



Once-Through Cooling Phase-Out

The Clean Water Act requires the U.S. Environmental Protection Agency to ensure that the location, design, construction, and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impacts. Since 1972, states have enforced this requirement on a case-by-case basis in the absence of a specific federal rule. California parties expressed concerns that federal regulations were inadequate and should be addressed by a clearer, more prescriptive California rule.

The State Water Resources Control Board (SWRCB) first described a California regulatory approach in March 2008 when it published a scoping document titled *Water Quality Control Policy on the Use of Coastal and Estuarine Waters for Power Plant Cooling* to implement Section 316(b) of the Clean Water Act, 33 U.S.C. § 1326(b).

The California Independent System Operator (California ISO), California Energy Commission (Energy Commission), and California Public Utilities Commission (CPUC) worked closely with the SWRCB to develop a policy to achieve water quality goals while ensuring electricity grid reliability.

On May 4, 2010, the SWRCB approved a once-through-cooling (OTC) policy that included many grid reliability recommendations made by the California ISO, as well as a joint implementation proposal developed by the Energy Commission, CPUC, and California ISO. The Office of Administrative Law approved the policy on September 27, 2010, and the policy became an effective regulation on October 1, 2010.

The regulation affected 19 California power plants. Of those, 16 power plants totaling about 17,500 megawatts (MW) are in the California ISO balancing authority area, and 3 are in the Los Angeles Department of Water & Power (LADWP) balancing area. The original regulatory compliance dates range from 2010 to 2024. In July 2011, LADWP obtained the SWRCB's consent to delay compliance for its three units until 2029. In return, LADWP agreed to exceed the ocean water best available control technology embodied in the OTC policy by completely eliminating use of ocean water for its repowered facilities.

The policy recognizes that some of these plants are critical for system and local reliability. Some may also provide operational services (such as flexible capacity requirements, ramping to follow net load, and regulation) needed to integrate renewable resources. Owners that plan to repower their plants face additional regulatory challenges due to the lack of air credits required for new facilities or major changes to existing facilities in one or more of the air basins. To assure effective communication among the state's energy and environmental agencies concerning the role of these plants in ensuring reliability, the OTC policy created a permanent advisory body – the Statewide Advisory Committee on Cooling Water Intake Structures (SACCWIS)¹ – that is

¹ SACCWIS includes seven organizations: California ISO, Energy Commission, CPUC, California Coastal Commission (CCC), State Lands Commission (SLC), California Air Resources Board (ARB), and SWRCB.



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scheduled to report annually to the SWRCB. Recognizing the unique circumstances of the two nuclear power plants in California that were using OTC technologies (now only one), the OTC policy also established a second advisory body – the Review Committee for Nuclear Fueled Power Plants (RCNFPP) – to refine the cost estimates for the nuclear power plants to satisfy the policy.

In 2014, the United States Environmental Protection Agency issued its own OTC regulations, but these do not appear to have substantive requirements for California plants that exceed those regulations already enacted by the SWRCB.

Several generating companies contested the SWRCB OTC policy in court, but a settlement was reached between the SWRCB and the current owners of the power plants in fall 2014. In this settlement, the Moss Landing compliance dates were pushed back to December 31, 2020, and the SWRCB agreed to several specific implementation constraints for the Pittsburg, Mandalay, and Ormond Beach facilities.

OTC Phase-Out Status Tracks

The OTC policy determined that closed-cycle evaporative cooling was the best available technology and established this as a benchmark for two compliance tracks.

Track 1: Reduce the intake flow rate at each power-generating unit to a level that can be attained with a closed-cycle evaporative cooling system.² A minimum of 93 percent reduction is required compared to the design intake flow rate.

Track 2: If compliance with Track 1 is not feasible, reduce the impingement mortality and entrainment³ for the facility as a whole to 90 percent of Track 1 reductions, using operational or structural controls, or both.

Alternatively, a plant can comply by shutting down.

² *Closed-cycle evaporative cooling system* refers to a cooling system that transfers waste heat to the surrounding air through the evaporation of water, thus enabling the reuse of a smaller amount of water several times to achieve the desired cooling effect. The only discharge of wastewater is from periodic blowdown to limit the buildup of materials in excess of desirable limits by best engineering practice.

³ Most power plants that obtain cooling water from surface water sources use some method of primary screening to prevent large objects from being drawn through the cooling system, where they may clog or damage sensitive equipment. These screens typically have mesh panels with slot sizes ranging from 3/8 inch to 1 inch and are rotated periodically or removed to clean any debris, including aquatic organisms. *Impingement* occurs when organisms are trapped against the screen as a result of the force of the intake water and are unable to escape. *Entrainment* is the action of drawing smaller objects through the entire cooling water system, including the pumps and condenser tubes, and discharging them along with the cooling water and other plant wastes.



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Recent Power Production Patterns of OTC Facilities

It is commonly understood that the OTC plants have, over decades, changed power production patterns from base load units to load-following or peaking units, but the reality is more nuanced. **Tables 1 and 2** provide annual capacity factors for each OTC unit in the California ISO and LADWP balancing authority areas, respectively, for 2012, 2013, 2014, and through September 2015.

Table 1: Annual Capacity Factors for OTC Units in the California ISO Balancing Authority Area, 2012 to 2015

Units	SWRCB Compliance Date	Unit Capacity	ANNUAL CAPACITY FACTORS			
			2012	2013	2014	2015 (<Oct)
Alamitos Unit 1	12/31/2020	175	2.2%	0.9%	1.4%	3.2%
Alamitos Unit 2	12/31/2020	175	4.0%	1.6%	5.4%	6.0%
Alamitos Unit 3	12/31/2020	326	13.0%	12.6%	16.6%	11.2%
Alamitos Unit 4	12/31/2020	324	9.7%	11.9%	18.7%	6.8%
Alamitos Unit 5	12/31/2020	485	9.7%	11.4%	1.7%	4.5%
Alamitos Unit 6	12/31/2020	485	7.1%	6.0%	4.5%	7.0%
El Segundo Unit 4	12/31/2015	335	11.7%	12.4%	6.2%	5.6%
Encina Unit 1	12/31/2017	107	14.2%	4.0%	2.0%	4.4%
Encina Unit 2	12/31/2017	104	13.9%	2.9%	2.6%	5.0%
Encina Unit 3	12/31/2017	110	16.3%	5.3%	4.7%	5.6%
Encina Unit 4	12/31/2017	300	14.1%	5.1%	6.3%	9.0%
Encina Unit 5	12/31/2017	330	17.8%	7.7%	9.9%	10.7%
Huntington Beach Unit 1	12/31/2020	215	12.6%	16.8%	22.3%	20.7%
Huntington Beach Unit 2	12/31/2020	215	27.3%	26.5%	26.2%	17.7%
Mandalay Unit 1	12/31/2020	218	5.2%	4.5%	3.6%	6.1%
Mandalay Unit 2	12/31/2020	218	5.5%	6.2%	4.0%	7.7%
Moss Landing Unit 1	12/31/2020	540	46.9%	48.4%	39.2%	33.8%
Moss Landing Unit 2	12/31/2020	540	47.0%	49.9%	47.0%	35.4%
Moss Landing Unit 6	12/31/2020	702	4.9%	4.3%	0.9%	7.0%
Moss Landing Unit 7	12/31/2020	702	4.4%	1.8%	0.4%	3.3%
Ormond Beach Unit 1	12/31/2020	806	2.7%	2.8%	0.8%	2.7%
Ormond Beach Unit 2	12/31/2020	806	1.0%	5.8%	2.4%	3.2%
Pittsburg Unit 5	12/31/2017	325	3.7%	2.3%	0.6%	4.6%
Pittsburg Unit 6	12/31/2017	325	3.3%	1.1%	1.1%	2.4%
Redondo Beach Unit 5	12/31/2020	179	3.3%	1.1%	2.3%	4.1%



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Units	SWRCB Compliance Date	Unit Capacity	ANNUAL CAPACITY FACTORS			
			2012	2013	2014	2015 (<Oct)
Redondo Beach Unit 6	12/31/2020	175	5.0%	2.7%	2.1%	4.5%
Redondo Beach Unit 7	12/31/2020	505	8.4%	4.0%	0.9%	6.0%
Redondo Beach Unit 8	12/31/2020	496	1.4%	1.5%	3.3%	3.7%

Source: California Energy Commission staff

Table 2: Annual Capacity Factors for OTC Units in the LADWP Balancing Authority Area, 2012 to 2015

Units	SWRCB Compliance Date	Unit Capacity	ANNUAL CAPACITY FACTORS			
			2012	2013	2014	2015 (<Oct)
Harbor 5	12/31/2029	75	4.0%	3.0%	3.3%	1.9%
Haynes Unit 1	12/31/2029	230	15.0%	7.0%	12.7%	5.2%
Haynes Unit 2	12/31/2029	230	21.0%	19.0%	13.1%	10.1%
Haynes 8	12/31/2029	264	22.0%	48.0%	34.2%	43.8%
Scattergood Unit 1	12/31/2024	163	4.0%	11.0%	24.5%	6.2%
Scattergood Unit 2	12/31/2024	163	30.0%	19.0%	6.6%	23.6%
Scattergood Unit 3	12/31/2015	497	14.0%	18.0%	16.1%	20.7%

Source: California Energy Commission staff

Although the annual capacity factors shown in **Tables 1 and 2** suggest relatively little use for most of these OTC facilities across the year, many of them operate at full capacity at some point in many months of these years. This reflects the usage of these plants as part of a complex system that the two balancing authorities manage to best serve the requirements of the overall grid within each area.

Status of OTC Facility Compliance

Below is a review of the compliance dates for each power plant, as reflected in the adopted policy or formally approved amendments, as well as information about compliance proposals from generator owners. Within the policy itself, generator owners have options for compliance and can petition the SWRCB for changes in compliance dates. Also provided below is information about the recommendations SACCWIS made to the SWRCB for compliance date changes needed to assure electric system reliability.

Facility Owner Plans

The owners of each facility were required to submit an implementation plan by April 1, 2011. In these plans the owners indicated whether they proposed to follow Track 1 or Track 2, or shut



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down the plant. SWRCB staff, with assistance from the technical staff of the SACCWIS agencies, submitted letters seeking clarifications of the original implementation plans and, in some cases, sought further clarification as new issues surfaced. In initial implementation plans, no facility owner proposed Track 1, and many proposed Track 2 if power purchase agreements justifying the investment in retrofit costs could be secured. As a general rule, most of the owners of fossil-fueled generating facilities, except for Dynegy – Moss Landing, have abandoned plans to pursue Track 2 and have announced retirement plans. In January 2012, the San Onofre Nuclear Generating Station (San Onofre) was shut down for steam generator tube leaks, which the owners later determined to be too costly to repair. Southern California Edison announced the permanent retirement of San Onofre in June 2013.

The information shown in **Table 3** is from the original April 2011 filings of owner implementation plans and any subsequent revisions, if applicable. This table shows each facility and unit, the existing net qualifying capacity (NQC),⁴ the mandated compliance date, and the owner-proposed method and date of compliance.

SACCWIS Analysis

In early September 2013, the CPUC, Energy Commission, California ISO staff, and some other SACCWIS member agencies put forward a preliminary reliability plan, and the Energy Commission conducted a workshop as part of the *2013 Integrated Energy Policy Report* to review it.⁵ Included within the plan is the opportunity for the energy agencies to request deferral of compliance dates for specific units if the primary mechanisms for assuring reliability (increased use of preferred resources, transmission system upgrades, and flexible gas-fired resource additions) fail to develop on schedule or at the level anticipated. In March 2014, the CPUC adopted a decision authorizing a combination of preferred resource development (energy efficiency, demand response,⁶ fuel cells, renewable distributed generation, combined heat and power, and so forth)⁷ and gas-fired procurement by the affected utilities.⁸ Subsequently, San Diego Gas & Electric and Southern California Edison have submitted specific power purchase agreements to the CPUC for review and approval under the procurement authority provided to

⁴ *Net qualifying capacity* is the concept used to describe the capacity from each resource that can be used by a load-serving entity to satisfy its overall obligation. Most technologies have a single value, such as dependable capacity, used year-round. Some technologies (wind and solar without backup) have monthly NQC values reflecting the variability in performance using historical data.

⁵ http://www.energy.ca.gov/2013_energypolicy/documents/#09092013.

⁶ [Demand response programs are designed to shift end-use customers' consumption patterns by altering the timing, level of instantaneous demand, or the total electricity consumption.](#)

⁷ Fuel cells and combined heat and power facilities can be environmentally desirable resources under some but not all circumstances. These technologies are preferred in situations where fuel source and efficiency characteristics of the power plant have a lower environmental impact than conventional power plants.

⁸ <http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M089/K008/89008104.PDF>.



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them.⁹ The CPUC has approved most of the power purchase agreements, while others are still in review.¹⁰ These power purchase agreements allow the retirement of steam-boiler units using OTC technology with new air-cooled, gas turbine technologies at several OTC facilities¹¹. At most OTC power plants, the new generating capacity being built is less than the OTC capacity being retired. Preferred resources (energy efficiency, distributed generation [power generation at the point of consumption], demand response, and storage) are being developed to serve some of the capacity needs once provided by legacy OTC units. Appropriate amounts of replacement capacity must be in place before the associated OTC facility can be retired. In adopting the *2013-2014 Transmission Plan*,¹² the California ISO board approved several additional transmission system upgrades that will reduce local capacity requirements.¹³ If any of the resources or transmission system upgrades fail to develop on schedule or at the level anticipated, a compliance date extension may be necessary.

The energy agencies are using the SACCWIS process to communicate the need for compliance date changes, if any, to the SWRCB. SWRCB management presented and confirmed an OTC deferral process and associated timeline on August 17, 2015, at an Energy Commission workshop as part of the *2015 Integrated Energy Policy Report*. In July 2015, SACCWIS suggested several power plants bear watching, but no final decisions about OTC compliance date deferrals have been made.¹⁴ **Table 4** provides a summary of the facilities that SACCWIS recommends watching.

Table 3: OTC Implementation Schedules – Adopted and Owner-Proposed

Facility & Units	NQC	SWRCB Compliance Date	Owner Proposed Compliance Method/Date
Humboldt Bay 1, 2	135	Dec. 31, 2010	Retired Sept. 30, 2010
Potrero 3	206	Oct. 1, 2011	Retired Feb. 28, 2011
South Bay	296	Dec. 31, 2011	Retired Dec. 31, 2010
Haynes 5,6	535	Dec. 31, 2013	Repowered as air cooled June 1, 2013
El Segundo 3	335	Dec. 31, 2015	Repowered as air cooled July 27, 2013
El Segundo 4	335	Dec. 31, 2015	Retired Dec. 31, 2015
Morro Bay 3, 4	650	Dec. 31, 2015	Retired Feb. 5, 2014
Scattergood 3	450	Dec. 31, 2015	Repowering as air cooled in progress
Encina 1,2,3,4,5	946	Dec. 31, 2017	Plans to comply by Dec. 31, 2017

9 CPUC D.14-03-004.

10 CPUC D.15-05-051 and CPUC D.15-11-041. In D.15-11-041, the CPUC approved all of Southern California Edison's power purchase agreements located in L.A. Basin except for 70 MW of demand response. These six demand response contracts were denied based on not meeting the definition of preferred resources and excessive costs.

11 Power purchase agreements have been approved to replace capacity at Alamitos, Huntington Beach, and Encina OTC facilities, and the power purchase agreement for the Mandalay replacement is in review.

12 http://www.caiso.com/Documents/Board-Approved2013-2014TransmissionPlan_July162014.pdf.

13 <http://www.caiso.com/Documents/DecisionTransmissionPlan-Presentation-Mar2014.pdf>.

14 http://www.waterboards.ca.gov/board_info/agendas/2015/nov/110415_3_saccwis_rpt071415.pdf.



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Facility & Units	NQC	SWRCB Compliance Date	Owner Proposed Compliance Method/Date
Contra Costa 6, 7	674	Dec. 31, 2017	Retired April 30, 2013 ¹⁵
Pittsburg 5,6,7	1,307	Dec. 31, 2017	Plans to comply by Dec. 31, 2017 ¹⁶
Moss Landing 1,2	1,020	Dec. 31, 2017	Settlement defers compliance to 12/31/2020 ¹⁷
Moss Landing 6,7	1,510	Dec. 31, 2017	Settlement defers compliance to 12/31/2020 ¹³
Huntington Beach 1, 2	452	Dec. 31, 2020	Plans to retire HB 1 on 10/31/2019 and HB 2 on 12/31/2020 ¹⁸
Huntington Beach 3, 4	452	Dec. 31, 2020	Retired Nov. 1, 2012
Redondo 5,	178	Dec. 31, 2020	Plans to retire by Aug. 31, 2019, to allow Alamitos to be repowered ¹⁹
Facility & Units	NQC	SWRCB Compliance Date	Owner Proposed Compliance Method/Date
Redondo 6, 7, 8	989	Dec. 31, 2020	Plans to retire by Dec. 31, 2020
Alamitos 1, 2	350	Dec. 31, 2020	Plans to retire on Dec. 31, 2020 ²⁰
Alamitos 3, 4	668	Dec. 31, 2020	Plans to retire on Dec. 31, 2020
Alamitos 5, 6	993	Dec. 31, 2020	Plans to retire AL 5 on Nov. 30, 2019, and AL 6 on July 31, 2019, to allow Alamitos to be repowered
Mandalay 1, 2	430	Dec. 31, 2020	Plans to comply on Dec.31, 2020
Ormond Beach 1, 2	1,516	Dec. 31, 2020	Plans to comply on Dec. 31, 2020
San Onofre 2, 3	2,246	Dec. 31, 2022	Retired Jan. 31, 2011 ²¹
Scattergood 1, 2	367	Dec. 31, 2024	Plans to repower by Dec. 31, 2020
Diablo Canyon 1, 2	2,240	Dec. 31, 2024	Plans to comply on Dec. 31, 2024 ²²
Haynes 1, 2	444	Dec. 31, 2029	Plans to repower by Dec. 31, 2023 ²³
Harbor 1, 2, 5	229	Dec. 31, 2029	Plans to repower by Dec. 31, 2026 ²⁴
Haynes 8 - 10	575	Dec. 31, 2029	Plans to repower by Dec. 31, 2029

Source: California Energy Commission staff

15 Although NRG retired Contra Costa 6-7, the Marsh Landing facility was constructed beside it.

16 Unit 7 (682 MW) cannot operate independently of Units 5-6.

17 Dynegy/SWRCB Settlement Agreement,

http://www.swrcb.ca.gov/water_issues/programs/ocean/cwa316/docs/energy_comp/settlement_dynegy_2014.pdf.

18 AES Huntington Beach, letter to SWRCB, April 23, 2015.

19 AES Redondo Beach, letter to SWRB, April 23, 2015.

20 AES Alamitos, letter to SWRB, April 23, 2015.

21 Although both San Onofre units ceased generation by January 31, 2011, they draw limited amounts of ocean water to cool nuclear fuel rods and other “hot” equipment. According to an SCE report to the SWRCB dated November 27, 2013, the combination of Units 2 and 3 is now drawing water at about 4 percent of normal power flow rates. The report says that San Onofre will continue to draw ocean water throughout the decommissioning, but not above Track 1 compliance levels.

http://www.waterboards.ca.gov/water_issues/programs/ocean/cwa316/powerplants/san_onofre/docs/sce_112713.pdf. San Onofre has reduced water intake below 93 percent of normal power flow rates, and therefore, is in compliance with Track 1 of the OTC policy.

22 The OTC requirements for Diablo Canyon may be affected by a study of mitigation options overseen by the SWRCB’s Review Committee for Nuclear Fueled Power Plants.

23 LADWP’s proposed compliance dates are based on its 2014 Power Integrated Resource Plan.

24 Harbor 1-2, 5, and Haynes 8-10 are combined-cycle units. Although only the heat recovery steam generator uses OTC technology, it is unclear whether LADWP will repower just that portion or replace the combustion turbines.



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Table 4: March 2014 SACCWIS Recommendations and Rationale

Facility	Adopted Compliance Date	SACCWIS Recommendation
Encina 1-5	Dec. 31, 2017	Watch – The need for resources in San Diego to address the retirement of San Onofre means that Encina should be retired only when its replacement capacity is operational.
Huntington Beach 1-2	Dec. 31, 2020	Watch – The need for resources in western L.A. Basin means that Huntington Beach should be retired only when appropriate replacement capacity is operational.
Alamitos 1-6	Dec. 31, 2020	Watch – The need for resources in western L.A. Basin means that Alamitos should be retired only when appropriate replacement capacity is operational.
Mandalay	Dec. 31, 2020	Watch – The need for resources in Moorpark subarea of Big Creek/Ventura local area means that Mandalay should be retired only when appropriate replacement capacity is operational.

Source: California Energy Commission staff

Implication of Owner Compliance Plans on Power Plant Water Usage

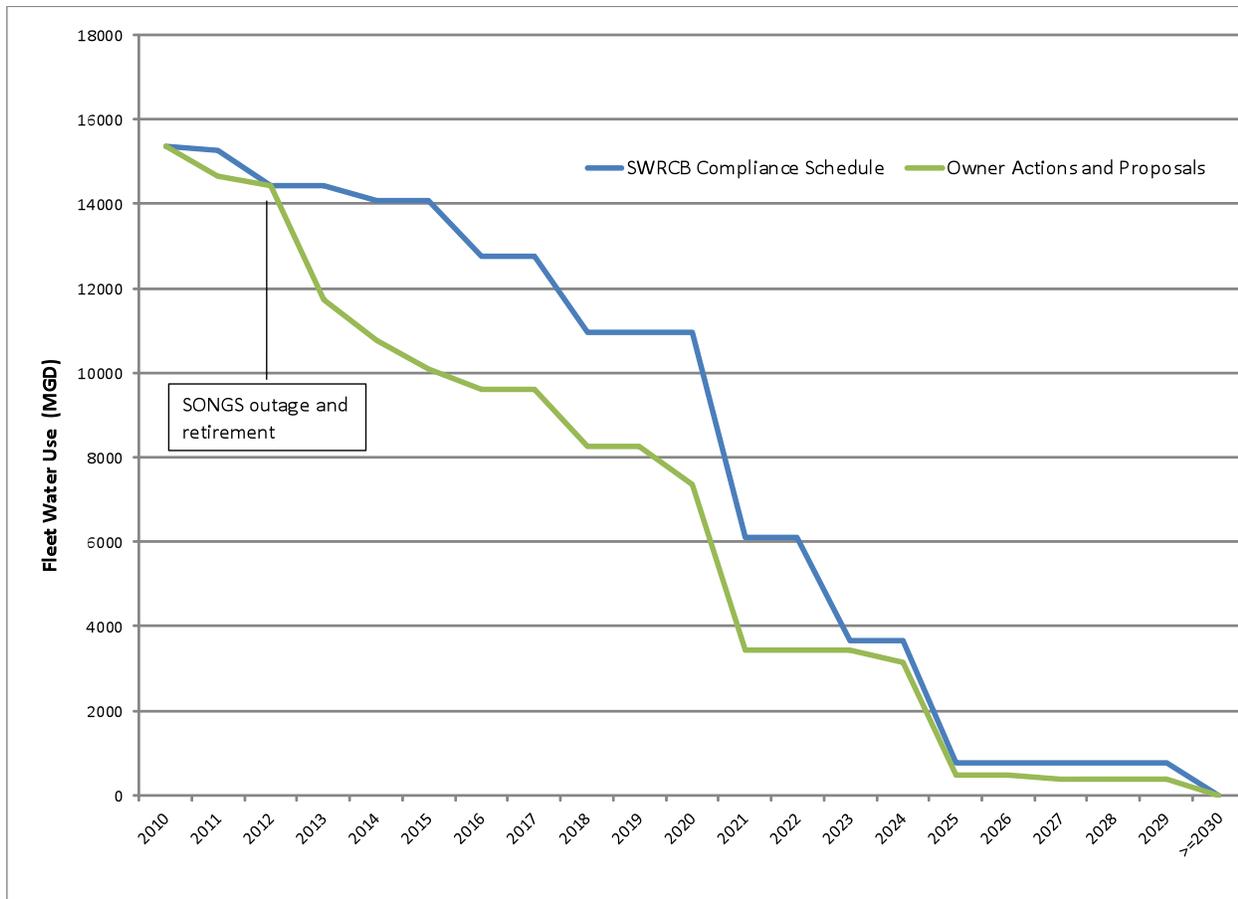
Figure 1 shows expected progress toward the goal of the OTC policy – reduction in the inflow of ocean and estuarine water for power plant cooling – assuming plants fully use cooling water inflows as designed.²⁵ The two lines show the variance between the progress that would be made using the SWRCB policy versus the progress that would be made using several sources of information – actual retirements to date, the power plant owners’ proposed dates noted in the April 2011 implementation plans, or in subsequent information made available to interagency staff. The line reflecting owners’ compliance plans is always below the line using the official compliance dates, meaning that water intake flow rates are being reduced faster than the OTC policy requires. The retirement of some power plants, especially San Onofre, on dates earlier than those incorporated into the OTC policy itself is responsible for this good news. All the owners’ latest implementation schedules show compliance with the OTC policy.

²⁵ Although most plants use less water in an actual operating year than expected under design conditions, data about actual water use are incomplete, and some available data appear to be inaccurate.



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Figure 1: Progress Toward OTC Policy Achievement



Source: California Energy Commission staff

Additional References:

http://www.swrcb.ca.gov/water_issues/programs/ocean/cwa316/docs/policy100110.pdf.

http://www.waterboards.ca.gov/water_issues/programs/ocean/cwa316/powerplants/.

http://www.energy.ca.gov/2013_energy_policy/documents/2013-09-09_workshop/2013-08-30_prelim_plan.pdf.

<http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M089/K008/89008104.PDF>.



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Next Update:

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