condenser upgrades, and the low pressure turbine upgrade) have the potential to be completed during earlier plant outages if availability allows. The potential for schedule improvement exists, since these potential optimizations are not considered in the schedules.

6.6 Key Events that Start Prior to NTP

Key events to commence before NTP are highlighted below:

- The initial preliminary design will commence to support the development of the Geotech permit as part of the overall permitting process.

- The permitting process for the project commences with the Geotech permitting process while the lead CEQA agency is being assessed and the services of the EIR contractor are secured. Permitting is assumed to be a 4.0-year process, based on the qualifications and assumptions stated previously.

- Initiating relocation of the 230 kV power line is a critical activity that must be performed soon after the CEQA permit is approved in order to avoid impact on mountain excavation activities.

- Initiation of the subsurface investigation for the mountain excavation will directly follow receipt of CEQA permitting approval.

6.7 Critical Path Activities

The critical paths for each closed-cycle cooling technology are essentially the same, since the schedules for each technology are based on the same general approach.

The “primary” critical path for a schedule is defined as the longest sequence of activities in a project plan that must be completed on time for the project to be completed by the expected finish date. The overall project duration cannot be improved without decreasing the length of the critical path. Conversely, if any activity on the primary critical path is delayed for a day, then the entire project will be delayed for a day as well.

The secondary and tertiary critical paths do not directly affect the project completion. However, if the primary critical path is sufficiently improved, then the secondary path would become the longest sequence and the new primary critical path for the project. This is also true for the tertiary path if sufficient improvements can be made to the durations of the primary and secondary critical paths.

These critical paths for the closed-cycle cooling technology options are detailed as follows:

- Primary Path – The primary critical path for the cooling towers runs through the Geotech permit and CEQA permitting process. After the CEQA permit is approved, follow-on critical activities include relocating the 230 kV power line, completing mountain excavation, constructing the cooling towers and constructing the two pumphouses; each are key predecessors to achieving the Preoutage Construction Complete milestone. The combined outage can commence once the Preoutage Construction Complete milestone is achieved. The outage start can be delayed until the best appropriate time based on plant operations and generation requirements. For the purpose of this report, the outage start is defined to occur immediately following the Preoutage Construction Complete milestone. Once the outage work is complete, the project will be ready for turnover to Operations for final plant testing and startup.

- Secondary Path – The secondary critical path begins with the CEQA permit approval and runs through the award of the cooling tower subcontract. The design of the cooling tower foundations and CW piping begins with the receipt of vendor information and progresses through CW piping installation and subsequently is completed with the commencement of the installation outage.

- Tertiary Path – The tertiary critical path begins with CEQA permit approval and runs through the receipt of the cooling tower subcontractor vendor information (VI). Receipt of the cooling tower VI initiates the procurement of the large vertical pumps. Receipt of the large vertical pump VI initiates the design of the pumphouses and subsequently ties into the Preoutage Construction Complete milestone.

6.8 Outage Work

To minimize the impact to plant operations as much as possible, all possible preoutage work will be completed prior to starting the outage. Additionally, the outage work will be performed on a 24/7 basis. The durations are based on the production rates required for the excavation quantities and installation of the CW conduit to the west of the plant. Major activities include excavation, demolition of existing concrete conduit, and installation of new concrete duct, tie-ins, backfill, and startup.

6.9 Schedule Risks

The schedule risks that have been identified are summarized below:

- CEQA Final Decision – Delays in receipt of the CEQA Final Decision will delay key equipment procurement and subcontract awards, which in turn will delay the start of physical work.

- EIR Preparation – the closed cooling system will require the preparation of an EIR, which has the potential to significantly extend the permitting process, depending on the EIR extensions of public review and comment periods and difficulties in responding to subsequent information requests.

- Possible Litigation Schedule Impacts – While litigation schedule impacts have not been included, a nominal 1-year appeal period was assumed.

- Mountain Excavation – Mountain excavation durations are based on available geotechnical information provided by PG&E regarding the soil composition and available data of soil properties in the area of the plant site. Results of the final geotechnical borings and associated soil properties could impact the overall excavation duration either positively or negatively.

- Recycle Water Pipe Routes – Recycle water pipe will be routed through existing rights of way in the communities within 20 miles of DCPP. Construction impacts from local communities may affect the duration of this effort. However, it is assumed that the CEQA permitting process will also address the local concerns and that local permitting can be accomplished well within the time period of the CEQA approval.

- Vendor/Subcontractor Schedule Variation – While efforts have been made to appropriately forecast lead times and subcontract durations, there is a risk for variation due to market conditions and other external factors until final contracts are awarded.

- Unknown Underground Conditions – Unknown underground conditions, particularly within the footprint of the operating units, could adversely impact the construction schedule.

- Labor Availability – Availability of qualified labor could negatively affect the construction durations assumed in the schedule.

6.10 Onshore Mechanical Fine Mesh Screening Technology

The summary level project implementation schedule developed for the onshore fine mesh screening option is provided as Figure 6.10-1 and shows an overall duration of approximately 4 years after NTP. As with the closed-cycle cooling and offshore modular wedge wire screening schedule approaches, the project team developed the schedule to ensure complete representation of the total project scope.

Schedule Qualifications and Assumptions

Onshore mechanical fine mesh screening technology schedule qualifications and assumptions are identified below:

- Detailed engineering/procurement/construction work will not begin until after permit approval is received, except for specification development for the fine mesh screens. The specification for the fine mesh screens will be ready for issue to bidders once permit approval is received. There may be a source of additional schedule improvement during implementation; based on confidence gained during the permitting process, PG&E may elect to release other work tasks prior to receiving CEQA approval.

- The construction approach will be to complete as much of the scope as possible during plant operation. The major work effort involves screen removal and installation of new dual-flow screens and control panels.

- The project execution schedule has been developed assuming that the affected unit will remain in operation under reduced intake during the screen replacement work. With the screens being replaced during plant operation, one pump (and associated screen set) will operate at a time and at reduced intake flow and lower power level. This approach offers the advantage of allowing the dual flow screens to be installed without an outage of either unit.

6.11 Key Events that Start Prior to NTP

Key events to commence before NTP are highlighted below:

- The conceptual design and Geotech permit for the fish return discharge area are initiated to support the permitting process.

- The permitting process will begin after the Geotech permit is approved.

- Permitting is assumed to be a 4.25-year process, based on the previously stated assumptions.

6.12 Critical Path Activities

The primary critical path for the onshore mechanical fine mesh screening technology begins with the approval of the Geotech and required permits. Once permitting approvals are received, the critical path continues with the detailed engineering, procurement, fabrication, and installation of the fine mesh screens and the screen wash pumps during the first partial outage for the first unit. Once the partial outage of the first unit partial outage (Outage 1) is complete, the critical path continues through installation of the fine mesh screens for the second unit (Outage 2) and is completed with the second unit turnover to Operations at Year 7.8.

Schedule Risks

The schedule risks that have been identified are summarized below:

- Permits and Regulatory Approvals – Delays in receipt of permits and regulatory approvals will delay the procurement of key equipment and in turn delay the start of physical work.
- Appeal Period – A nominal 3-month appeal period has been assumed in conjunction with the CEQA approval process.
- Vendor/Subcontractor Schedule Variation – There is risk for variation due to market conditions and other external factors.
- Possible Need for new Rack Structure – If a new rack structure must be installed, the schedule sequence and durations would change significantly.

6.13 Offshore Modular Wedge Wire Screening System Technology

The Level 2 project implementation schedule developed for the modular wedge wire screening system technology option is provided as Figure 6.13-1 and shows an overall duration of 4.4 years. As with the closed-cycle cooling and onshore fine mesh screening schedule approaches, the project team developed the schedule to ensure complete representation of the total project scope. The overall schedule duration for the onshore mechanical fine mesh screening technology includes 5 years dedicated solely to acquiring permit approvals.

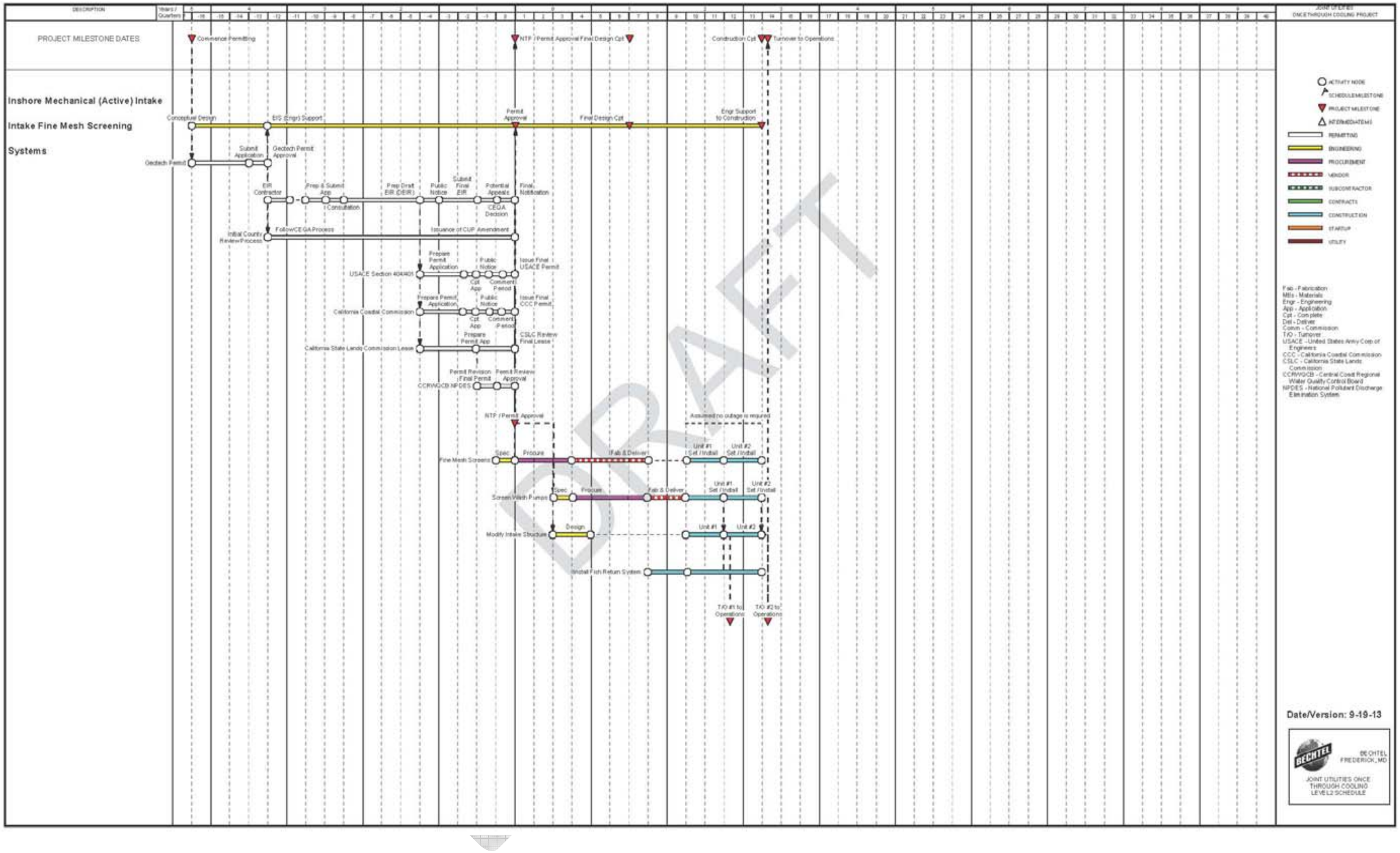


Figure 6.10-1. DCPP Onshore Mechanical (Active) Intake Fine Mesh Fine Mesh Screening

6.14 Schedule Qualifications and Assumptions

Modular wedge wire screening technology schedule qualifications and assumptions are identified below:

- An in-situ testing program for the wedge wire screens will take place during the permitting process in advance of the CEQA permit approval.
- Construction work will not begin until permit approvals are obtained.
- A plant outage will not be required for the installation of the offshore modular wedge wire screening system technology, allowing the plant to operate continually during project execution.

6.15 Key Events that Start Prior to NTP

Key events to commence before NTP are highlighted below:

- The conceptual design and Geotech permit process is initiated to support the permitting process.
- The permitting process will commence after the Geotech permit is approved.
- Permitting is assumed to be a 4.0-year process, based on the previously stated assumptions.
- In-situ testing for biological and debris effects will be accomplished during the permitting process.

6.16 Critical Path Activities

The primary critical path for the modular wedge wire screening technology begins with the acquisition of the Geotech and remaining permits and approval to proceed with the in-situ testing. Once permitting approvals are received, the critical path continues with the award of the detailed engineering leading to the award of the marine subcontract and associated design, procurement, fabrication, and installation of the wedge wire screens and piping headers. The critical path continues through construction of the breakwater enclosure and is completed with the final PG&E testing and turnover to Operations.

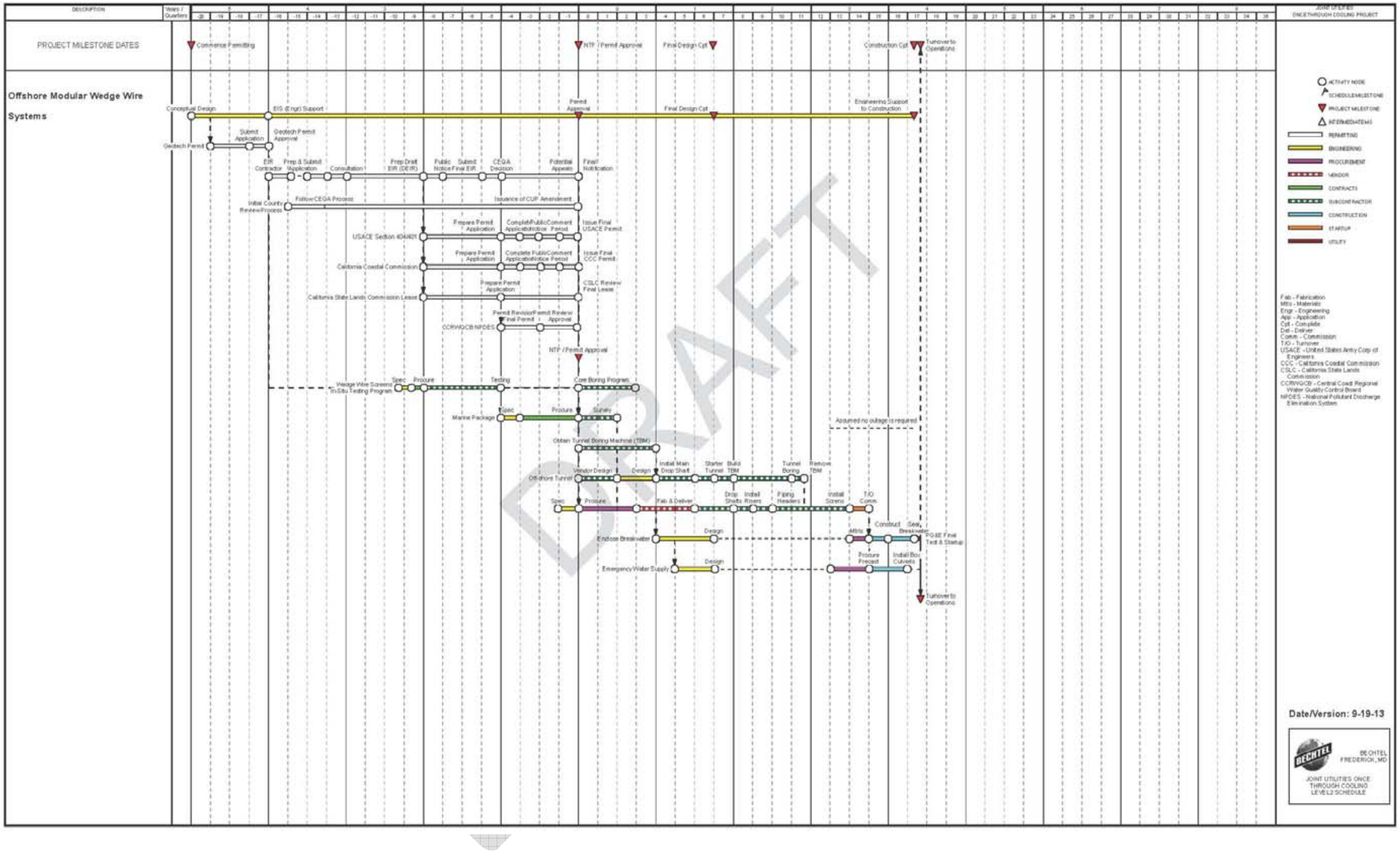


Figure 6.13-1. DCPP Offshore Modular Wedge Wire Screening

Schedule Risks

The schedule risks that have been identified are summarized below:

- Permit Approvals – Delays in receipt of permits will delay the award of key equipment and in turn delay the start of physical work.
- CEQ Permitting Approvals – Significant CEQ permitting appeal activity is assumed (nominal 1-year appeal period).
- Severity of Offshore Fault – The Geotech report indicates that the offshore fault is more severe than previously thought.
- Vendor/Subcontractor Schedule Variation –There is risk for variation due to market conditions and other external factors.

6.17 Schedule Confidence

The schedules developed for each technology are based on quantity information, given work schedule, and historical unit rates. They have been developed without contingency or other schedule allowance to reflect the individual tasks or overall project duration. The schedules are based on recent vendor schedule information and adjusted based on historical schedule knowledge to attain a higher level of confidence in the reflected durations.

The schedules will be further refined during the detail design phase when construction and installation quantities are finalized. The critical path (Section 6.7) identifies the key work scope with the greatest dependence on and sensitivity to the project completion.

7 Estimate Development

7.1 Estimate Overview

For this study, Bechtel implemented its proprietary Estimating Process Integration and Control (EPIC) estimating process to develop the costs for the DCPP, consistent with the Association for Advancement of Cost Engineers International (AACEI) Class 3 estimating standard defined in Section 1.2 of the AACEI standard. The estimating process is depicted in Figure 7.1-1. The estimating methodology used to develop the costs is the same as the one that would be used for any large and complex project. Bechtel used our proprietary cost database developed from new generation, power uprate, and capital equipment replacement project experience. In addition, Bechtel applied our fossil plant estimating experience to support the estimating of similar scope items such as the design and construction of similar cooling water intake structures.

The estimate is founded on a well-defined scope developed by Engineering and refined by Construction and Estimating walking down the DCPP site and providing constructability and execution feedback. Engineering completed the design in the range of 10% to 15%, which yielded the quantities for the commodities used to develop the estimate. Construction refined the execution strategy based on the final quantities and to meet the schedule requirements, which formed the basis for the development of craft labor productivity and craft labor wage rates, and identification of the specialty subcontracts required for the performance of the scope of work. The local craft labor conditions were investigated and craft wage rate information was secured, which was used to develop the labor wages and potential craft incentives to attract and retain qualified craft. Equipment supply was investigated to understand current equipment supply pricing. Equipment supply and install was investigated for the specialty subcontracts identified as part of execution strategy, to understand current equipment supply and installation pricing. This provided the total estimate for the direct cost component in the EPIC model. The replacement turbine costs were provided by PG&E based on its previous experience, which was escalated to current-day pricing.

The indirect cost component, such as startup labor, was estimated based on the scope of work as defined by Engineering. Engineering services labor was estimated based the engineering effort necessary to complete the design. The balance of cost components such as distributable cost, indirect cost, other home office services, and other costs, (e.g., insurance, taxes etc.) was estimated using the Bechtel proprietary database capturing actual cost experience from other projects of similar scope and size. The estimates are based on overnight pricing and exclude escalation. The project price includes a nominal fee for the contractor to perform the scope of work.

The estimating methodology outlined above is consistent with the AACEI Class 3 estimating standard defined in Section 1.2 of the AACEI standard.

7.2 Estimate Classification

The estimate for each technology has been prepared in accordance with AACEI 18R-97: Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Process Industries. The estimates provided in this report are being classified as Class 3 estimates.

According to AACEI, “Class 3 estimates are generally prepared to form the basis for budget authorization, appropriation, and/or funding. As such, they typically form the initial control estimate against which all actual costs and resources will be monitored. Typically, engineering is from 10% to 40% complete, and would comprise at a minimum the following: process flow diagrams, utility flow diagrams, preliminary piping and instrument diagrams, plot plan, developed layout drawings, and essentially complete engineered process and utility equipment lists.”

According to AACEI, the estimating methodology for, “Class 3 estimates generally involve more deterministic estimating methods than stochastic methods. They usually involve predominant use of unit cost line items, although these may be at an assembly level of detail rather than individual components. Factoring and other stochastic methods may be used to estimate less-significant areas of the project.”

According to AACEI, the expected accuracy range for, “Class 3 estimates are -10% to -20% on the low side, and +10% to +30% on the high side, depending on the technological complexity of the project, appropriate reference information, and other risks (after inclusion of an appropriate contingency determination). Ranges could exceed those shown if there are unusual risks.”

Following the methodology outlined in Section 7.1 and the estimate standards outlined in this section, the cost estimate details for each of the technologies were developed and are provided in Section 7.3, a summary of all technologies is provided in Table 7.3-1.

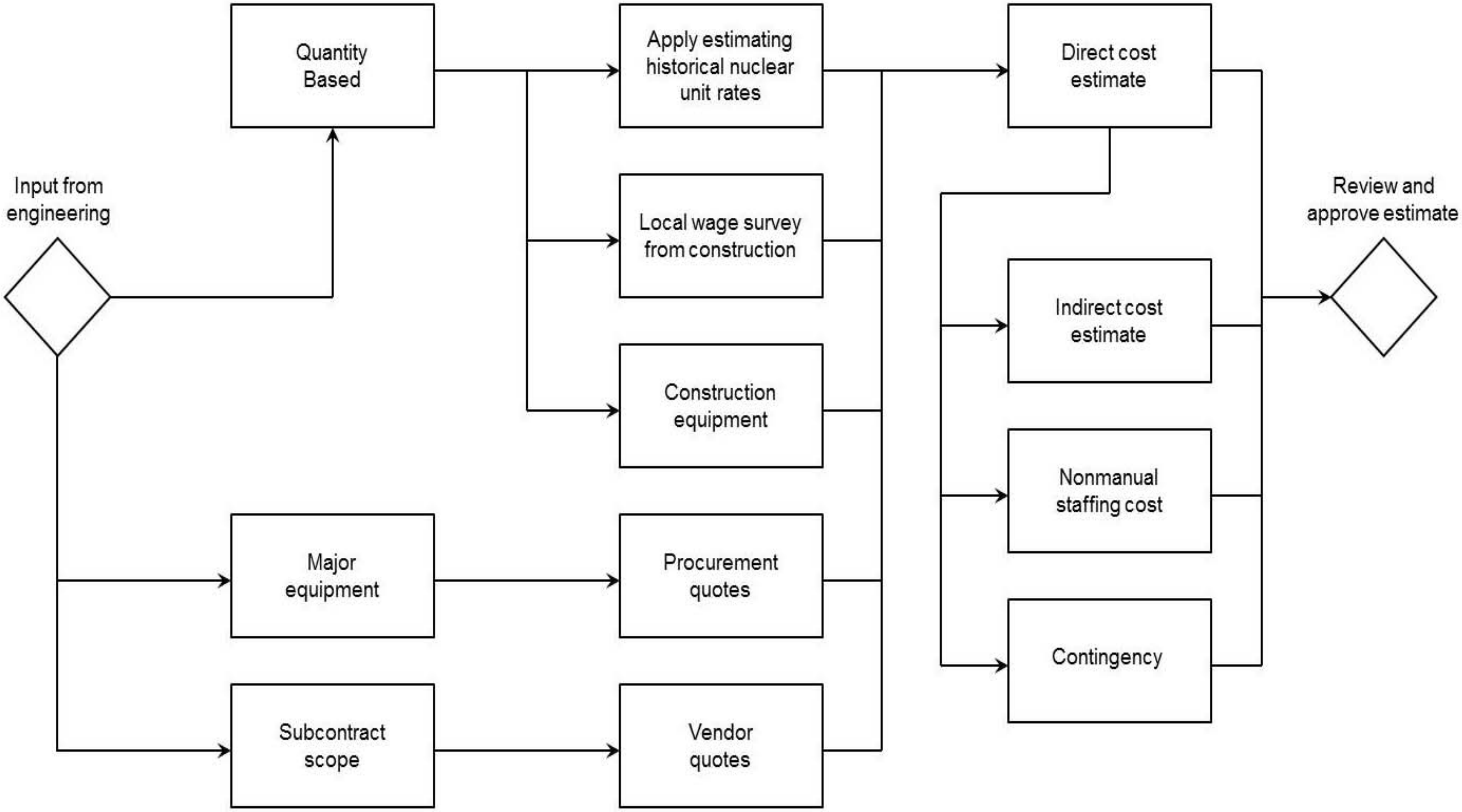


Figure 7.1-1. Phase 2 Estimating Process for Each Technology

7.3 Estimate Summary

The estimates for all technologies are summarized in Table 7.3-1.

Table 7.3-1. Technology Estimate Summary

Technology	Project Cost ($ x 1,000,000)	PG&E Costs ($ x 1,000,000)	Grand Total[1] ($ x 1,000,000)
Mechanical (Forced) Draft Dry/Air Cooling [2]	7,026 – 10,960	1,493	8,519 - 12,453
Passive Draft Dry/Air Cooling [3]	7,038 – 10,979	1,374	8,412 – 12,353
Wet Mechanical (Forced) Draft Cooling	5,501 – 8,581	1,374	6,875 – 9,955
Wet Natural Draft Cooling	7,011 – 10,938	1,493	8,504 – 12,431
Hybrid Wet/Dry Cooling	5,480 – 8,549	1,374	6,854 – 9,923
Onshore Mechanical Fine Mesh Screening	164 - 256	237	371 - 493
Offshore Modular Wedge Wire Screening System	261 - 407	0	261 - 407

7.3.1 Estimate Summary Explained

The estimate summary is explained in the Table 7.3.1-1.

The estimate summaries for each technology are provided below:

DCPP Once Through Cooling System TECHNOLOGY OPTION Estimate Summary		
Description		**Comments**
Civil		Typical items included are material, labor and subcontract costs for mountain excavation, foundation excavation and back fill, concrete, structural steel and architectural as applicable.
Mechanical		Typical items included are material, labor and subcontract costs for cooling towers, rotating equipment, steam generator blade replacements, condenser upgrades, water treatment, tanks and other mechanical equipment as applicable

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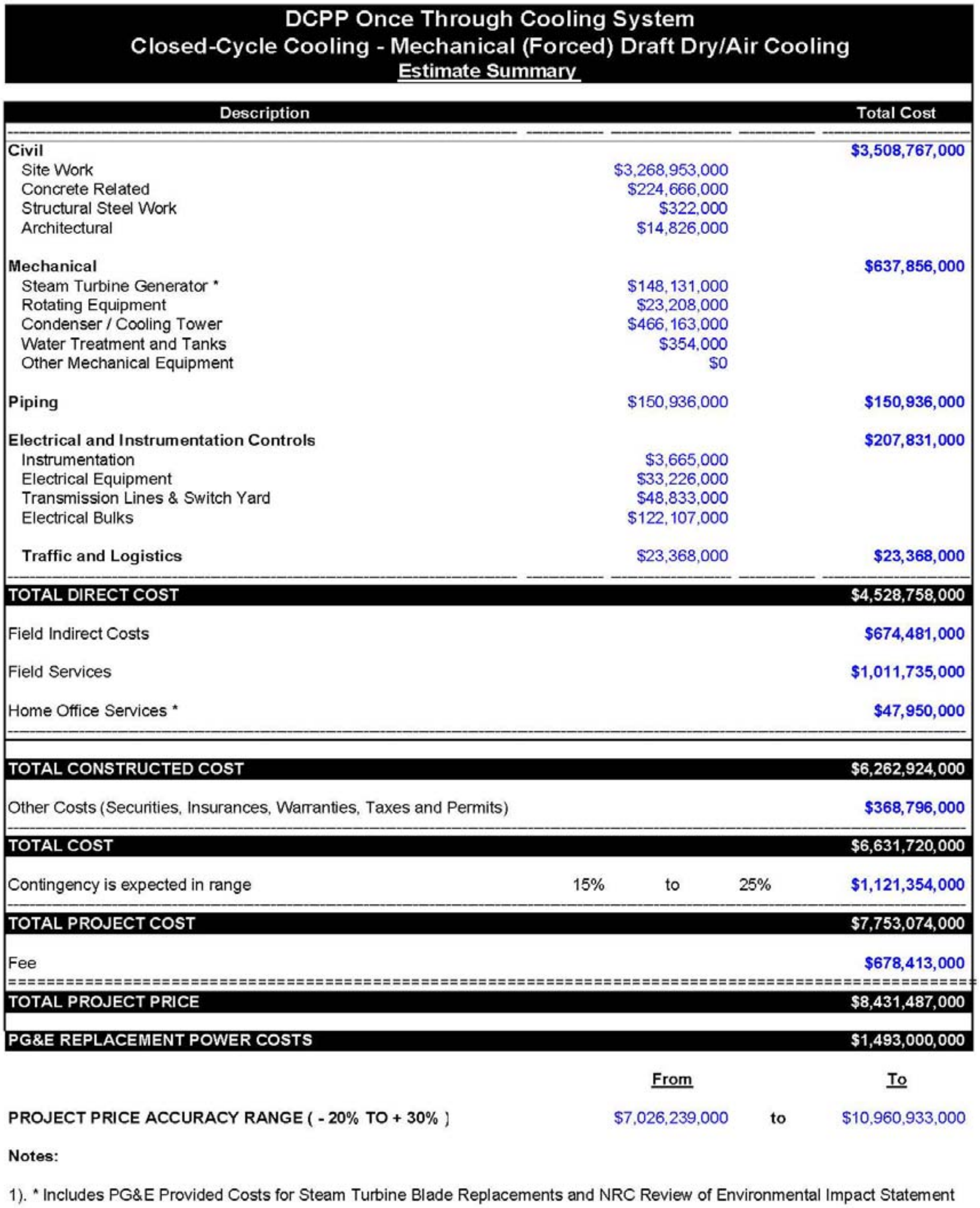
[1] All technology estimates include PG&E provided cost for USNRC review of environmental impact statements

[2, 3] Includes PG&E-provided steam turbine replacement costs.

Piping		Typical items included are material, labor and subcontract costs for piping systems associated with recycle water pipe line, service and fire water systems as applicable.
Electrical and Instrumentation Controls		Typical items included are material, labor and subcontract costs associated with instrumentation, electrical equipment, transmission lines, switch yard and electrical bulks as applicable
Traffic and Logistics		Includes freight costs for materials.
TOTAL DIRECT COST		
Other Field Costs (Field Non-Manual, Craft Distributables)		Typical Items included are field craft indirect labor (such as Temporary construction, housekeeping, tool room management, etc.) and materials (such as small tools, consumables, construction equipment, cranes, craft break trailer, office trailers, etc.), field non-manual labor (such as craft supervision, field engineering, safety, quality, field project controls, etc.) and their other direct costs such as (computers, internet, office supplies, business travel, relocation and living costs, etc.).
Engineering Services		Includes engineering and other home office services costs
TOTAL CONSTRUCTED COST		
Other Costs (Securities, Insurances, Taxes Warranties and Permits)		Insurances, Securities, Sales Taxes, Construction Permits, etc.
TOTAL COST		
Contingency is expected in range		Appropriate contingency for unknowns
TOTAL PROJECT COST		
Fee		Contractor fee
TOTAL PROJECT PRICE		

7.3.2 Mechanical (Forced) Dry/Air Cooling

Mechanical (forced) dry/air cooling is summarized in the following table.



DCPP Once Through Cooling System
Closed-Cycle Cooling - Mechanical (Forced) Draft Dry/Air Cooling
Estimate Summary

Description				Total Cost
Civil				$3,508,767,000
Site Work	$3,268,953,000			
Concrete Related	$224,666,000			
Structural Steel Work	$322,000			
Architectural	$14,826,000			
Mechanical				$637,856,000
Steam Turbine Generator *	$148,131,000			
Rotating Equipment	$23,208,000			
Condenser / Cooling Tower	$466,163,000			
Water Treatment and Tanks	$354,000			
Other Mechanical Equipment	$0			
Piping	$150,936,000			$150,936,000
Electrical and Instrumentation Controls				$207,831,000
Instrumentation	$3,665,000			
Electrical Equipment	$33,226,000			
Transmission Lines & Switch Yard	$48,833,000			
Electrical Bulks	$122,107,000			
Traffic and Logistics	$23,368,000			$23,368,000
TOTAL DIRECT COST				$4,528,758,000
Field Indirect Costs				$674,481,000
Field Services				$1,011,735,000
Home Office Services *				$47,950,000
TOTAL CONSTRUCTED COST				$6,262,924,000
Other Costs (Securities, Insurances, Warranties, Taxes and Permits)				$368,796,000
TOTAL COST				$6,631,720,000
Contingency is expected in range	15%	to	25%	$1,121,354,000
TOTAL PROJECT COST				$7,753,074,000
Fee				$678,413,000
TOTAL PROJECT PRICE				$8,431,487,000
PG&E REPLACEMENT POWER COSTS				$1,493,000,000

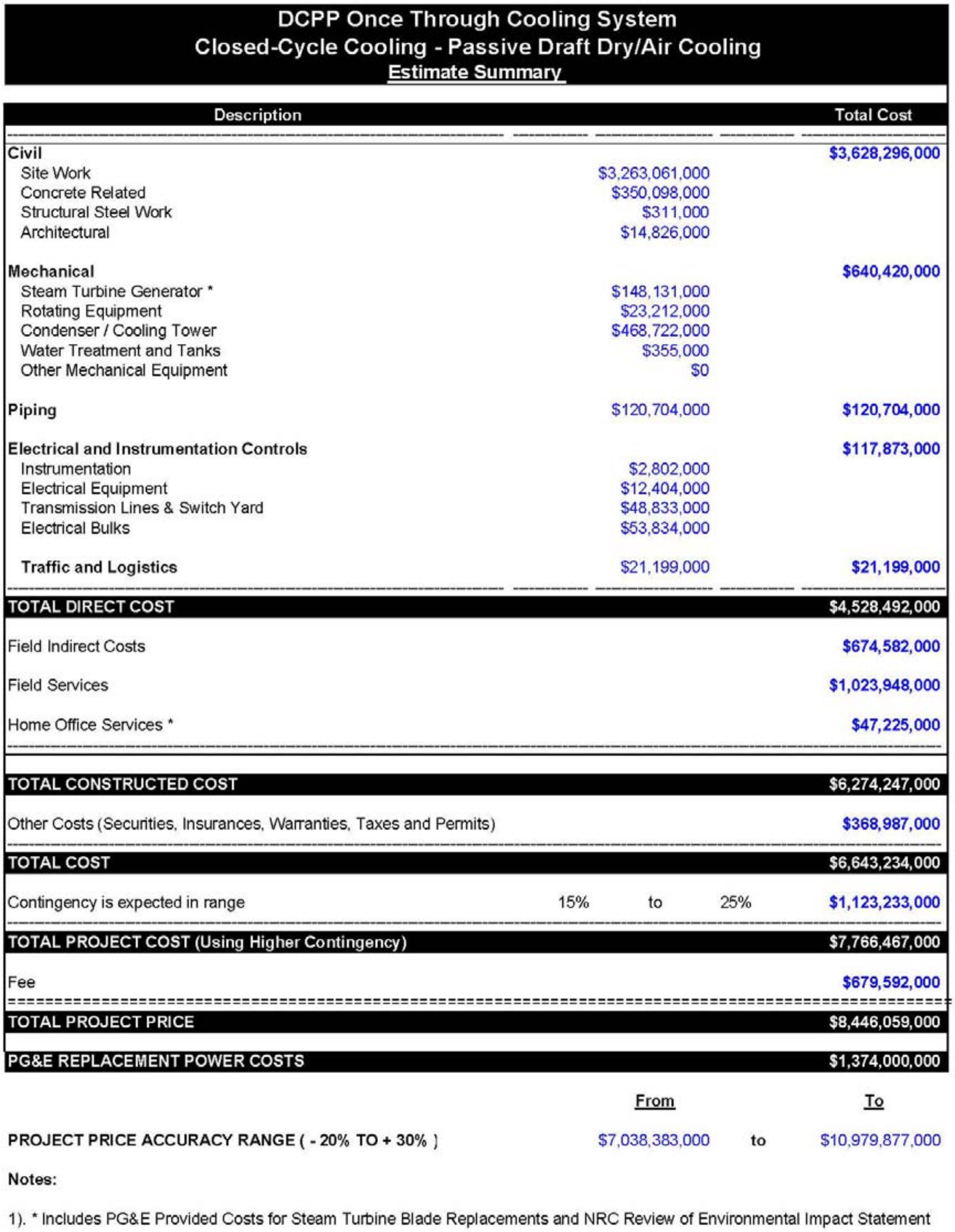
	From		To
PROJECT PRICE ACCURACY RANGE (- 20% TO + 30%)	$7,026,239,000	to	$10,960,933,000

Notes:

1). * Includes PG&E Provided Costs for Steam Turbine Blade Replacements and NRC Review of Environmental Impact Statement

7.3.3 Passive Draft Dry/Air Cooling

Passive draft dry/air cooling is summarized in the following table.



DCPP Once Through Cooling System
Closed-Cycle Cooling - Passive Draft Dry/Air Cooling
Estimate Summary

Description				Total Cost
Civil				$3,628,296,000
Site Work	$3,263,061,000			
Concrete Related	$350,098,000			
Structural Steel Work	$311,000			
Architectural	$14,826,000			
Mechanical				$640,420,000
Steam Turbine Generator *	$148,131,000			
Rotating Equipment	$23,212,000			
Condenser / Cooling Tower	$468,722,000			
Water Treatment and Tanks	$355,000			
Other Mechanical Equipment	$0			
Piping	$120,704,000			$120,704,000
Electrical and Instrumentation Controls				$117,873,000
Instrumentation	$2,802,000			
Electrical Equipment	$12,404,000			
Transmission Lines & Switch Yard	$48,833,000			
Electrical Bulks	$53,834,000			
Traffic and Logistics	$21,199,000			$21,199,000
TOTAL DIRECT COST				$4,528,492,000
Field Indirect Costs				$674,582,000
Field Services				$1,023,948,000
Home Office Services *				$47,225,000
TOTAL CONSTRUCTED COST				$6,274,247,000
Other Costs (Securities, Insurances, Warranties, Taxes and Permits)				$368,987,000
TOTAL COST				$6,643,234,000
Contingency is expected in range	15%	to	25%	$1,123,233,000
TOTAL PROJECT COST (Using Higher Contingency)				$7,766,467,000
Fee				$679,592,000
TOTAL PROJECT PRICE				$8,446,059,000
PG&E REPLACEMENT POWER COSTS				$1,374,000,000

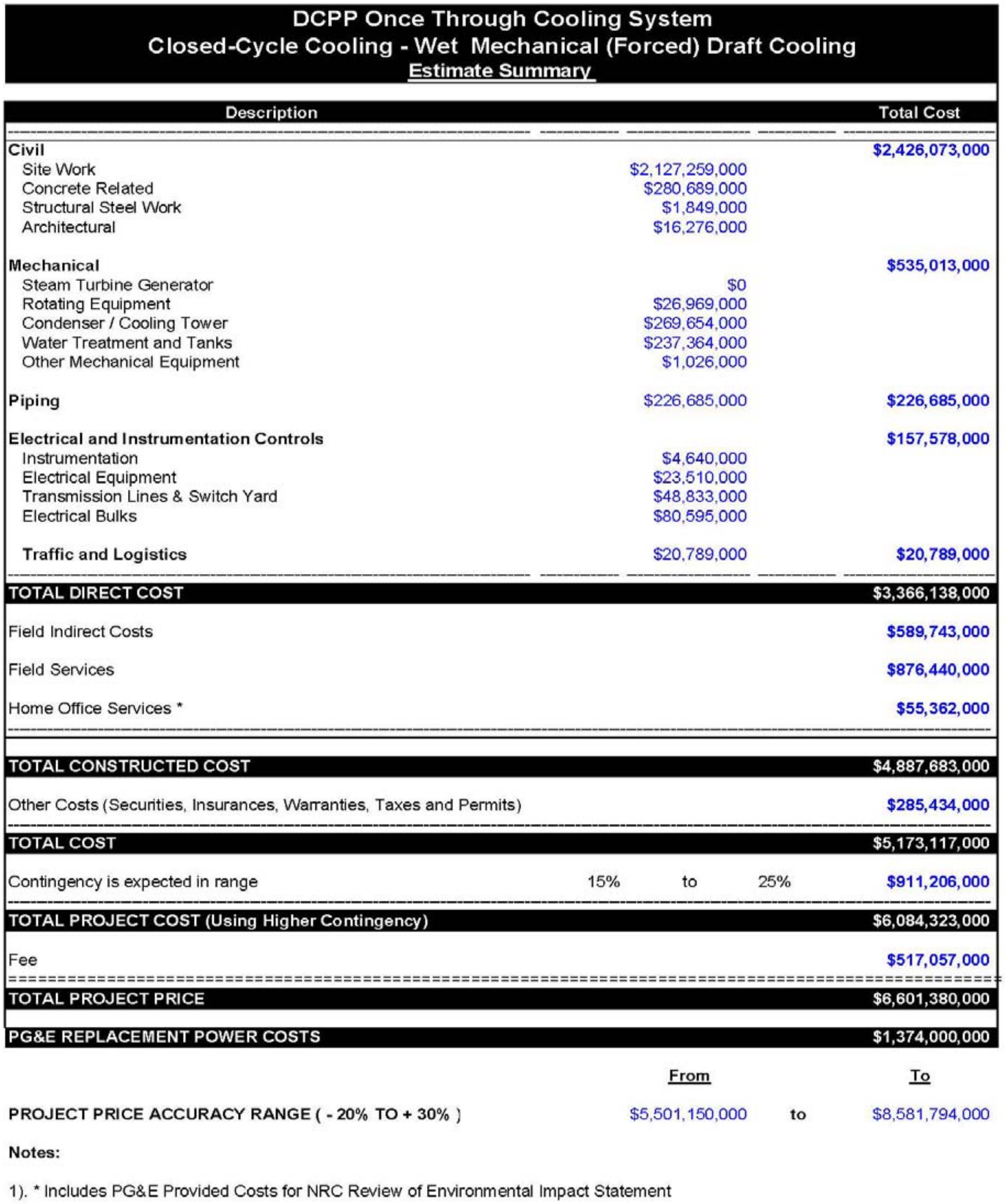
	From		To
PROJECT PRICE ACCURACY RANGE (- 20% TO + 30%)	$7,038,383,000	to	$10,979,877,000

Notes:

1). * Includes PG&E Provided Costs for Steam Turbine Blade Replacements and NRC Review of Environmental Impact Statement

7.3.4 Wet Mechanical (Forced) Draft Cooling

Wet mechanical (forced) draft cooling is summarized in the following table.



DCPP Once Through Cooling System
Closed-Cycle Cooling - Wet Mechanical (Forced) Draft Cooling
Estimate Summary

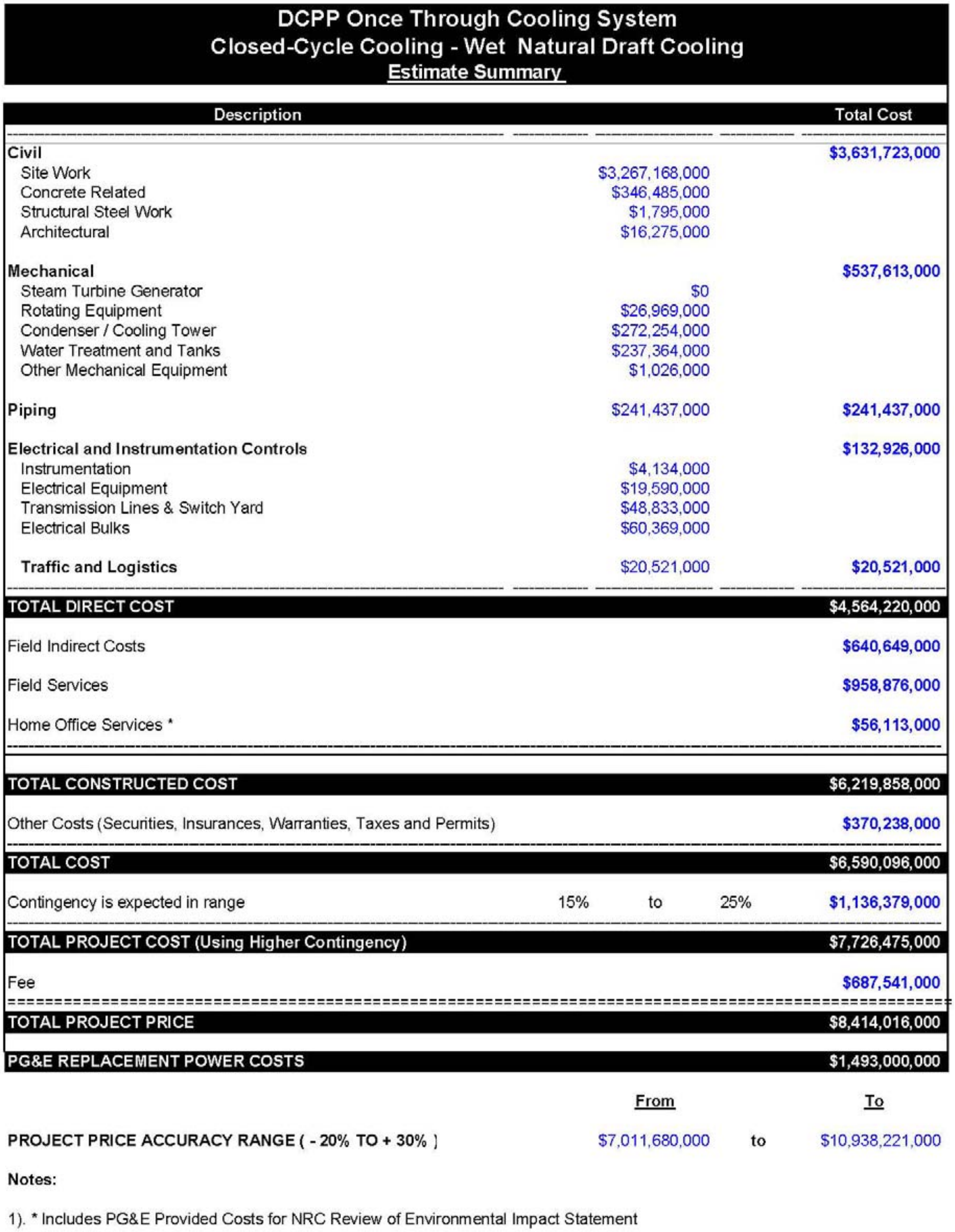
Description				Total Cost
Civil				$2,426,073,000
Site Work	$2,127,259,000			
Concrete Related	$280,689,000			
Structural Steel Work	$1,849,000			
Architectural	$16,276,000			
Mechanical				$535,013,000
Steam Turbine Generator	$0			
Rotating Equipment	$26,969,000			
Condenser / Cooling Tower	$269,654,000			
Water Treatment and Tanks	$237,364,000			
Other Mechanical Equipment	$1,026,000			
Piping	$226,685,000			$226,685,000
Electrical and Instrumentation Controls				$157,578,000
Instrumentation	$4,640,000			
Electrical Equipment	$23,510,000			
Transmission Lines & Switch Yard	$48,833,000			
Electrical Bulks	$80,595,000			
Traffic and Logistics	$20,789,000			$20,789,000
TOTAL DIRECT COST				$3,366,138,000
Field Indirect Costs				$589,743,000
Field Services				$876,440,000
Home Office Services *				$55,362,000
TOTAL CONSTRUCTED COST				$4,887,683,000
Other Costs (Securities, Insurances, Warranties, Taxes and Permits)				$285,434,000
TOTAL COST				$5,173,117,000
Contingency is expected in range	15%	to	25%	$911,206,000
TOTAL PROJECT COST (Using Higher Contingency)				$6,084,323,000
Fee				$517,057,000
TOTAL PROJECT PRICE				$6,601,380,000
PG&E REPLACEMENT POWER COSTS				$1,374,000,000
	From			To
PROJECT PRICE ACCURACY RANGE (- 20% TO + 30%)	$5,501,150,000	to		$8,581,794,000

Notes:

1). * Includes PG&E Provided Costs for NRC Review of Environmental Impact Statement

7.3.5 Wet Natural Draft Cooling

Wet natural draft cooling is summarized in the following table.



DCPP Once Through Cooling System
Closed-Cycle Cooling - Wet Natural Draft Cooling
Estimate Summary

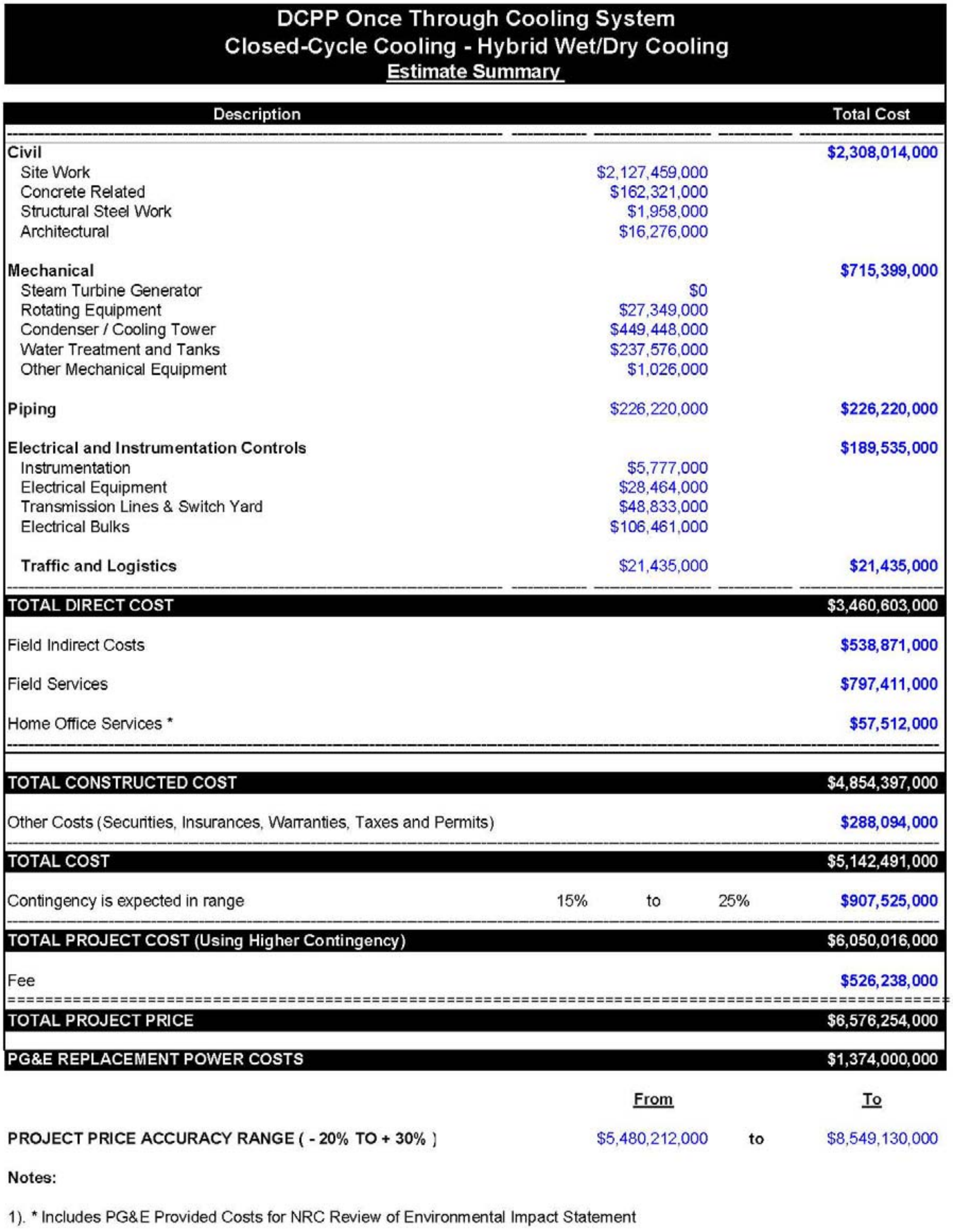
Description				Total Cost
Civil				$3,631,723,000
Site Work		$3,267,168,000		
Concrete Related		$346,485,000		
Structural Steel Work		$1,795,000		
Architectural		$16,275,000		
Mechanical				$537,613,000
Steam Turbine Generator		$0		
Rotating Equipment		$26,969,000		
Condenser / Cooling Tower		$272,254,000		
Water Treatment and Tanks		$237,364,000		
Other Mechanical Equipment		$1,026,000		
Piping		$241,437,000		$241,437,000
Electrical and Instrumentation Controls				$132,926,000
Instrumentation		$4,134,000		
Electrical Equipment		$19,590,000		
Transmission Lines & Switch Yard		$48,833,000		
Electrical Bulks		$60,369,000		
Traffic and Logistics		$20,521,000		$20,521,000
TOTAL DIRECT COST				$4,564,220,000
Field Indirect Costs				$640,649,000
Field Services				$958,876,000
Home Office Services *				$56,113,000
TOTAL CONSTRUCTED COST				$6,219,858,000
Other Costs (Securities, Insurances, Warranties, Taxes and Permits)				$370,238,000
TOTAL COST				$6,590,096,000
Contingency is expected in range	15%	to	25%	$1,136,379,000
TOTAL PROJECT COST (Using Higher Contingency)				$7,726,475,000
Fee				$687,541,000
TOTAL PROJECT PRICE				$8,414,016,000
PG&E REPLACEMENT POWER COSTS				$1,493,000,000
		From		To
PROJECT PRICE ACCURACY RANGE (- 20% TO + 30%)		$7,011,680,000	to	$10,938,221,000

Notes:

1). * Includes PG&E Provided Costs for NRC Review of Environmental Impact Statement

7.3.6 Hybrid Wet/Dry Cooling

Hybrid wet/dry cooling is summarized in the following table.



DCPP Once Through Cooling System
Closed-Cycle Cooling - Hybrid Wet/Dry Cooling
Estimate Summary

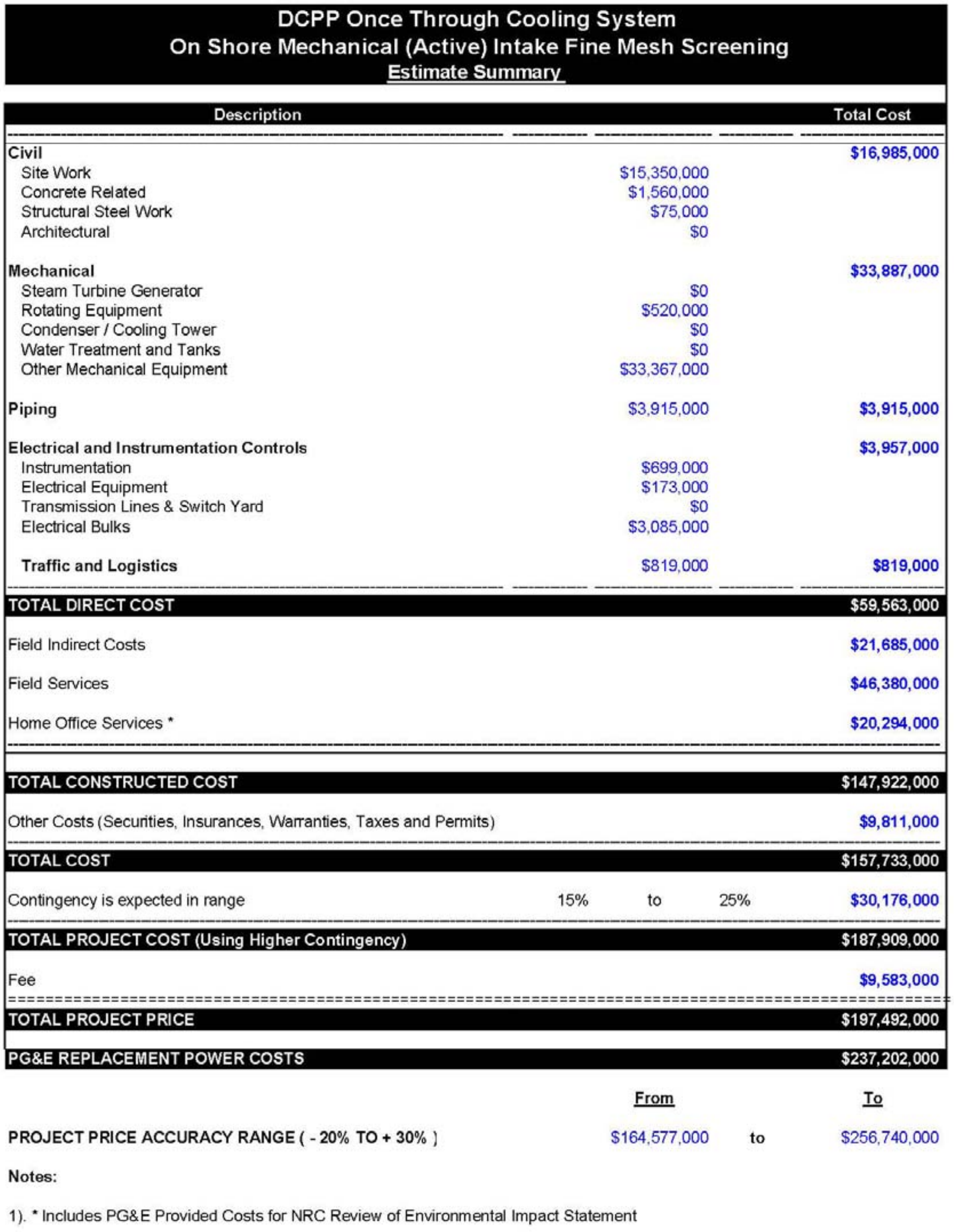
Description				Total Cost
Civil				$2,308,014,000
Site Work		$2,127,459,000		
Concrete Related		$162,321,000		
Structural Steel Work		$1,958,000		
Architectural		$16,276,000		
Mechanical				$715,399,000
Steam Turbine Generator		$0		
Rotating Equipment		$27,349,000		
Condenser / Cooling Tower		$449,448,000		
Water Treatment and Tanks		$237,576,000		
Other Mechanical Equipment		$1,026,000		
Piping		$226,220,000		$226,220,000
Electrical and Instrumentation Controls				$189,535,000
Instrumentation		$5,777,000		
Electrical Equipment		$28,464,000		
Transmission Lines & Switch Yard		$48,833,000		
Electrical Bulks		$106,461,000		
Traffic and Logistics		$21,435,000		$21,435,000
TOTAL DIRECT COST				$3,460,603,000
Field Indirect Costs				$538,871,000
Field Services				$797,411,000
Home Office Services *				$57,512,000
TOTAL CONSTRUCTED COST				$4,854,397,000
Other Costs (Securities, Insurances, Warranties, Taxes and Permits)				$288,094,000
TOTAL COST				$5,142,491,000
Contingency is expected in range	15%	to	25%	$907,525,000
TOTAL PROJECT COST (Using Higher Contingency)				$6,050,016,000
Fee				$526,238,000
TOTAL PROJECT PRICE				$6,576,254,000
PG&E REPLACEMENT POWER COSTS				$1,374,000,000
		From		To
PROJECT PRICE ACCURACY RANGE (- 20% TO + 30%)		$5,480,212,000	to	$8,549,130,000

Notes:

1). * Includes PG&E Provided Costs for NRC Review of Environmental Impact Statement

7.3.7 Onshore Mechanical (Active) Fine Mesh Screening

Onshore mechanical (active) fine mesh screening is summarized in the following table.



DCPP Once Through Cooling System
On Shore Mechanical (Active) Intake Fine Mesh Screening
Estimate Summary

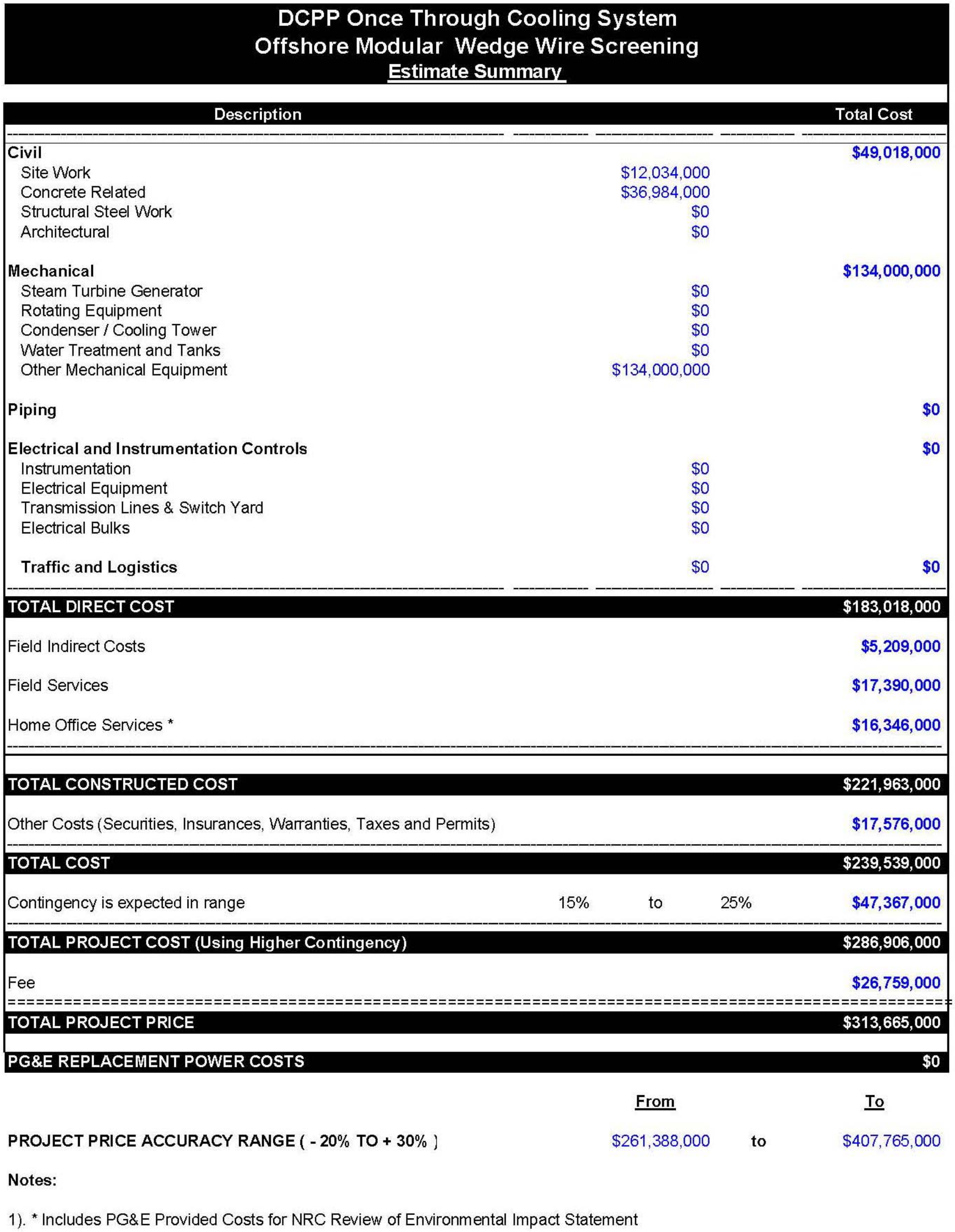
Description				Total Cost
Civil				$16,985,000
Site Work	$15,350,000			
Concrete Related	$1,560,000			
Structural Steel Work	$75,000			
Architectural	$0			
Mechanical				$33,887,000
Steam Turbine Generator	$0			
Rotating Equipment	$520,000			
Condenser / Cooling Tower	$0			
Water Treatment and Tanks	$0			
Other Mechanical Equipment	$33,367,000			
Piping	$3,915,000			$3,915,000
Electrical and Instrumentation Controls				$3,957,000
Instrumentation	$699,000			
Electrical Equipment	$173,000			
Transmission Lines & Switch Yard	$0			
Electrical Bulks	$3,085,000			
Traffic and Logistics	$819,000			$819,000
TOTAL DIRECT COST				$59,563,000
Field Indirect Costs				$21,685,000
Field Services				$46,380,000
Home Office Services *				$20,294,000
TOTAL CONSTRUCTED COST				$147,922,000
Other Costs (Securities, Insurances, Warranties, Taxes and Permits)				$9,811,000
TOTAL COST				$157,733,000
Contingency is expected in range	15%	to	25%	$30,176,000
TOTAL PROJECT COST (Using Higher Contingency)				$187,909,000
Fee				$9,583,000
TOTAL PROJECT PRICE				$197,492,000
PG&E REPLACEMENT POWER COSTS				$237,202,000
	From			To
PROJECT PRICE ACCURACY RANGE (- 20% TO + 30%)	$164,577,000	to		$256,740,000

Notes:

1). * Includes PG&E Provided Costs for NRC Review of Environmental Impact Statement

7.3.8 Offshore Modular Wedge Wire Screening

Offshore modular wedge wire screening is summarized in the following table.



DCPP Once Through Cooling System
Offshore Modular Wedge Wire Screening
Estimate Summary

Description				Total Cost
Civil				$49,018,000
Site Work		$12,034,000		
Concrete Related		$36,984,000		
Structural Steel Work		$0		
Architectural		$0		
Mechanical				$134,000,000
Steam Turbine Generator		$0		
Rotating Equipment		$0		
Condenser / Cooling Tower		$0		
Water Treatment and Tanks		$0		
Other Mechanical Equipment		$134,000,000		
Piping				$0
Electrical and Instrumentation Controls				$0
Instrumentation		$0		
Electrical Equipment		$0		
Transmission Lines & Switch Yard		$0		
Electrical Bulks		$0		
Traffic and Logistics		$0		$0
TOTAL DIRECT COST				$183,018,000
Field Indirect Costs				$5,209,000
Field Services				$17,390,000
Home Office Services *				$16,346,000
TOTAL CONSTRUCTED COST				$221,963,000
Other Costs (Securities, Insurances, Warranties, Taxes and Permits)				$17,576,000
TOTAL COST				$239,539,000
Contingency is expected in range	15%	to	25%	$47,367,000
TOTAL PROJECT COST (Using Higher Contingency)				$286,906,000
Fee				$26,759,000
TOTAL PROJECT PRICE				$313,665,000
PG&E REPLACEMENT POWER COSTS				$0
		From		**To**
PROJECT PRICE ACCURACY RANGE (- 20% TO + 30%)		$261,388,000	to	$407,765,000

Notes:

1). * Includes PG&E Provided Costs for NRC Review of Environmental Impact Statement

The details used to develop estimates above are explained in the following sections.

7.4 Quantity Development

Engineering prepared the scope of work documents and quantity takeoffs in support of a Class 3 estimate and provided those documents to the Estimating department for each closed-cycle cooling technology and the onshore mechanical fine mesh screening technology separately. Estimating prepared an estimate for the technologies based on the following:

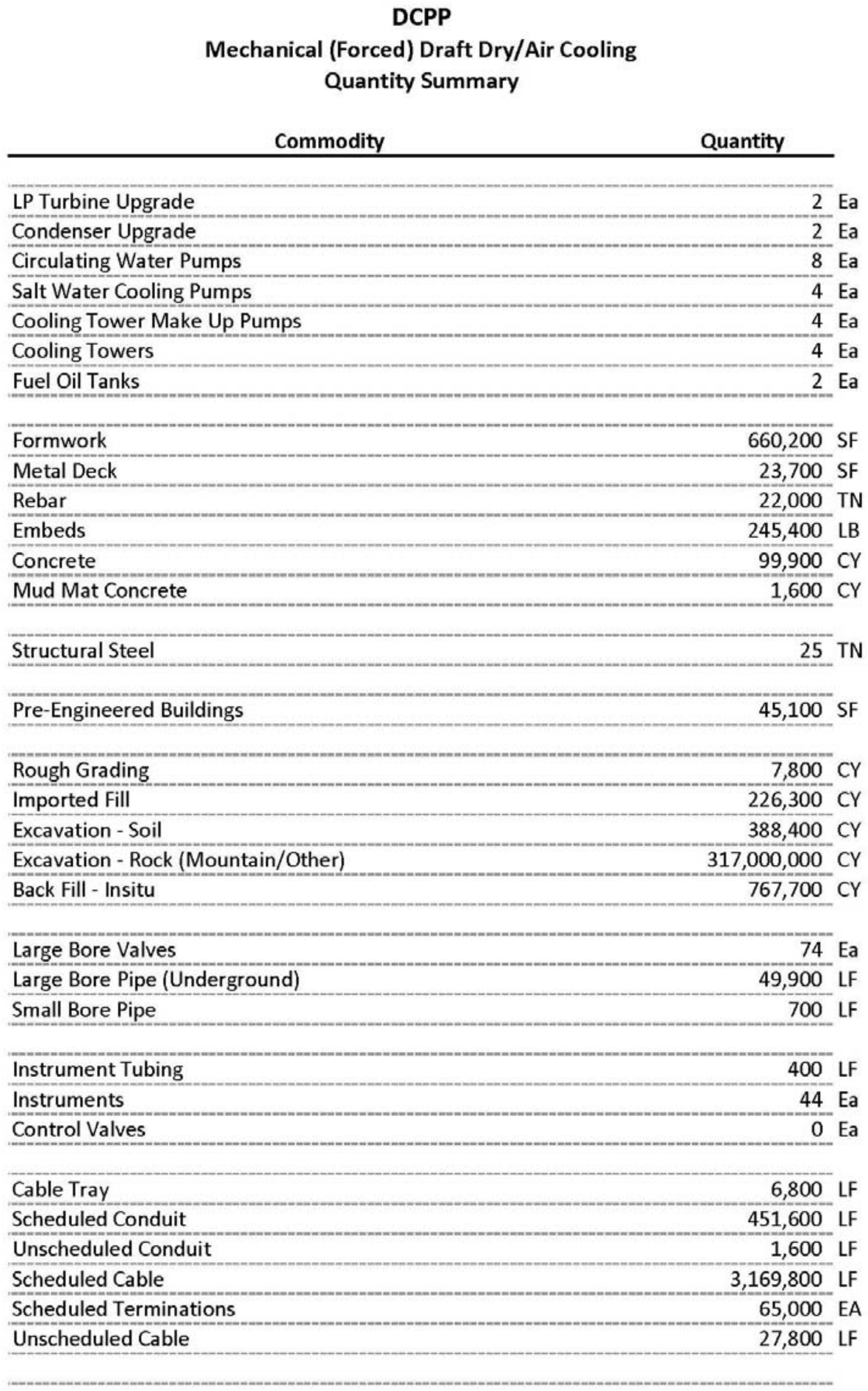
Item	Comments
Plant Layout/General Arrangement	Preliminary plot plans based on equipment layouts from vendors
Site Work	Preliminary based on volume of mountain excavation, CW duct excavation, underground pipeline excavations, and foundation excavations
Concrete	Preliminary foundation designs
Steel	Preliminary steel designs
Mechanical Equipment	Equipment lists
Concrete CW Ducts	Preliminary layout drawings
Piping	Based on preliminary piping and instrumentation diagrams (P&IDs) and layout drawings
Electrical Equipment	Preliminary single-line diagrams
Electrical Bulks	Based on preliminary layout and equipment location
Instruments and Controls	Based on Preliminary P&I Schematics

For the offshore modular wedge wire screening option, Engineering prepared a performance specification with all the necessary drawings and documents to solicit budgetary quotes for a complete marine works package. Estimating validated the quotes received for the marine works package based on clarification meeting with the selected vendor and in house data. Estimating prepared quantity takeoffs from drawings in the performance specification and estimated costs for extending and sealing the existing breakwater on a direct-hire union construction basis. The selected vendor quote and estimate for extending and sealing the existing breakwater form the basis of the offshore modular wedge wire screening estimate.

The following sections provide quantity summaries for each technology.

7.4.1 Mechanical (Forced) Dry/Air Cooling

Mechanical (forced) dry/air cooling quantities are summarized in the following table.



DCPP
Mechanical (Forced) Draft Dry/Air Cooling
Quantity Summary

Commodity	Quantity	
LP Turbine Upgrade	2	Ea
Condenser Upgrade	2	Ea
Circulating Water Pumps	8	Ea
Salt Water Cooling Pumps	4	Ea
Cooling Tower Make Up Pumps	4	Ea
Cooling Towers	4	Ea
Fuel Oil Tanks	2	Ea
Formwork	660,200	SF
Metal Deck	23,700	SF
Rebar	22,000	TN
Embeds	245,400	LB
Concrete	99,900	CY
Mud Mat Concrete	1,600	CY
Structural Steel	25	TN
Pre-Engineered Buildings	45,100	SF
Rough Grading	7,800	CY
Imported Fill	226,300	CY
Excavation - Soil	388,400	CY
Excavation - Rock (Mountain/Other)	317,000,000	CY
Back Fill - Insitu	767,700	CY
Large Bore Valves	74	Ea
Large Bore Pipe (Underground)	49,900	LF
Small Bore Pipe	700	LF
Instrument Tubing	400	LF
Instruments	44	Ea
Control Valves	0	Ea
Cable Tray	6,800	LF
Scheduled Conduit	451,600	LF
Unscheduled Conduit	1,600	LF
Scheduled Cable	3,169,800	LF
Scheduled Terminations	65,000	EA
Unscheduled Cable	27,800	LF

7.4.2 Passive Draft Dry/Air Cooling

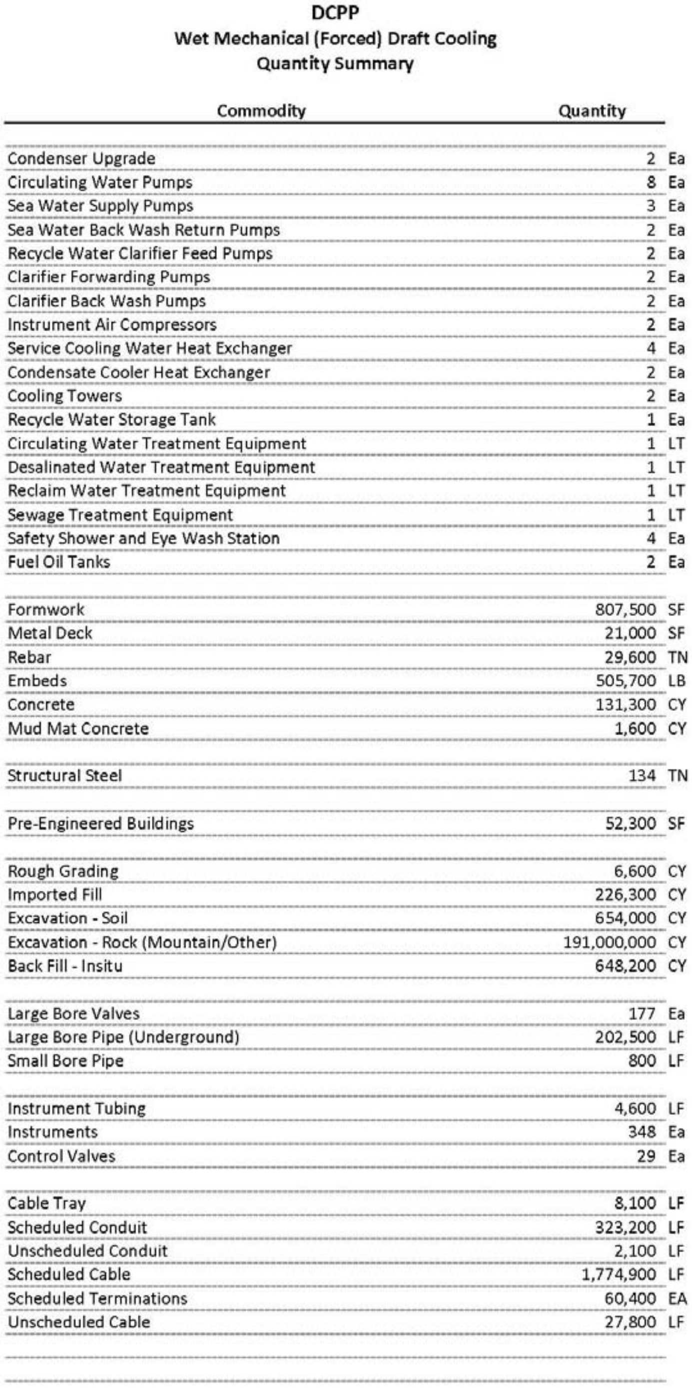
Passive draft dry/air cooling quantities are summarized in the following table.

DCPP
Passive Draft Dry/Air Cooling
Quantity Summary

Commodity	Quantity	
LP Turbine Upgrade	2	Ea
Condenser Upgrade	2	Ea
Circulating Water Pumps	8	Ea
Salt Water Cooling Pumps	4	Ea
Cooling Tower Make Up Pumps	4	Ea
Cooling Towers	4	Ea
Fuel Oil Tanks	2	Ea
Formwork	1,159,200	SF
Metal Deck	3,800	SF
Rebar	36,500	TN
Embeds	625,800	LB
Concrete	157,300	CY
Mud Mat Concrete	1,600	CY
Structural Steel	25	TN
Pre-Engineered Buildings	45,100	SF
Rough Grading	8,600	CY
Imported Fill	226,400	CY
Excavation - Soil	381,700	CY
Excavation - Rock (Mountain/Other)	317,000,000	CY
Back Fill - Insitu	787,600	CY
Large Bore Valves	74	Ea
Large Bore Pipe (Underground)	40,500	LF
Small Bore Pipe	600	LF
Instrument Tubing	1,600	LF
Instruments	452	Ea
Control Valves	0	Ea
Cable Tray	2,600	LF
Scheduled Conduit	217,300	LF
Unscheduled Conduit	1,600	LF
Scheduled Cable	1,551,800	LF
Scheduled Terminations	22,900	EA
Unscheduled Cable	25,000	LF

7.4.3 Wet Mechanical (Forced) Draft Cooling

Wet mechanical (forced) draft cooling quantities are summarized in the following table.



DCPP
Wet Mechanical (Forced) Draft Cooling
Quantity Summary

Commodity	Quantity	
Condenser Upgrade	2	Ea
Circulating Water Pumps	8	Ea
Sea Water Supply Pumps	3	Ea
Sea Water Back Wash Return Pumps	2	Ea
Recycle Water Clarifier Feed Pumps	2	Ea
Clarifier Forwarding Pumps	2	Ea
Clarifier Back Wash Pumps	2	Ea
Instrument Air Compressors	2	Ea
Service Cooling Water Heat Exchanger	4	Ea
Condensate Cooler Heat Exchanger	2	Ea
Cooling Towers	2	Ea
Recycle Water Storage Tank	1	Ea
Circulating Water Treatment Equipment	1	LT
Desalinated Water Treatment Equipment	1	LT
Reclaim Water Treatment Equipment	1	LT
Sewage Treatment Equipment	1	LT
Safety Shower and Eye Wash Station	4	Ea
Fuel Oil Tanks	2	Ea
Formwork	807,500	SF
Metal Deck	21,000	SF
Rebar	29,600	TN
Embeds	505,700	LB
Concrete	131,300	CY
Mud Mat Concrete	1,600	CY
Structural Steel	134	TN
Pre-Engineered Buildings	52,300	SF
Rough Grading	6,600	CY
Imported Fill	226,300	CY
Excavation - Soil	654,000	CY
Excavation - Rock (Mountain/Other)	191,000,000	CY
Back Fill - Insitu	648,200	CY
Large Bore Valves	177	Ea
Large Bore Pipe (Underground)	202,500	LF
Small Bore Pipe	800	LF
Instrument Tubing	4,600	LF
Instruments	348	Ea
Control Valves	29	Ea
Cable Tray	8,100	LF
Scheduled Conduit	323,200	LF
Unscheduled Conduit	2,100	LF
Scheduled Cable	1,774,900	LF
Scheduled Terminations	60,400	EA
Unscheduled Cable	27,800	LF

7.4.4 Wet Natural Draft Cooling

Wet natural draft cooling quantities are summarized in the following table.

DCPP
Wet Natural Draft Cooling
Quantity Summary

Commodity	Quantity	
Condenser Upgrade	2	Ea
Circulating Water Pumps	8	Ea
Sea Water Supply Pumps	3	Ea
Sea Water Back Wash Return Pumps	2	Ea
Recycle Water Clarifier Feed Pumps	2	Ea
Clarifier Forwarding Pumps	2	Ea
Clarifier Back Wash Pumps	2	Ea
Instrument Air Compressors	2	Ea
Service Cooling Water Heat Exchanger	4	Ea
Condensate Cooler Heat Exchanger	2	Ea
Cooling Towers	4	Ea
Recycle Water Storage Tank	1	Ea
Circulating Water Treatment Equipment	1	LT
Desalinated Water Treatment Equipment	1	LT
Reclaim Water Treatment Equipment	1	LT
Sewage Treatment Equipment	1	LT
Safety Shower and Eye Wash Station	4	Ea
Formwork	952,000	SF
Metal Deck	14,300	SF
Rebar	40,100	TN
Embeds	717,700	LB
Concrete	173,600	CY
Mud Mat Concrete	1,600	CY
Structural Steel	130	TN
Pre-Engineered Buildings	52,300	SF
Rough Grading	10,100	CY
Imported Fill	226,300	CY
Excavation - Soil	643,900	CY
Excavation - Rock (Mountain/Other)	317,000,000	CY
Back Fill - Insitu	829,200	CY
Large Bore Valves	177	Ea
Large Bore Pipe (Underground)	205,900	LF
Small Bore Pipe	900	LF
Instrument Tubing	4,100	LF
Instruments	271	Ea
Control Valves	29	Ea
Cable Tray	6,300	LF
Scheduled Conduit	249,200	LF
Unscheduled Conduit	2,300	LF
Scheduled Cable	1,278,500	LF
Scheduled Terminations	48,900	EA
Unscheduled Cable	34,800	LF

7.4.5 Hybrid Wet/Dry Cooling

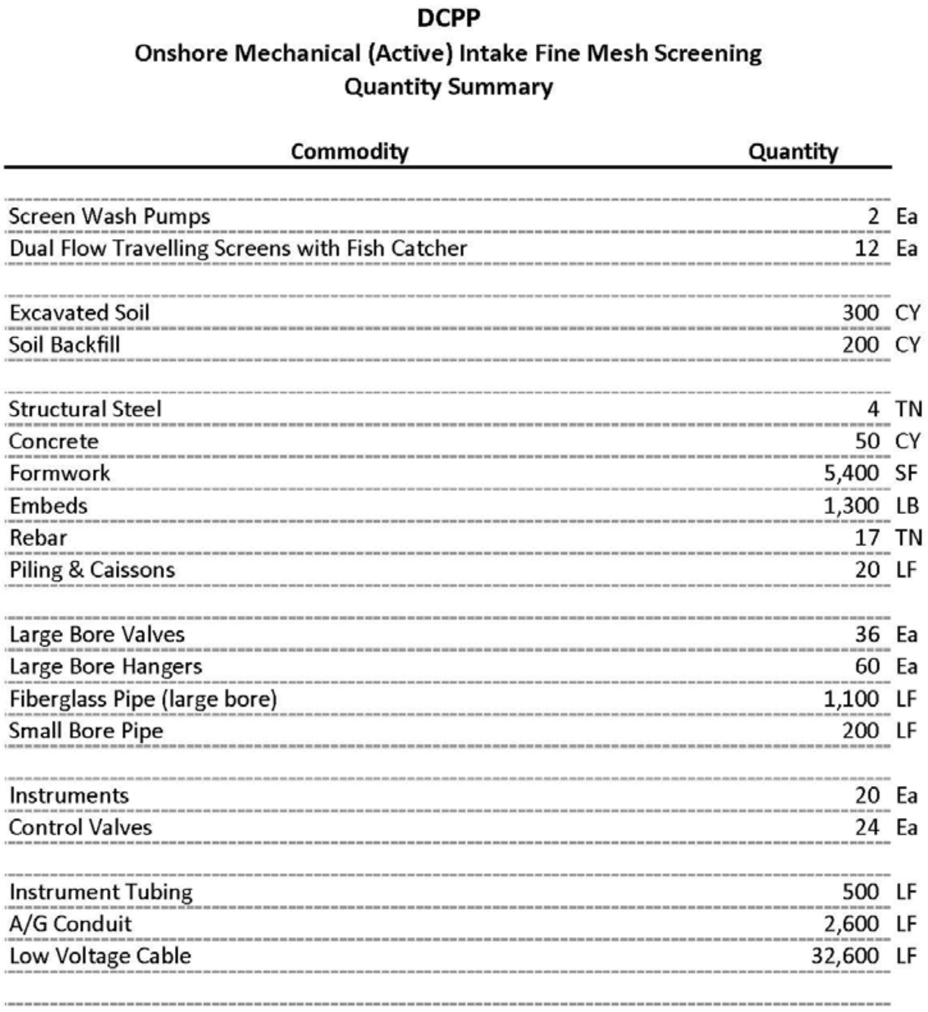
Hybrid wet/dry cooling quantities are summarized in the following table.

DCPP
Wet Natural Draft Cooling
Quantity Summary

Commodity	Quantity	
Condenser Upgrade	2	Ea
Circulating Water Pumps	8	Ea
Sea Water Supply Pumps	3	Ea
Sea Water Back Wash Return Pumps	2	Ea
Recycle Water Clarifier Feed Pumps	2	Ea
Clarifier Forwarding Pumps	2	Ea
Clarifier Back Wash Pumps	2	Ea
Instrument Air Compressors	2	Ea
Service Cooling Water Heat Exchanger	4	Ea
Condensate Cooler Heat Exchanger	2	Ea
Cooling Towers	4	Ea
Recycle Water Storage Tank	1	Ea
Circulating Water Treatment Equipment	1	LT
Desalinated Water Treatment Equipment	1	LT
Reclaim Water Treatment Equipment	1	LT
Sewage Treatment Equipment	1	LT
Safety Shower and Eye Wash Station	4	Ea
Fuel Oil Tanks	2	Ea
Formwork	952,000	SF
Metal Deck	14,300	SF
Rebar	40,100	TN
Embeds	718,300	LB
Concrete	173,800	CY
Mud Mat Concrete	1,600	CY
Structural Steel	130	TN
Pre-Engineered Buildings	52,300	SF
Rough Grading	10,100	CY
Imported Fill	226,300	CY
Excavation - Soil	643,900	CY
Excavation - Rock (Mountain/Other)	317,000,000	CY
Back Fill - Insitu	829,200	CY
Large Bore Valves	177	Ea
Large Bore Pipe (Underground)	205,900	LF
Small Bore Pipe	900	LF
Instrument Tubing	4,100	LF
Instruments	271	Ea
Control Valves	29	Ea
Cable Tray	6,300	LF
Scheduled Conduit	249,200	LF
Unscheduled Conduit	2,300	LF
Scheduled Cable	1,278,500	LF
Scheduled Terminations	48,900	EA
Unscheduled Cable	34,800	LF

7.4.6 Onshore Mechanical Fine Mesh Screening

Onshore mechanical fine mesh screening quantities are summarized in the following table.

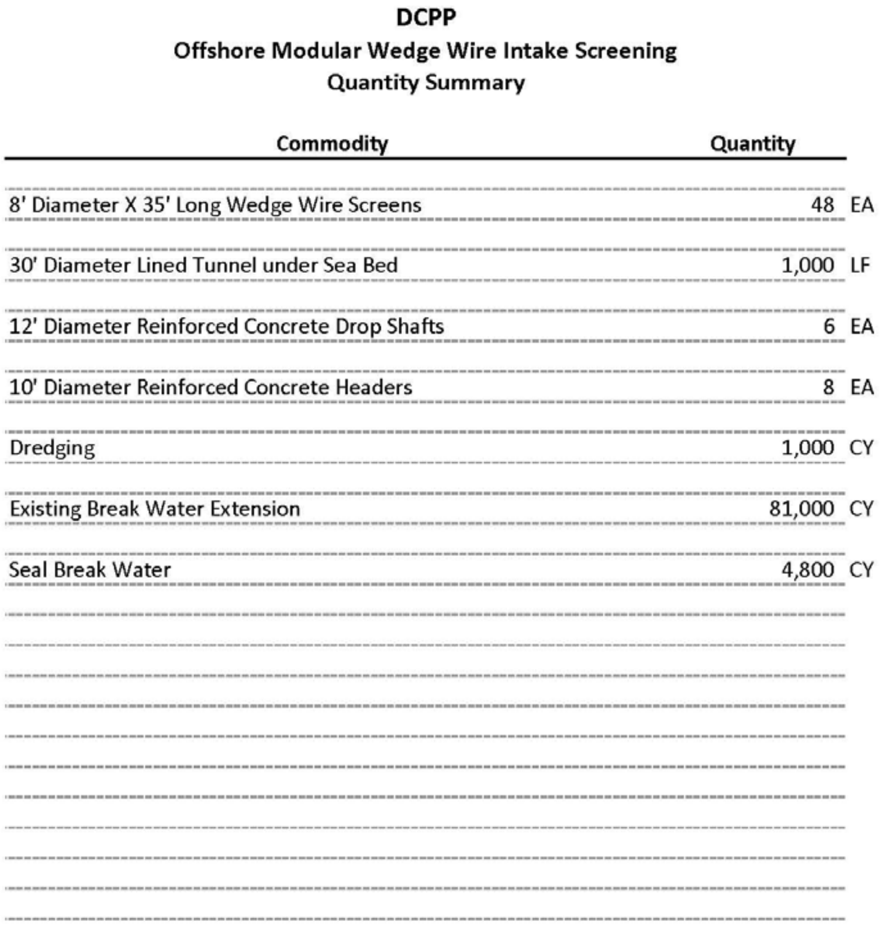


DCPP
Onshore Mechanical (Active) Intake Fine Mesh Screening
Quantity Summary

Commodity	Quantity	
Screen Wash Pumps	2	Ea
Dual Flow Travelling Screens with Fish Catcher	12	Ea
Excavated Soil	300	CY
Soil Backfill	200	CY
Structural Steel	4	TN
Concrete	50	CY
Formwork	5,400	SF
Embeds	1,300	LB
Rebar	17	TN
Piling & Caissons	20	LF
Large Bore Valves	36	Ea
Large Bore Hangers	60	Ea
Fiberglass Pipe (large bore)	1,100	LF
Small Bore Pipe	200	LF
Instruments	20	Ea
Control Valves	24	Ea
Instrument Tubing	500	LF
A/G Conduit	2,600	LF
Low Voltage Cable	32,600	LF

7.4.7 Offshore Modular Wedge Wire Screening System

Offshore modular wedge wire screening system quantities are summarized in the following table.



DCPP
Offshore Modular Wedge Wire Intake Screening
Quantity Summary

Commodity	Quantity	
8' Diameter X 35' Long Wedge Wire Screens	48	EA
30' Diameter Lined Tunnel under Sea Bed	1,000	LF
12' Diameter Reinforced Concrete Drop Shafts	6	EA
10' Diameter Reinforced Concrete Headers	8	EA
Dredging	1,000	CY
Existing Break Water Extension	81,000	CY
Seal Break Water	4,800	CY

7.5 Direct Material and Subcontract Pricing

7.5.1 Closed-cycle Cooling Technology Supply Bids

Closed-cycle cooling technology equipment supply bids are highlighted below:

- FRP
- Cooling towers (passive draft dry/air and mechanical [forced] draft dry/air)
- Electrical transformers
- Heat exchangers
- Condenser upgrades
- Water treatment plant
- Desalination plant
- Vertical pumps
- Butterfly valves

7.5.2 Onshore Mechanical Fine Mesh Screening Technology Supply Bids

Onshore mechanical fine mesh screening technology supply bids are highlighted below:

- Onshore mechanical fine mesh screens

7.5.3 Closed-Cycle Cooling Technolgy Supply and Install Bids

Closed-cycle cooling technology supply and install bids are highlighted below:

- Cooling towers (hybrid, wet mechanical and wet natural)

7.5.4 Offshore Modular Wedge Wire Screening System Technology Supply and Install Bids

Offshore modular wedge wire screening system technology supply and install bids are highlighted below:

- Marine works

The pricing for the balance of equipment and bulk materials were based on actual pricing from current projects.

Mountain excavation and disposal costs for all closed-cycle cooling options were developed as subcontracted costs on a dollar per cubic yard of excavated rock basis based on equipment schedules for the work involved and number of Teamsters, equipment operators, and other craft labor required to perform the work. The rock blasting portion of the costs are based on a vendor quotation. The haul distance and disposal site included in the estimate is within 5 miles of the plant site (Reference Table 4.3-5, Mountain Excavation Quantities).

Steam turbine rotor replacement costs for the passive draft dry/air cooling and mechanical (forced) draft dry/air cooling options were provided by the Owner in 2005 dollars and escalated to 2013 dollars.

Freight costs are included at 6% of applicable equipment and bulk material costs for all options based on historical experience.

7.6 Construction

7.6.1 Direct Craft Labor Hours

Direct craft hours for each option were estimated based on standard labor installation rates appropriate for the work involved plus adjustments for the following:

- Work in an operating nuclear facility
- Work within protected areas
- Congestion and interferences
- Design complexities
- Time needed to transport labor on buses to and from the plant
- Labor efficiencies due to work schedules
- Outage work efficiencies
- Safety-related training classes

7.6.2 Craft Labor Wages

Craft wages were estimated based on a May 2013 wage survey of the prevailing union local agreements in the southern California area. Labor costs were developed based on an anticipated work schedule to minimize schedule duration. It is assumed that labor fatigue rules do not apply for this scope. For scheduled nonoutage-related work, craft wages are based on two shifts working 10-hour days 5 days per week. For scheduled outage-related work, craft wages are based on two shifts working 12-hour days 7 days per week. Closed-cycle cooling technologies were priced as a combination of nonoutage and outage work based on schedule requirements. The onshore mechanical fine mesh screening and offshore modular wedge wire screening system technologies were priced as nonoutage work. Travel incentives were included in the estimate to attract and retain qualified craftworkers.

7.6.3 Field Indirect Costs

Construction field indirect material costs, e.g., construction equipment, small tools, purchased utilities required during the construction period, office trailers, temporary buildings, craft labor change facilities, and craft busing costs, are based on ratios of indirect materials to direct labor hours from current and historical projects worked in existing nuclear facilities.

Field indirect labor hours were estimated as a percentage of direct craft labor hours for each option, based on review of ratios from current and historical projects worked in existing nuclear facilities.

Startup field indirect material costs, e.g., vendor testing services, flushes, testing equipment, tools, vehicles, and other consumable supplies were developed based on scope of work documents and engineered quantities for each technology.

Startup craft labor hours were estimated based on specific requirements for each technology.

7.7 Home Office Services

Engineering developed service hours by discipline to provide a complete design for each technology and based on anticipated engineering deliverables,

Other home office services hours, e.g., Project Management, Project Controls, Procurement, Administrative Services, Accounting, Information Systems, Quality Management, Construction department functional support, Startup department functional support and Contracts Management department functional support were estimated for each option based on current and historical projects worked in existing nuclear plants.

7.8 Engineering Services Subcontracts

7.8.1 Closed-Cycle Cooling Technologies

Geotechnical subsurface and topographical studies, National Fire Protection Association inspection services, seismic analysis services, traffic consultant services, and archeological consultant services were assumed to be required and priced based on historical costs for similar services. Costs for USNRC review of the environmental impact statement were provided by PG&E.

7.8.2 Onshore Mechanical Fine Mesh Screening Technology

Costs for traffic consultant services were assumed to be required and priced based on historical costs for similar services .Costs for USNRC review of the environmental impact statement were provided by PG&E.

7.8.3 Offshore Modular Wedge Wire Screening System Technology

Traffic consultant services, seismic analysis services, the hydrographic survey, the bathymetric survey, and the offshore geotechnical subsurface study were assumed to be required and priced based on historical costs for similar services. Costs for USNRC review of the environmental impact statement were provided by PG&E. Wedge wire screen in-situ pilot testing was based on a budgetary quotation.

7.9 Procurement Services Subcontracts

For each technology, Bechtel supplier quality inspection services were priced based on historical data.

7.9.1 Field Nonmanual

Based on professional skill sets required for work in a nuclear plant, for each technology field nonmanual hours for field administration and direct supervision of the work involved for each option were estimated as percentage of craft hours based on current and historical projects.

Field staff relocation costs were estimated based on actual domestic employment conditions from similar historical projects in the same geographical area.

7.9.2 Startup

Based on the work involved and professional skill sets required for each technology, Startup developed nonmanual staffing plans for field administration and direct start up supervision of startup of all equipment and systems.

Relocation costs for the field startup staff were estimated based on the actual domestic employment conditions from similar historical projects in the same geographical area.

7.10 Other Costs

7.10.1 Insurances

Umbrella coverage is assumed to be included as part of workmen's compensation insurance built into craft labor costing rates.

Builder's risk is based on typical rates for work in nuclear plants.

Marine transit coverage is based on typical industry rates.

7.10.2 Securities

A letter of credit for 120 months valued at 10% of project price is included for all options and is priced at 125 bps per annum.

A warranty letter of credit for 1 year valued at 5% of price is included for all options and is priced at 150 bps per annum.

7.10.3 Warranty

Costs have been included at 0.50% of total constructed cost.

7.10.4 Taxes

Costs have been included at 7.5% of all field direct and field indirect materials.

7.10.5 Escalation

Costs have been excluded from the estimate, which is in 2013 dollars.

7.10.6 Contingency

A contingency evaluation was performed by the project team that considered, among other things, the scope of work definition, completeness of the engineering design, knowledge of the pricing basis used for the estimates, and craft labor hours. The results of the evaluation fell within the band of 15% to 25%, the typical contingency level for a Class 3 estimate.

7.10.7 Permits

Costs included in the estimates are from the following tables:

- IFMS-1, DCCP Environmental Permit/Approval Cost Assessment Onshore Mechanical (Active) Intake Fine Mesh Screening System
- WW-1, DCCP Environmental Permit/Approval Cost Assessment Offshore Modular Wedge Wire Screening System
- CC-1, DCCP Environmental Permit/Approval Cost Assessment Dry/Air Cooling Technologies – Passive Draft and Mechanical (Forced) Draft
- CC-2, DCCP Environmental Permit/Approval Cost Assessment Wet Cooling Technologies – Natural Draft, Mechanical (Forced) Draft and Hybrid Wet/Dry (Fresh and Reclaimed Water)

7.10.8 PG&E Costs

PG&E provided the basis for calculating replacement power costs at $46.76/MWG. The cost calculation is based on 1,155 MW x 24 hours x 2 units as follows:

- Mechanical (Forced) Draft Dry/Air Cooling – 576 days
- Passive Draft Dry/Air Cooling – 530 days
- Hybrid Wet/Dry Cooling – 530 days
- Wet Mechanical (Forced) Draft Cooling – 530 days
- Wet Natural Draft Cooling – 576 days
- Onshore Mechanical Fine Mesh Screening – 183 days at 50% capacity
- Offshore Modular Wedge Wire Screening – 0 days

7.11 Qualifications and Assumptions

The following are qualifications and assumptions:

1. The existing fire water system has adequate pressure and flow.
2. No load increase is expected on the turbine building floor due to condenser and steam turbine upgrades.
3. Unaffected mechanical, piping, electrical, and instrumentation systems will not be affected by modifications.
4. Existing intake structure civil, mechanical, and electrical features will accommodate modifications with no major modifications.
5. Existing equipment in the intake structure will be left in place except as noted.
6. The haul route and disposal site for mountain excavation is within 5 miles of site.
7. Field nonmanual staff turnover for long durations has not been considered.
8. Replacement power costs are included with PG&E costs.
9. Mitigation costs that were clearly defined in the permit process are included as part of permitting related costs.
10. Brine return dilution piping system is required for closed cooling technologies with desalination plants.
11. Steam turbine upgrades are not required for the wet technology options.

12. Cooling tower makeup is by gravity flow from water holding pond for the wet technology options. Pumps are not required.
13. Underground utilities relocations have not been considered for the new fish recovery tunnel included in the offshore modular wedge wire screening system technology.
14. Emergency stop logs for the offshore modular wedge wire screening system technology will be removed using an existing mobile maintenance crane.
15. HVAC for all new buildings was accounted for in the estimated cost per square foot.
16. Potable water for the desalination plant is available from the existing potable water system.
17. Existing plant sanitary system can accept sanitary waste from new facilities and buildings.
18. Existing plant potable water system has adequate pressure to accommodate additional facilities and buildings.
19. Electrical equipment for the onshore mechanical fine mesh screens technology will be located in the existing pumphouse.
20. No new duct bank or cable tray is required for the onshore mechanical fine mesh technology traveling screens. Electrical raceway for existing traveling screens will be reused or extended for new onshore mechanical fine mesh technology replacement screens.
21. Mechanical designs for the new onshore mechanical (active) intake fine mesh screening systems will use available piping, supports, and platforms used for the existing pumphouse screening system.
22. For the new mechanical (active) intake fine mesh screening systems technology, existing traveling screens servicing the existing safety-related ASW system pumps will not require modification.
23. Additional screen wash water requirements for the new onshore mechanical (active) intake fine mesh screening systems technology will be provided by the new CW pumps.
24. Work at the intake structure will be inside a security protected area.
25. No radiological or contaminated areas will be encountered.
26. The mountain area is available for new cooling towers.
27. Geotechnical data is based on existing plant data. New geotechnical data will be needed to confirm validity.

7.12 Exclusions

The following exclusions apply:

1. Real estate costs for recycle water processing and pumping facility
2. Right of way costs for recycle water pipelines
3. Asbestos and lead abatement
4. Remediation costs associated with mountain excavations and CW duct installation
5. Allowance for impact mitigation and/or offsets associated with permit approval conditions
6. Mitigation costs, except for those in Tables IFMS-1, WW-1, CC-1, and CC-2, which are unpriced
7. Traffic control along the recycle water pipeline route

8. Engineering oversight by PG&E
9. Security oversight by PG&E and security system modifications and/or impacts
10. Scrap values of demolished equipment and structures, which are assumed to be offset by disposal costs
11. Plant shutdown and startup costs
12. Annual increase in station operation and maintenance costs
13. Annual cost of replacement power for lost MW due to de-rated capacity
14. Simulator update
15. Sea lion and marine craft relocations
16. Unexpected underground interferences, which have been excluded from estimate
17. Bar rack screening structure for the onshore mechanical fine mesh screening technology
18. Fuel removal, disposal and replenishment for the fuel oil storage tanks being demolished and replaced.

8 References

1. Bechtel Power Corporation, “Independent Third-Party Interim Technical Assessment for the Alternative Cooling Technologies or Modifications to the Existing Once-Through Cooling System for Diablo Canyon Power Plant,” Report No. 25762-000-30R-G01G-00009, Rev. 0, prepared for Pacific Gas and Electric Company and the California State Water Resources Control Board Nuclear Review Committee, November 5, 2012.

2. Pacific Gas and Electric Company, “Report on the Analysis of the Shoreline Fault Zone, Central Coastal California,” report to the U.S. Nuclear Regulatory Commission for Diablo Canyon, January 2001.

3. Tenera Environmental , “Length-Specific Probabilities of Screen Entrainment of Larval Fish Based on Head Capsule Measurements”

Attachment 1: Phase 1 Report: Independent Third-Party Interim Technical Assessment for the Alternative Cooling Technologies to the Existing Once-Through Cooling System for Diablo Canyon Power Plant

(Attachment 1 under separate cover)

Attachment 2: DCPP Offshore Modular Wedge Wire Screen Field Pilot Testing Plan

A.1 Introduction and Purpose

This narrative represents an overview of a preliminary plan for conducting a pilot study for a narrow-slot wedge wire screen (WWS) at the proposed offshore wedge wire location for Pacific Gas and Electric's (PG&E's) Diablo Canyon Power Plant (DCPP). The narrative is based on two proposals received by ALDEN Research Laboratory, Inc. (ALDEN) (Reference A-1) and Tenera Environmental (Tenera) (Reference A-2). The engineering design for the study will be done by ALDEN and the design of biological sampling will be by Tenera. Both entities will jointly oversee the design, planning, preparation, testing, and evaluation of the test results.

DCPP uses power plant cooling water from the Pacific Ocean through a shoreline intake protected by breakwaters. The pilot study would evaluate both the biological and engineering feasibility of the WWS system.

The primary objectives of the pilot study are to determine:

- The biological exclusion efficiency of both a 2.0-mm and a 6.0-mm cylindrical T-shape WWS in comparison with an open port for reducing impingement and entrainment and by comparing concentrations of ichthyoplankton from samples collected through an intake fitted with a WWS and an intake designed to screen out only larger organisms.
- The operating performance relative to biofouling.
- The operating performance relative to debris clogging.

The deliverable for this pilot study will be a report that combines the engineering and biological sampling program components of the study. The report will be submitted to the California State Water Resources Control Board as part of the Once-Through Cooling Policy Nuclear-Fueled Power Plant (NFPP) Special Studies. More details on the study and deliverables are provided below.

A.2 Scope of the Study

The pilot study is anticipated to be performed through four tasks:

- Task 1 is the development of a study plan.
- Task 2 is the engineering design of the pilot WWS deployment and biological sampling facilities.
- Task 3 lays out a biological sampling plan.
- Task 4 investigates debris, biofouling, and screen cleaning potentials and evaluates the effort and techniques needed to facilitate operability.

A.2.1 Plan Details Development

The objective of this task is to develop a study plan for pilot-scale WWS evaluation at DCPP. The study plan will be used by PG&E as a submittal to the State Water Resources Control Board, California Coastal Commission, and/or any other state or regional resource and permitting agencies. The test plan will be developed in cooperation with Bechtel, ALDEN, Tenera, PG&E, and regional resource and permitting agencies. The study plan will include:

- Justification for testing WWSs at the station, including a summary of existing data on the efficacy of WWSs
- Detailed engineering design of the pilot-scale test facility, including screens, pumping, piping, and anchoring systems (Task 2)
- Detailed sampling operation and processing and quality assurance/quality control (QA/QC) plans for system operation and the methods used to collect and process biological samples and monitor clogging and biofouling (Tasks 3 and 4)

A.2.2 Engineering Design and Testing

The design of a WWS pilot study at DCPP, with a proposed intake deployment located about 600 feet offshore, will require significant effort to ensure that the screen deployment and study objectives are met. The deployment would include two WWSs (2.0-mm and 6.0-mm slot openings) and one open port. At this initial stage, the following design features and components are anticipated:

- 2.0-mm and 6.0-mm slot opening, copper-nickel alloy, 24-inch-diameter cylindrical WWSs by Johnson Screens
- A single open port with a 3/8-inch (9.5-mm) mesh located adjacent to pilot screens
- Tee-screens and open port mounted to a large weighted frame for support and stability
- Submerged high density polyethylene (HDPE) piping routed to the shoreline or the nearest breakwater
- Pipe anchored with ballast weights along its route and with rip rap near the shoreline as necessary
- Submersible pump(s) located in protected near-shore enclosure(s)
- Onshore sampling facilities and power supply

The proposed designs were sized to provide a through-slot average velocity of approximately 0.4 ft/sec for 24-inch-diameter tee-screens and at the face of an open port. The 2-mm screen would be designed for a maximum flow of 4 cfs (1,795 gpm) and the 6-mm screen for a maximum flow of 6 cfs (2,693 gpm) based on the final screen size and to achieve the design through-slot velocity of 0.4 ft/sec.

The WWSs and open port would be constructed of copper-nickel alloy because this material has been shown to retard biofouling growth. The open port with a 3/8-inch mesh across the opening is required to provide a baseline entrainment estimate. The screens would be mounted to a heavy frame anchored on the sea floor near the proposed full-scale deployment location. It is important for the pilot-scale test screens to be located at or near the deployment location because both biological efficacy and debris/biofouling would be affected by the ambient currents. At DCPP the deployment location would be approximately 600 feet offshore in 70 feet of water (Figure A.1).

Figure A.1. Preliminary Wedge Wire Pilot Study Layout at DCPP (Reference A-1)

The two test screens and open port would be connected to an onshore sampling facility via HDPE pipes. HDPE pipe material was selected because it can be installed using a “float-and-sink method” that is expected to be less expensive and faster than other installation methods. The pipes for the 2-mm screen and open port would have a 12-inch internal diameter (ID), and the pipe for the 6-mm screen would have a 15-inch ID. These pipes are sized for a velocity of approximately 5 ft/sec to reduce the risk of sediment and biofouling build-up in the pipes. The pipes would be anchored to the bottom with concrete ballast weights. Riprap would be added in the near-shore area to help secure and protect the pipes.

Flow through the pipes would be provided by three submersible, fish-friendly pumps located in a wet well installed near the sampling facility. This pump chamber would be designed to protect the pumps during storm events. The pump discharges would be connected to the sampling system, where they would either be routed through the sampling equipment or discharged back to the Pacific Ocean.

The sampling systems would be located near the shoreline to reduce additional piping needs. At DCPP, the intended sampling location could be behind the breakwater near the existing boat ramp (Figure A.1), but it also could be located on breakwaters and/or a barge used to reduce installation cost if determined to be warranted by the pilot study. The system would be designed to allow simultaneous sampling from either of the two WWSs and the open port. Biological efficacy would be determined by comparing the egg and larval concentrations of the screened and unscreened intakes, as outlined in Section 2.3. The pumps would discharge into vertically-oriented conical plankton nets suspended in water-filled tanks. The nets would have 335-µm mesh netting and a codend cup to collect the entrained organisms. The filtered water would flow through pipes back to the ocean.

The engineering design section of the study will include detailed drawings of the WWS deployment, including redundant intake lines for both the wedge wire screen and unscreened intake. The design will allow the collection of paired samples to determine the effectiveness of the WWS at reducing entrainment. The redundant lines for each intake will allow one of the lines to be closed off and cleaned while sampling is continued in the second line. This design component is critical to the study due to the potential settlement and growth of fouling organisms in the intake lines. The concentrations of larvae passing through the intake lines will be reduced due to feeding by the fouling organisms. The engineering design will incorporate all the system components necessary for collecting samples from the two intakes, including the intake pump outlets where the samples will be collected. The sample collection pumps will use "fish friendly" impellers to minimize damage to the fragile fish larvae that are the target organisms for the study. The collection pumps will be sized to collect a minimum sample volume of 100 m^3 (26,417 gal) over a 60-minute period. The system will also be designed so that the WWS module can be exchanged to allow testing of more than one slot width.

The materials and costs to install the pilot WWSs and sampling equipment are preliminary in nature, based on conceptual designs, and do not reflect detailed, site-specific conditions. Detailed site investigations and engineering analyses, as well as consultation with local contractors, are required to refine the design and associated costs. The costs to complete a detailed design and cost estimate will vary, depending on the final requirements of the study plan (Task 1).

A.2.3 Biological Sampling

The biological sampling component of the study design will include details on the sampling, sample processing, analysis, and QA/QC. The sampling will likely be proposed to take place over a 12-month period with more intensive sampling efforts during the peak larval periods from March–June. The sampling effort will be adaptively managed to allow sampling to be reduced or curtailed if the study goals are achieved. All of the larval fishes collected during the sampling will be measured to determine the size range of larvae effectively excluded from entrainment by the WWS. Impingement of organisms on the WWS will be evaluated through an underwater video, system, which will also be used to monitor debris accumulation on the screen. The underwater video system and its cabling will be incorporated into the engineering design.

Task 3 will comprise finalizing the sampling, sample processing, and QA/QC program which includes collecting the entrainment samples from the pilot-scale screens, processing the samples in the laboratory, entering and analyzing data, and assembling a report summarizing the approach and results.

The biological sampling study will be designed to provide information on the efficacy of the WWSs for minimizing entrainment. Determining the screens' efficacy requires that a sufficient number of organisms are present to provide data that can be analyzed statistically; therefore, a greater number of samples will be targeted during periods of peak abundance (described in more detail below). Biological samples will also be collected, though less frequently, over the balance of the 12-month study duration to account for changes that could occur throughout the year in species composition and larval size distribution (each of which may impact screening efficacy).

Final collection procedures would be based on the design of the sampling facility (Task 2), best professional judgment, and input from resource agencies. If desired, entrainment samples at DCPP could be collected concurrently with WWS samples to help quantify the location benefit associated with moving the point of withdrawal from the shoreline at the surface to an offshore, submerged location.

The study period should run for at least 12 months. During that time, the screens would be operated 24 hours per day and monitored for clogging by debris and biofouling (Task 4). In addition to the remote monitoring of clogging, underwater video cameras with battery packs would be positioned to collect data on debris and impingement. Entrainment sampling would be targeted during periods of peak ichthyoplankton abundance. At DCPP, approximately half of the total entrainment occurs between April and June. By contrast, peak algae impingement occurs at DCPP during the fall and winter. Since a primary goal of testing is to determine the screen's ability to handle potentially heavy debris loads, the debris and biofouling testing would need to extend beyond the period of peak ichthyoplankton abundance.

Biological sampling would be conducted every other week over the 12-month study duration. More samples could be collected during the months of highest ichthyoplankton density (April, May, and June) to estimate the screens' efficacy for minimizing entrainment. Fewer samples would be collected during the other 9 months to account for changes in species composition and larval size distribution that could occur throughout the year. During the primary sampling period, collections would be made every other week on three consecutive days. Since ichthyoplankton abundance is typically highest during evening and night hours, the majority of biological sampling would occur between 1800 and 0600 hours. However, some sampling would be done during daylight hours to determine if there are species differences. During the remaining 9 months, collections would be made every other week on a single day.

Paired samples would be collected with one of the two WWSs and the open pipe. As many paired samples as possible will be collected during each sampling event. The exact number would depend on the time required to divert flow, wash down nets, and transfer sample contents to jars for transport to the laboratory. Approximately 50 to 100 m^3 (measured with an in-line flow meter) would be filtered through a 335-µm mesh plankton net and codend suspended in water to minimize damage to larval fish (Figure A.2). At the end of the collection, contents of the net would be rinsed into the codend, transferred to a labeled jar, and preserved in 5%-10% buffered formalin-seawater solution.

The objective of the biological sampling will be to collect as many paired samples as possible during periods of peak ichthyoplankton abundance. To the greatest extent possible, flexibility would be incorporated into the study design so that sampling could be terminated early when a requisite number of paired samples with ample organism density are collected. Similarly, sampling could be extended if insufficient numbers of organisms are collected during the predetermined sampling duration. The ultimate goal would be to collect enough paired samples to make valid statistical comparisons of larval fish densities between the screens and open port and to develop an estimate of biological effectiveness with reasonably tight confidence intervals.

Samples would be processed under a dissecting microscope in the ichthyoplankton processing laboratory. Fish eggs and larvae would be removed, enumerated, and identified to lowest taxonomic level possible. The notochord length (NL) and head capsule depth (HCD) for a subsample of larvae would be measured. A QA/QC program would be applied to all laboratory processing.

A.2.4 Debris and Biofouling Study

The pilot study screens would be constructed of a copper-nickel alloy that has been shown to significantly reduce biofouling of wedge wire screens. However, this alloy does have limitations. Once a biofilm develops, biofouling organisms (e.g., mollusks) may be able to colonize the screen surface. During a 12-month study period, the screens would be monitored to determine the biofouling and debris accumulation rate. The sampling pumps would operate continuously throughout the entire study duration to estimate the biofouling and debris loading rates. This monitoring would be done both remotely with battery-powered cameras and with regular diver inspections. The frequency of diver inspections would be based on the expected battery life of the cameras. Each of the test screens would be equipped with differential pressure cells to monitor the impact of biofouling and debris on the head loss through the screens. This impact is important to monitor so that a cleaning schedule can be developed for a full-scale installation and because excessive head loss across the screens can impact the sampling pumps. The screens would not be cleaned during the study period unless the head loss starts to impact the flow through the screens.

A.3. Study Duration

The pilot study schedule will depend on the final study plan and screen facilities design. The initial estimate to complete the study from study plan development to demobilization is approximately 2.5 years, with entrainment, biofouling, and debris sampling lasting about 1 year. Included in the schedule is a 6-month window between the completion of the final engineering design and the start of construction. Included in this 6-month window are the material and equipment lead times as well as permitting.

A.4. Results of Pilot Study

Comparing collected aquatic life through a sampling program will provide necessary information for finalizing screen slot size and performance. Use of collected samples data will assist in the following interpretations:

a. Comparison of the WWS data against the open intake will determine the effectiveness of the wedge wire operation for reducing the entrainment and impingement.

b. Comparison of the 2-mm and 6-mm slot screens' aquatic life samples will determine the incremental effectiveness of 2-mm slot screen over 6-mm screen.

c. Comparison of the 2-mm and 6-mm slot screens' trash and debris loading will determine the impact of smaller screen size on screen performance due to debris loading.

After evaluation of results, if the incremental effectiveness of the foregoing three items is insignificant and debris loading reduction is still desired, a screen slot size larger than 6 mm can be considered. On the other hand, if comparison shows a clear advantage in biological efficacy of 2-mm over 6-mm slot screens and insignificant incremental effectiveness for Item c above, then 2-mm slot screens can be used.

A.5. References

A-1 ALDEN Research Laboratory, Inc., *Preliminary Evaluation of Narrow-Slot Wedge Wire Screen Pilot Studies at the Diablo Canyon and San Onofre Nuclear Generating Stations*. May 2013.

A-2 Tenera Environmental, *Proposal for Preparation of an Engineering and Study Design for Testing the Effectiveness of Wedge Wire Screens at Diablo Canyon Power Plant –* Proposal SLO2013-28, July 26, 2013.