Diablo Canyon: 78 Percent of California Coastal Power Plant Once-Through Cooling Water Withdrawals

Bill Powers, P.E., November 23, 2013

The average annual capacity assumed by Bechtel for Diablo Canyon is 90 percent.\(^1\) Assuming a 90 percent capacity factor, the total annual once-through cooling water throughput at Diablo Canyon is 816 billion gallons per year.\(^2,3\)

In contrast, the approximately 15,964 MW of coastal once-though cooled steam boiler capacity operates on average with a low capacity factor of 4.1 percent.\(^4\) Annual coastal steam boiler once-through cooling water throughput, assuming the circulating water pumps are not in use when the coastal steam units are not producing electricity, would be about 158 billion gallons per year.\(^5\)

There is approximately 1,900 MW of coastal once-through cooled combined cycle plant capacity.\(^6\) These combined cycle units operate with an average capacity factor of about 37 percent.\(^7\) Annual combined coastal cycle once-through cooling water throughput, assuming the circulating water pumps are not in use when the combined cycle units are not producing electricity, would be about 73 billion gallons per year.\(^8\)

The total once-through cooling water withdrawal rate of California coastal power plants, following the retirement of San Onofre, is approximately: 816 billion gallons/yr (Diablo Canyon) + 158 billion gallons/yr (coastal boiler plants) + 73 billion gallons/yr (coastal combined cycle plants) = 1,047 billion gallons/yr. Diablo Canyon once-through cooling withdrawals

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\(^3\) 2 units × (862,690 gallon/min per unit)(60 min/hr)(24 hr/day) = 2.485 billion gallon/day × 365 days/yr × 0.9 = 816 billion gallons per year.
\(^5\) TetraTech, *California’s Coastal Power Plants: Alternative Cooling System Analysis*, February 2008, Chapter O (803 MW Scattergood Generating Station) p. O-3. Scattergood cooling water flowrate = 344,000 gpm. Unit once-through cooling water usage rate = (344,000 gpm × 60 min/hr)/803 MW = 25,704 gallons/MW-hr. Assuming the Scattergood unit cooling water usage rate is representative of coastal natural gas-fired steam units, the annual cooling water throughput for coastal steam boilers collectively would be: 15,964 MW × 8,760 hr/yr × 0.041 × 27,504 gallons/MW-hr = 158 billion gallons per year.
\(^6\) These combined cycle units include: Moss Landing Units 1&2, 1080 MW; Harbor Unit 5, 235 MW; and Haynes Unit 8, 575 MW. Total California coastal once-through cooled combined cycle capacity = 1,080 MW + 235 MW + 575 MW = 1,890 MW.
\(^7\) TetraTech, *California’s Coastal Power Plants: Alternative Cooling System Analysis*, February 2008, Chapter J (Moss Landing Power Plant, 1,080 MW Units 1&2) p. J-2. Units 1&2 combined cycle once-through cooling water flowrate = 214,000 gpm. Unit once-through cooling water usage rate = (214,000 gpm × 60 min/hr)/1,080 MW = 11,889 gallons/MW-hr.
\(^8\) Assuming the Moss Landing Units 1&2 unit cooling water usage rate is representative of coastal once-through cooled combined cycle units, the annual cooling water throughput for coastal combined cycle units collectively would be: 1,900 MW × 8,760 hr/yr × 0.37 × 11,889 gallons/MW-hr = 73 billion gallons per year.
represent about 78 percent of total California once-through cooled coastal power plant ocean water withdrawals (816 billion gal/yr ÷ 1,047 gal/yr = 0.779, or 77.9 percent).

The coastal steam boiler plants account for about 15 percent of once-through cooling withdrawals. The once-through cooled coastal combined cycle plants account for about 7 percent of once-through cooling withdrawals.9

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9 Diablo Canyon once-through cooling withdrawals = 816 billion gallon/yr. Coastal steam boiler withdrawals = 158 billion gallons per year. Coastal once-through cooled combined cycle withdrawals = 73 billion gallons per year. Total annual withdrawals = 1,047 billion gallons per year. Percentage nuclear = 78%. Percentage steam boiler = 158 billion gal/yr ÷ 1,047 billion gal/yr = 0.15, or 15%. Percentage combined cycle = 73 billion gal/yr ÷ 1,047 billion gal/yr = 0.07, or 7%.