El Segundo Power, LLC
301 Vista Del Mar
El Segundo, CA 90245

Phone: 310.615.6342
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May 12, 2005

Mr. Jonathan Bishop, P.E.
Executive Officer
California Regional Water Quality Control Board, Los Angeles Region
320 W. 4th Street, Suite 200
Los Angeles, CA 90013

Re: El Segundo Power, LLC - Response to 2nd Supplemental Date Request for Report of Waste Discharge Application for NPDES Permit No. CA0001147, CI-4667

Dear Mr. Bishop,

On February 15, 2005, the Los Angeles Regional Water Quality Control Board ("Regional Board") submitted a letter to El Segundo Power, LLC ("ESP") requesting supplemental information regarding the El Segundo Generating Station ("ESGS") Report of Waste Discharge ("ROWD") for renewal of NPDES Permit No. CA0001147, CI-4667. Herein please find our responses to each of the three data requests.

Please be advised that ESP does not consider this supplemental information as necessary or required by 40 CFR §122.21, Subpart B, Subsection (g), which specifies what information is required for a complete ROWD. ESP continues to consider its original ROWD application submitted on September 24, 2004, as complete for purposes of meeting the minimum requirements of 40 CFR §122.21, Subpart B, Subsection (g). Nevertheless, ESP has provided as complete a response to the data request as was possible considering the time frame allowed.

Item #1: Discharge from Outfall 001

You have asked that we provide a "justification" for any discharge from Outfall 001. That justification is two fold.

First, the existing Units 1 & 2 cooling water system has not been modified or changed in any physical way. Further, the existing Units 1 & 2 cooling water system continues to operate despite the fact that Generating Units 1 & 2 are not currently being operated to produce electricity. The Units 1 & 2 cooling system provides several functions for ESGS that cannot be provided by the Units 3 & 4 cooling water system. The primary function is the continuous discharge of sanitary waste streams from waste treatment plant #1 located on the northern side (Units 1 & 2 side) of ESGS. The once flow through cooling water

system is an integral part of the sanitary waste treatment system and requires circulation of sufficient continuous cooling water flow to avoid excessive fouling of the cooling system, and to properly discharge the treated sanitary wastes. Additionally, service air compressors in use at Units 1 & 2 utilize bearing cooling water from the Units 1 & 2 bearing cooling water heat exchangers, which are cooled from the Units 1 & 2 cooling water system. These service air compressors are critical to the operation of the plant by supplying high volumes of compressed air used for various purposes throughout the plant and at Units 3 and 4. Further, the bearing cooling water heat exchangers on Units 3 & 4 draw additional cooling water from the Units 1 & 2 cooling water system during peak operational periods when the heat transfer is poor across the Units 3 & 4 bearing cooling water heat exchangers that may be caused by marine fouling. The cooling water utilized during these peak periods is drawn through the cross over between Units 1 & 2 and Units 3 & 4. This cross over is considered a backup and supplement to the Units 3 & 4 cooling water system and therefore a critical component to the operation of Units 3 & 4. Finally, Units 1 & 2 cooling water system is used for storm water discharge from various locations at the facility and the cooling water circulation is the means by which the storm water is conveyed to the outfall.

The second justification is that the California Energy Commission ("CEC') recently approved a construction permit allowing new generating units to be built in place of the existing Generation Units 1 & 2 that provides a continued need and requirement for the Units 1 & 2 cooling water system, since the new generating units will rely on the existing Units 1 & 2 cooling water system for cooling purposes and waste discharge. Representatives of the Regional Board monitored, commented and generally participated in the CEC permitting process that led to the issuance of the permit earlier this year. The CEC permit does not place any new, specific constraints on the daily operation of the Units 1 & 2 cooling system and recognizes its daily volumetric intake limit of 207 MGD inherent in the NPDES permit for ESGS. CEC permit Condition of Certification BIO-3 sets a facility wide (both cooling systems) annual intake flow limit of 126.7 billion gallons, which is roughly equivalent to 57% of the flow volume that would occur should both cooling systems at ESGS operate at their full daily capacity for the entire year. BIO-3 also sets facility wide intake limits for the months of February, March, and April. For all of these limits, the operator is free to choose how much flow volume to use through either cooling system. These flow limits will be applicable upon commercial operation of the new units. The CEC decision is founded upon the NPDES permit for ESGS and its permitted flows through the Units 1 & 2 cooling water intake of 207 MGD.

The new units will provide extremely efficient new power generation capacity at ESGS using state of the art emissions control equipment. Additional power generation capacity is desperately needed in the Los Angeles region and this project provides that new capacity using existing resources such as the cooling systems at ESGS. The repowering project is exceptionally valuable by virtue of its tremendously efficient use of cooling water. By using combined cycle technology, the new units will generate a significantly larger amount of electricity with the same amount or less cooling water flow.

Because of the multiple agency jurisdictions that coastal projects such as this one undergo, permit decisions are complex documents that reflect interdependence upon many agencies. In particular here, the dual roles of the Regional Board and the CEC have been carefully worked out so that the NPDES permit issued by the Regional Board and the CEC permit are able to function side by side. The CEC permit process for the project took more than four years to be approved and during that time, the decision to not renew the air permit issued by the South Coast Air Quality Management District for Units 1 & 2 was made. This occurred because a new permit had been submitted to the SCAQMD to replace those same units and because the permit was pending from the CEC to replace those units with new Units 5, 6, and 7. The NPDES permit has been preserved, however, because the cooling system is not being changed and its capacity is not being increased, which is the necessary design to operate the new generating units. Removing the authority to use the Units 1 & 2 cooling water system and its full capacity would remove a necessary component for the repowering project and greatly upset the interdependent balance between the CEC and the Regional Board and threaten the viability of this important electricity project

For all of these reasons, a renewal of the NPDES permit for ESGS, including the full capacity of the Units 1 & 2 cooling water system, is merited and allowed by law.

You have also asked for additional information on expected effluent characteristics from Units 1 & 2 cooling water system. It is too early in the planning process for the new facility to provide any specific, detailed information on changes that might occur to the characteristics of the waste stream in the Units 1 & 2 cooling water system. However, generally speaking, the condensers of Units 1 & 2 will be replaced with a single condenser of uncertain design. Additionally, the sanitary waste streams will be removed from their current ocean discharge paths and will instead be sent to the City of Manhattan Beach sewer pipeline system via a new pipeline. At this time, there have not been any physical changes made to the discharge streams at ESGS. Nor has the applicant submitted any final plans, drawings, or other requests to the CEC to begin the construction or implementation of any changes to the facilities at ESGS. The applicant will, however, ensure that the Regional Board staff is fully informed of any needed administrative changes to the NPDES permit to accommodate changes caused by the construction of the new Generating Units 5, 6, and 7 at ESGS.

Item #2: Evidence of Chlorine Variance

Evidence of the existing Clean Water Act Section 301(g) variance for chlorine at ESGS is provided in **Attachment A** of this document.

Item #3: Dilution Ratio Justification

The California Ocean Plan allows water quality objectives to be met after completion of initial dilution. In other words, the discharge leaving the Zone of Initial Dilution (ZID), must meet the water quality objectives (Attachment A). The Ocean Plan defines initial dilution as "the process which results in the rapid and irreversible turbulent mixing of wastewater with ocean water around the point of discharge." For cooling water wastes, completion of initial dilution "is considered completed when the momentum induced velocity of the discharge ceases to produce significant mixing of the waste, or the diluting plume reaches a fixed distance from the discharge to be specified by the Regional Board, whichever results in the lower estimate for initial dilution." Both acute and chronic toxicity objectives, as well as all other water quality objectives, must be met at the edge of the ZID.

According to the Ocean Plan, the SWRCB Executive Director shall identify standard dilution models for use in determining minimum probable dilutions. Based on these models, the RWQCB determined the initial dilutions for the ESGS Outfalls 001 and 002 to be, respectively, 12 to 1 and 18 to 1 (receiving water to effluent). However, the Ocean Plan allows dischargers to propose alternative methods of calculating the minimum probable dilution; the RWQCB may accept such methods upon verification of their accuracy and applicability.

SCE submitted an alternative dilution model based on a flux-weighted-average dilution method. In applying this model, SCE used heat as a tracer in determining dilution since both contaminants and heat will be diluted the same mechanisms. Water temperature around the discharge point was plotted on a map as contours. This map was then used to plot the centerline temperature decay as a function of distance from the discharge point. Where the curve (temperature decay vs. distance) significantly changes slope, initial dilution is assumed complete. Since temperature isotherms correspond to pollutant isopleths, the distance corresponding to the breakpoint temperature defines the ZID. Initial dilution can then be calculated using the breakpoint temperature and SCE's flux-weighted-averaged dilution methodology. In the case of ESGS, SCE calculated the initial dilutions to be 13 to 1 for Outfall 001 and 19 to 1 for Outfall 002 (Attachment C).

SWRCB and the Regional Board approved of the SCE proposed initial dilutions, but required the dilution ratios be reduced by 1 (Attachment D), resulting in approved dilution ratios of 12 for Outfall 001 and 18 for Outfall 002 (Attachment F).

On March 16, 2005, ESP met with the Regional Board staff to discuss the rationale for requiring an update of the original dilution ratio modeling. At the meeting, Regional Board staff indicated that updated dilution modeling should be conducted using a computer model such as Visual Plume or CORMIX. On April 28, 2005, ESP again met with the Regional Board staff along with representatives of the other power generation dischargers

in the region. Dr. John List of Flow Science was also at the meeting, who provided an overview of how the original dilution modeling was still relevant and appropriate.

ESP consulted further with Dr. List to document the derivation of the existing dilution ratios or assist in selecting which one of the two models suggested by the Regional Board would be appropriate for use at the El Segundo facility. Dr. List stated that neither the CORMIX nor Visual Plume models are capable of accurately modeling the mixing zone from a discharge point in a shallow near shore ocean environment. These models were designed for deepwater discharges where the discharge field is able to rise until it reaches equilibrium. This is not the case for discharges in less than 30 feet of water. Dr. List determined that the calculation of the original dilution ratios is still relevant and applicable today, has been verified by direct measurement of the thermal field, and that there is no need to update the demonstration. The single best method for such flows continues to be the application of field and hydraulic model data, as was used in the original method. There is no point in numerically modeling a discharge when it already exists.

Historical documentation of the dilution ratio calculation, demonstration, and acceptance is provided in this letter in the following attachments:

- **Attachment B** – Memorandum dated January 1979; From: Cal Tech, To: Southern California Edison; Subject: Initial Dilution and California State Ocean Plan.

- **Attachment C** – Memorandum dated April 13, 1979; From Cal Tech, To: Southern California Edison; Subject: Initial Dilution.

- **Attachment D** – Memorandum dated May 4, 1984; From: State Water Resources Control Board, To: Southern California Edison; Subject: Minimum Initial Dilution Ratios For Power Generating Stations: Alamitos, Haynes, Long Beach, Harbor, El Segundo, Ormond Beach, Redondo Beach, Scattergood, and Mandalay.

- **Attachment E** – Letter dated September 12, 1979; From: Southern California Edison, To: State Water Resource Control Board; Initial Dilution Factors.

- **Attachment F** – Memorandum dated February 4, 1985, From: State Water Resources Control Board, To: Southern California Edison; Subject: Initial Dilution Ratios For Scattergood and El Segundo Power Generation Facilities Cooling Water Discharge.

As documented in the above attachments, the original dilution ratio demonstration for the generating station discharges was conducted by the top experts in the field, including Cal Tech scientists, and remains today a very thorough accounting of the special circumstances of the ESGS and other power plant discharge configurations. With such a robust demonstration, it does not appear appropriate to use the other models, which are unsuited

for the type of discharge at ESGS. It is ESP's opinion, and the professional opinion of Dr. List, that there is no need to produce a new numerical model for the ESGS facility. The justification for the existing dilution ratios is provided by the historical documentation from the original calculation.

ESP looks forward to continuing to work with the Regional Board in renewing the ESGS NPDES application. If you have any questions on this matter, please contact Mr. Tim Hemig at 760.268.4037.

Sincerely,
El Segundo Power, LLC
By: NRG El Segundo Operations Inc.
It's Authorized Agent

By: _____
Greg Hughes
Regional Plant Manager

cc: Tim Hemig, Alex Sanchez
John McKinsey, David Lloyd

Attachment A

El Segundo Generating Station

US EPA CWA Section 301 (g) Chlorine Variance Documentation

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

Re:

Southern California Edison Company) EL Segundo Generating Station) El Segundo, CA) Application for Section 301(g)) Variance from Best Available) Technology Economically Achievable) (BAT) Requirements of the Clean) Water Act)		FINAL DECISION, REGIONAL ADMINISTRATOR, REGION 9, PURSUANT TO SECTION 301(g) OF THE CLEAN WATER ACT

Based on the attached final evaluation, I am approving the Southern California Edison Company's (SCE) request for a variance from the Clean Water Act's Best Available Technology Economically Achievable (BAT) requirement for total residual chlorine for its El Segundo Generating Station. This decision is contingent upon SCE's compliance with the terms and conditions set forth in the attached document.

I issued a tentative decision to grant this variance request on April 23, 1995. A public notice addressing this decision was published in the Los Angeles Times on May 8, 1995. This final decision takes into consideration the two comment letters received during the 30-day public comment period.

This decision is based on evidence specific to the El Segundo Generating Station and is not intended to assess the need for BAT by other industrial facilities discharging to the aquatic environment. This decision is also subject to revision on the basis of subsequently acquired information relating to the impacts of the modified effluent limitations on the aquatic environment and human health.

Any person may contest this decision by submitting a timely request for a hearing in accordance with 40 CFR 124.74 or 124.114.

23 May 1995
DATE

for FELICIA MARCUS
REGIONAL ADMINISTRATOR

FINAL ANALYSIS OF 301(g) VARIANCE APPLICATION

FOR

THE SOUTHERN CALIFORNIA EDISON COMPANY

EL SEGUNDO GENERATING STATION

Prepared by
Water Management Division
EPA Region 9
May 1996

SUMMARY OF THE 301(g) VARIANCE REQUEST FOR SOUTHERN CALIFORNIA EDISON COMPANY EL SEGUNDO GENERATING STATION EL SEGUNDO, CALIFORNIA

Will Southern California Edison Company's *Alternate* Proposed Modified Effluent Limitations[1] for Total Residual Chlorine:

1.	Meet the Best Practicable Technology (BPT)?	yes
2.	Meet the State Water Quality Standards?	yes
3.	Require additional treatment for any other point or non-point source?	no
4.	Protect downstream water supplies?	yes
5.	Allow recreational activities?	yes
6.	Assure protection and propagation of a balanced population of shellfish, fish and wildlife?	yes

Pose an unacceptable risk due to:

a.	bioaccumulation?	no
b.	persistence?	no
c.	acute toxicity?	no
d.	chronic toxicity?	no
e.	carcinogenicity?	no
f.	mutagenicity?	no
g.	teratogenicity?	no
h.	synergism?	no

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[1]Southern California Edison's (SCE's) original variance application requested Proposed Modified Effluent Limits (PMELs) of 0.574 mg/l for Outfall 001 and 0.820 mg/l for Outfall 002. The National Pollutant Discharge Elimination System (NPDES) permit for the El Segundo Generating Station currently allows the facility to discharge at these *original* PMELs. This variance evaluation, however, is based on a review of a more stringent *alternate* PMEL of 0.4 mg/l for both outfalls. EPA's determination is based on this *alternate* PMEL because the chronic and acute toxicity data for the El Segundo facility are more representative of the *alternate* PMEL than of the *original* PMELs (i.e, the chlorine concentrations in the toxicity samples were less than the *original* PMELs).

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INTRODUCTION

The Southern California Edison Company (SCE) has requested a variance under Section 301(g) of the Clean Water Act (the Act) as amended, 33 USC Section 1311(g), from Best Available Technology Economically Achievable (BAT) effluent limitations for Total Residual Chlorine (TRC), required by Section 301(b)(2)(A), for its El Segundo Generating Station (ESGS) at 301 Vista Del Mar in El Segundo, CA. The National Pollutant Discharge Elimination System (NPDES) permit currently in effect for the ESGS allows the facility to discharge TRC from Outfalls 001 and 002 at the Proposed Modified Effluent Limitations (PMELs) originally requested by SCE, pending EPA's decision on this variance request. SCE's original PMELs are greater than the BAT limit of 0.2 mg/l. The NPDES permit (No. CA0001147) was reissued by the Los Angeles Regional Water Quality Control Board (RWQCB) on December 5, 1994; it's scheduled to expire on November 10, 1999. The previous NPDES permit, which was issued in February 1990, also included the PMELs originally requested by SCE.

In evaluating this variance request, EPA considered an alternate modified effluent limit (referred to in this report as the "alternate PMEL") of 0.4 mg/l, in addition to SCE's original PMELs of 0.574 and 0.820 mg/l. EPA's tentative decision is based on the alternate PMEL.

EPA has evaluated the applicant's variance request and other related information to determine whether the applicant's *alternate* PMEL (which is more stringent that SCE's *original* PMELs) satisfies the variance criteria. The variance request contains effluent and receiving water data and other empirical evidence. In addition, EPA reviewed more recent effluent acute and chronic toxicity data. In developing this decision, EPA referred to the draft technical guidance manuals for 301(g) variances, as well as the criteria set forth in Section 301(g) of the Act.

This document presents EPA's findings, conclusions, and recommendations regarding the SCE variance application for the ESGS. EPA has concluded that the *alternate* PMEL for the ESGS will comply with all the requirements of Section 301(g). EPA is therefore granting a Section 301(g) variance based on the *alternate* PMEL of 0.4 mg/l for TRC for Outfalls 001 and 002. The *alternate* PMEL is more stringent than ESCE's *original* PMELs, but less stringent than the BAT limit. (Because the *alternate* PMEL is more stringent or conservative than the *original* PMELs, all of the SWRCB's findings regarding the *original* PMELs also apply to the *alternate* PMEL.) The *alternate* PMEL was derived from the toxicity data for January 1991 through June 1994.

Throughout the remainder of this report, the terms "PMEL" and

"PMELs" will apply to both the *alternate* and *original* PMELs unless specifically noted.

SUMMARY OF SCE's APPLICATION

SCE initially submitted an application for a Section 301(g) variance from BAT for the nonconventional pollutant Total Residual Chlorine (TRC) on August 11, 1983. The variance application applies to the ESGS in El Segundo, CA. Effluent, consisting of once-through cooling water from four steam electric generating units, chemical metal cleaning wastes, low volume wastes and treated sanitary wastes, is discharged from Outfalls 001 and 002 to Santa Monica Bay (Pacific Ocean).

Discharges from the ESGS have been classified as ocean discharges by the California State Water Resources Control Board (SWRCB). The maximum permitted flows for Outfall 001 (condenser units 1 and 2) and Outfall 002 (condenser units 2 and 3) are 207 million gallons per day (MGD) and 398.6 MGD, respectively.

Chlorine, in the form of sodium hypochlorite, is intermittently injected into each condenser half's cooling water stream in order to control biological growth in the condenser units. The *original* PMELs requested by the applicant for the discharge of TRC from outfalls 001 and 002 are 0.574 mg/l and 0.820 mg/l (maximum concentrations), respectively. The *alternate* PMEL for both outfalls is 0.4 mg/l. Both the original and alternate PMELs are less stringent than the BAT limitation of 0.2 mg/l (maximum concentration) for the Steam Electric Generating Industrial Category. There are no Best Practicable Technology Currently Available (BPT) limitations for TRC. There is a BPT effluent guideline for free available chlorine (FAC). As required by §301(g)(2)(A), the PMELs must comply with BPT and must allow compliance with applicable water quality standards. BPT limitations for FAC are 0.2 mg/l average concentration and 0.5 mg/l maximum concentration.

The Water Quality Control Plan, Ocean Waters of California ("Ocean Plan"), contains two equations - one for calculating water quality objectives (i.e., standards) during the intermittent discharges of chlorine and one for calculating effluent limitations. The water quality objective equation for the intermittent discharge of TRC is based on the duration of each chlorination event. The effluent limitation equation is based on the calculated water quality objective and a dilution factor. The SWRCB granted the applicant an exception to the TRC discharge limitation calculated by the effluent limitation equation in the Ocean Plan. The applicant's *original* PMELs reflect this exception.

This exception to the Ocean Plan was granted to the ESGS, as

well as to several other facilities, by SWRCB Resolution 88-80. SWRCB Resolution 88-80 was approved based on evidence submitted by the dischargers, including the results of toxicity tests on 3 species of indigenous marine organisms. The SWRCB concluded that the evidence showed that the dischargers' proposed modified TRC effluent limitations (i.e., PMELs) would be adequate to protect beneficial uses, would have a minimal impact on receiving waters, and should result in meeting the numeric receiving water quality objectives for chlorine. (It therefore follows that the *alternate* PMEL would also be adequate to protect beneficial uses, etc., since it is more stringent that SCE's *original* PMELs.) The SWRCB also concluded that the effluent limitation equation contained in the Ocean Plan did not consider the reduction of chlorine to a nontoxic state during initial dilution. EPA concurred with this exception on February 15, 1989.

When the SWRCB adopted Resolution 88-80 and granted the exception to the ESGS, the 1983 Ocean Plan was in effect. The Ocean Plan was subsequently amended in September 1988 and March 1990. The 1988 Ocean Plan contained the same equations as the 1983 Plan. The 1990 Ocean Plan, on the other hand, revised the equation for calculating the water quality objectives applicable to intermittent discharges of chlorine, making the objectives more stringent. However, SWRCB Resolution 88-80 is a "permanent" exception, and it therefore remains in effect despite the revisions to the Ocean Plan. As described above, Resolution 88-80 was approved based on biotoxicity data which indicated that the PMELs would have a minimal impact on receiving waters and would protect beneficial uses.

Note that the PMELs are expressed in terms of a maximum concentration, which also serves as the basis for BAT. In accordance with BAT and the effluent guidelines for the Steam Electric Power Generating category, chlorine discharges are limited to a total of two hours per day per generating unit. The Ocean Plan also stipulates that use of the water quality objective equation for "intermittent discharges" of chlorine applies to intermittent discharges not exceeding two hours. The exception to the Ocean Plan granted to the ESGS by the SWRCB is based upon SCE's *original* PMELs of 0.574 mg/l and 0.820 mg/l for Outfalls 001 and 002 and an uninterrupted chlorination duration of 30 minutes per discharge event. (In this case, discharge "event" means the uninterrupted chlorination of one condenser-half). This variance decision only addresses the conditions specific to SCE's El Segundo Generating Station.

DECISION CRITERIA

Section 301(g) of the Act provides for modification of otherwise applicable BAT limitations for nonconventional pollutants if certain substantive criteria are met. Filing

deadlines for Section 301(g) requests are specified in Section 301(j)(1)(B) of the Act and Code of Federal Regulations (40 CFR) 122.21(1)(2) and require submission of Section 301(g) variance requests within 270 days of the date of promulgation of the appropriate effluent limitation guideline. In this case, effluent limitation guidelines for the Steam Electric Category (40 CFR Part 423) were promulgated on November 19, 1982. SCE's initial request (August 11, 1983) was made within 270 days of the promulgation of these guidelines and is considered a timely request.[2]

On February 4, 1987, the Water Quality Act of 1987, P.L. 100-4 (WQA) was enacted. Section 302 of the WQA amended various provisions of Section 301(g) of the Act, including limiting the availability of Section 301(g) variance requests to five specifically listed nonconventional pollutants: ammonia, chlorine, color, iron, and total phenols (4AAP) (when determined to be a nonconventional pollutant by the Administrator). Provisions for listing additional nonconventional pollutants were established by the WQA in Section 301(g)(4) of the Act.

The Administrator of the EPA or his designee (e.g., the Regional Administrator) shall approve ESGS's request for a variance for BAT for TRC provided SCE demonstrates that the variance will comply with the following criteria listed in Section 301(g), as amended:

- TRC is a nonconventional pollutant. Section 301(g)(1).
- The State of California concurs with the variance. Section 301(g)(1).
- The PMEL will result in compliance with the State's Water Quality Standard (WQS) for TRC. Section 301(g)(2)(A).
- The PMEL will not result in any additional treatment requirements on any other point or nonpoint sources. Section 301(g)(2)(B).
- The PMEL will not interfere with the attainment and maintenance of water quality necessary to:

  -Protect public water supplies (ESGS uses ocean water as a source for cooling water and discharges the effluent back into the ocean);

  -Allow recreational activities in and on the water;

  -Assure protection and propagation of a balanced population

[2]Reference 3

of shellfish, fish, and wildlife. Section 301(g)(2)(C).

- The PMEL will not:

  -Result in the discharge of pollutants which may reasonably be anticipated to pose an unacceptable risk to human health or the environment because of bioaccumulation, persistency in the environment; acute and chronic toxicity (including carcinogenicity, mutagenicity, or teratogenicity), or synergistic propensities. Section 301(g)(2)(C).

SUMMARY OF FINDINGS

Based upon a review of the data, references, and additional sampling conducted by the applicant, EPA makes the following findings with regard to the alternate PMEL's compliance with the statutory criteria:

- TRC is a nonconventional pollutant.

- The State of California has concurred with the variance. This is documented in SWRCB Resolution 88-80, and the NPDES permit issued by the Los Angeles RWQCB.

- The original PMELs, and therefore the more stringent alternate PMEL, will result in compliance with the Ocean Plan WQS for TRC. This conclusion by the SWRCB is documented in SWRCB Resolution 88-80. EPA concurred with SWRCB Resolution 88-80 on February 15, 1989.

- The PMEL will not result in any additional treatment requirements on any other point or nonpoint sources.

- The PMEL should not interfere with the attainment and maintenance of water quality necessary to:

  -Protect public water supplies;

  -Allow recreational activities in and on the water;

  -Assure protection and propagation of a balanced population of shellfish, fish and wildlife.

- The PMEL should not:

  -Result in the discharge of pollutants which may reasonably be anticipated to pose an unacceptable risk to human health or the environment because of bioaccumulation; persistency in the environment; acute of chronic toxicity (including carcinogenicity, mutagenicity, teratogenicity);

or synergistic propensities.

DESCRIPTION OF THE FACILITY

The ESGS is located in El Segundo, CA. It discharges once-through cooling water, metal cleaning wastes, treated sanitary wastes, storm water runoff and low volume wastes into the Pacific Ocean (Santa Monica Bay) under NPDES permit No. CA0001147. To cool generating units 1 and 2, ocean water is supplied at a rate of about 144,000 gallons per minute (gpm). The intake water is brought through a concrete conduit which extends approximately 2,600 feet offshore to a depth of 20 feet Mean Lower Low Water (MLLW). A screening structure removes trash, algae, and marine organisms which enter the intake structure with the seawater. After passing through the screens, the seawater is pumped to the two steam condensers. The water temperature is increased 23° F when the units are operated at full capacity. The heated water is discharged through a 10-ft. diameter conduit which terminates approximately 1,900 ft. offshore at a depth of about 20 ft. MLLW.

Units 3 and 4 have a similar cooling water system. The intake conduit extends 2,600 ft. offshore at a depth of 20 ft. MLLW; it supplies water at about 295,000 gpm. The effluent is discharged to the ocean through Outfall 002 which extends about 2,100 feet offshore at a depth of about 20 ft MLLW. The temperature increase across the condensers is about 22° F.[3]

Effluent discharged through Outfall 001 (207 MGD) consists primarily of once-through cooling water from steam electric generating units 1 and 2. The effluent also includes 0.028 MGD of low volume wastes (primarily condenser sump wastes at 0.015 MGD, boiler blowdown at 0.013 MGD, and rainfall runoff); and 0.001 MGD of treated sanitary wastes from Wastewater Treatment Plant #1. Floor drain wastes and storm water runoff are passed through an oil/water separator before being discharged to a retention basin and then to the ocean.

Wastes discharged through Outfall 002 (398.6 MGD) consist primarily of once-through cooling water from steam electric generating units 3 and 4. The effluent also includes 1.603 MGD of low volume wastes; and 0.001 MGD of treated sanitary wastes from Wastewater Treatment Plant #2. The low volume wastes are comprised of floor drain wastes (0.07 MGD), boiler blowdown (0.013 MGD), fireside and air preheater wastes (0.6 MGD), units 1

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[3] National Pollutant Discharge Elimination System 1993 Receiving Water Monitoring Report, El Segundo and Scattergood Generating Stations, Los Angeles County, CA, 1993 Survey; Prepared by MBC Applied Environmental Sciences.

or synergistic propensities.

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[3] National Pollutant Discharge Elimination System 1993 Receiving Water Monitoring Report, El Segundo and Scattergood Generating Stations, Los Angeles County, CA, 1993 Survey; Prepared by MBC Applied Environmental Sciences.

- 4 metal chemical cleaning wastes (0.12 MGD), fuel pipeline hydrostatic testing water (0.8 MGD), and storm water runoff. Chemical metal cleaning wastes are routed to a chemical cleaning waste retention basin where they are treated by lime precipitation. Rainfall runoff and floor drain wastes are passed through oil/water separators. Except for rainfall runoff and the treated sanitary wastes, the pretreated metal cleaning wastes and other wastes are stored in a retention basin prior to discharge to the ocean. Sanitary wastes are treated in Treatment Plants 1 and 2, which are aerated activated sludge secondary treatment package plants.[4]

The condenser tubes are arranged in two banks per generating unit. Each bank is called a condenser half. According to the ESGS's NPDES permit and subsequent information provided by SCE by letter dated September 26, 1994, each condenser half is chlorinated for 30 minutes per chlorination cycle, and there is a maximum of one chlorination cycle per 24-hour period. This results in a maximum total chlorination time of 1 hour per day for each generating unit, or 2 hours per day per outfall. With four generating units, the total duration of chlorination is a maximum of 240 minutes or 4 hours per day. The cooling water from the four generators is not chlorinated on a daily basis, but is chlorinated an average of 65 days per quarter. The NPDES permit No. CA0001147 states for Outfall 001:

"Total residual chlorine may not be discharged from any single generating unit for more than 30 minutes per condenser half per shift. For chlorine discharges of up to 30 minutes, the daily maximum limit is 0.574 mg/l. For chlorine discharges exceeding 30 minutes, the applicable chlorine limitation shall be that calculated using procedures outlined in Table B "Toxic Material Limitations" of the Ocean Plan."

The NPDES permit (CA0001147) contains the same stipulation for Outfall 002, except the daily maximum TRC limit is 0.820 mg/l.

It's noted that Table B applies to continuous discharges of TRC.

RECEIVING WATER

Outfalls 001 and 002 discharge to the Pacific Ocean at Santa Monica Bay (Latitude 33° 54' 30", Longitude 118° 25' 50"; and Latitude 33° 54' 27", Longitude 118° 25' 50"). SWRCB has classified the discharges from the ESGS as ocean discharges, and as such, the ESGS discharges must comply with the CA Ocean Plan.

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[4]References 9 and 10

Designated Uses and Water Quality Objectives

The current Ocean Plan, which specifies beneficial uses and water quality objectives for the coastal waters of California, was approved by EPA in June 1990.[5] For the purposes of this variance, the Ocean Plan has designated the following beneficial uses for Santa Monica Bay and the Pacific Ocean in the area of ESGS: industrial service supply; water contact and non-contact recreation, including aesthetic enjoyment; navigation; ocean commercial and sport fishing; mariculture; preservation and enhancement of Areas of Special Biological Significance; rare and endangered species; marine habitat; fish migration; fish spawning; and shellfish harvesting.

As discussed above, the Ocean Plan's water quality objectives or standards (WQSs) for intermittent discharges of total residual chlorine are determined through the use of an equation. This equation, which applies to intermittent discharges not exceeding two hours, calculates the WQS based on the duration of uninterrupted chlorine discharge.

Initial Dilution

The CA Ocean Plan allows water quality objectives to be met after completion of initial dilution. In other words, the discharge leaving the Zone of Initial Dilution, or ZID, must meet the water quality objectives. The 1990 Ocean Plan defines initial dilution as "the process which results in the rapid and irreversible turbulent mixing of wastewater with ocean water around the point of discharge." For cooling water wastes, completion of initial dilution "is considered completed when the momentum induced velocity of the discharge ceases to produce significant mixing of the waste, or the diluting plume reaches a fixed distance from the discharge to be specified by the Regional Board, whichever results in the lower estimate for initial dilution." Both acute and chronic toxicity objectives, as well as all other water quality objectives, must be met at the edge of the ZID.

According to the Ocean Plan, the SWRCB Executive Director shall identify standard dilution models for use in determining minimum probable dilutions. Based on these models, the RWQCB determined the initial dilutions for the ESGS Outfalls 001 and 002 to be, respectively, 12 to 1 and 18 to 1 (receiving water to effluent). However, the Ocean Plan allows dischargers to propose alternative methods of calculating the minimum probable dilution; the RWQCB may accept such methods upon verification of their accuracy and applicability.

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[5]Reference 7

SCE submitted an alternative dilution model based on a flux-weighted-average dilution method. In applying this model, SCE used heat as a tracer in determining dilution since both contaminants and heat will be diluted by the same mechanisms. Water temperature around the discharge point was plotted on a map as contours. This map was then used to plot the centerline temperature decay as a function of distance from the discharge point. Where the curve (temperature decay vs. distance) significantly changes slope, initial dilution is assumed complete. Since temperature isotherms correspond to pollutant isopleths, the distance corresponding to the this breakpoint temperature defines the ZID. Initial dilution can then be calculated using the breakpoint temperature and SCE's flux-weighted-averaged dilution methodology. In the case of ESGS, SCE calculated the initial dilutions to be 13 to 1 for Outfall 001 and 19 to 1 for Outfall 002.

The SWRCB did not accept this alternative method, but did approve an exception to the Ocean Plan's effluent limitation equation. The exception granted by the SWRCB specified alternative effluent limits for TRC for the El Segundo Generating Station, but cited the RWQCB's original dilution factors of 12 and 18. A chronology of the Ocean Plan exception is provided below.

Chronology of the Ocean Plan Exception

On September 7, 1984, SCE submitted a request for exception from the effluent limitations contained in the 1983 CA Ocean Plan in accordance with provisions contained in the Plan. At a hearing on June 24, 1985, the RWQCB adopted Order No. 85-35 which amended the discharge limitation for TRC and directed this Order to be forwarded to the SWRCB for its concurrence. The RWQCB based its determination on bioassay results obtained from the generating stations; receiving water data [including data on water quality, local benthic (infauna and epifauna) populations and underlying sediments, and local fish populations] collected at three of the generating stations; and a chlorine dissipation study conducted by SCE at the San Onofre Generating Station.[6]

On May 22, 1986, the SWRCB granted the applicant a temporary exception from the TRC effluent limitation calculated by the CA Ocean Plan. This temporary exception (Resolution No. 86-42) required further toxicity testing. EPA's concurrence with the SWRCB decision to grant the temporary request was also based on the understanding that SCE would be required to undertake additional toxicity testing.

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[6]Reference 23

During 1987, SCE and the Los Angeles Department of Water and Power (LADWP) conducted a chlorine toxicity screening study at three power plants which were determined to be representative of discharge conditions at the other generating stations: a shoreline discharger (Haynes Generating Station); an open coast discharger (Scattergood Generating Station); and a harbor discharger (Long Beach Generating Station). Bioassays were performed on the early life stages of three indigenous species: a plant (giant kelp); an invertebrate (purple sea urchin, Strongylocentrotus purpuratus); and fish.

Based on this study, on July 21, 1988, SWRCB adopted Resolution No. 88-80 which grants a permanent exception to the CA Ocean Plan for TRC. On February 15, 1989, the SWRCB received EPA concurrence with its decision to grant the permanent exception to the CA Ocean Plan.[7] Because Resolution 88-80 granted a permanent exception to the Ocean Plan effluent limitation equation and specifically set forth alternate effluent limits for TRC, these alternate limits remain in effect even though the Ocean Plan was subsequently amended in 1990.

EFFLUENT LIMITATIONS

As discussed previously, the Ocean Plan contains an equation for calculating effluent limitations necessary to meet the water quality objectives for a particular parameter. The necessary inputs for the equation include the numeric water quality objective (or the concentration to be met at the completion of initial dilution) and the minimum probable initial dilution. However, SWRCB Resolution 88-80 granted the ESGS an exception to this equation, and specifically stated that alternate TRC effluent limitations (or PMELs) of 0.574 mg/l and 0.820 mg/l (daily maximum) are applicable to the ESGS's Outfall 001 and Outfall 002, respectively. SWRCB Resolution 88-80 concluded the following:[8]

"4. The Ocean plan method for calculating effluent limitations does not consider the reduction of chlorine to a nontoxic state during initial dilution.

5. Sufficient evidence exists to show that the proposed alternate total chlorine residual effluent limitations should result in meeting the numeric chlorine receiving water quality objectives at the edge of the zone of initial dilution allowed by the Ocean Plan.

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[7]Reference 12 and Reference 13

[8]Reference 17

6. The dischargers have submitted evidence, including the results of toxicity tests on indigenous marine organisms, to show that the alternate total chlorine residual effluent limitations are adequate to protect beneficial uses..."

For the ESGS, Resolution 88-80 granted the following maximum total chlorine residual effluent limitations:

FACILITY NAME	DISCHARGE NUMBER(S)	INITIAL DILUTION	NPDES NUMBER	CHLORINE DURATION MIN/EVENT	DISCHARGE CONCENTRATION (MG/L)
EL SEGUNDO	001	12	CA0001147	30	0.574
	002	18	CA0001147	30	0.820

TRC Monitoring Results

As stated above, the daily maximum TRC effluent limitations currently set forth in NPDES Permit No. CA0001147 for the ESGS are 0.574 mg/l (Outfall 001) and 0.820 mg/l (Outfall 002). In addition to the information submitted by SCE as part of its variance application, EPA also reviewed the TRC monitoring results for the years 1991, 1992, 1993 and 1994 (through June 1994). A discussion of EPA's findings, including compliance with the permit limits, follows.

Outfall 001: During 1991, maximum TRC concentrations exceeded the BAT limit during four months. The maximum TRC concentrations for these months ranged from 0.29 mg/l to 0.39 mg/l. There was either no discharge, or the discharge was not chlorinated, during 4 months. For the remaining months, maximum monthly TRC concentrations ranged from 0.05 mg/l to 0.18 mg/l.

During 1992, the BAT limit was exceeded during 7 months, with maximum monthly TRC concentrations ranging from 0.25 to 0.43 mg/l during these 7 months. For the remaining 5 months, there was no discharge during 1 month and all other maximum monthly TRC concentrations ranged between 0.08 mg/l and 0.18 mg/l.

In 1993, the BAT limit was exceeded during 4 months; maximum TRC concentrations for each month varied between 0.29 mg/l and 0.4 mg/l. There was no chlorination (or no discharge) during 1 month. Remaining maximum monthly TRC concentrations ranged between 0.05 mg/l and 0.2 mg/l.

In 1994 (through June), BAT was exceeded twice (0.32 mg/l and 0.23 mg/l). Other values ranged between 0.15 and 0.18 mg/l.

Based on the above information, there were no violations of

the permit limit (PMEL) in 1991, 1992, 1993 or through June 1994. It is also noted that during most days a significant portion of the TRC was in the form of free available chlorine (FAC).

Outfall 002: During 1991, BAT was exceeded during 2 months (0.45 mg/l and 0.5 mg/l). The effluent was not chlorinated (or there was no discharge) during 6 months.

During 1992, BAT was exceeded during 9 months; maximum TRC concentrations for each month ranged between 0.25 mg/l and 0.53 mg/l. For all remaining months, TRC concentrations varied from 0.05 mg/l to 0.18 mg/l.

For 1993, BAT was exceeded during 4 months. The maximum TRC concentrations for these 4 months ranged from 0.26 mg/l to 0.35 mg/l. During the remaining 7 months, TRC values ranged from 0.08 mg/l to 0.2 mg/l.

During 1994, BAT was exceeded during 2 months (0.5 mg/l and 0.25 mg/l). Maximum TRC values for the remaining 3 months were 0.09, 0.18 and 0.1 mg/l.

Based on available information, the permit limit for TRC for Outfall 002 (0.82 mg/l) was not exceeded during 1991, 1992, 1993 or 1994 (through June). As discussed above for Outfall 001, a significant percentage of the TRC was in the FAC form.

It should be noted that some reduction of the chlorine concentration is expected between the effluent monitoring point and the actual discharge to the receiving waters as a result of chlorine decay within the discharge pipe. Data collected in 1977 for Outfall 002 at the ESGS indicated a significant reduction in maximum total residual oxidant concentration between the condenser outlet and the end of Outfall 002. On February 8, 1977, maximum total residual oxidant was measured at about 3.25 mg/l at the outlet and 0.18 mg/l at the outfall. On January 18, 1977, the maximum total residual oxidant was measured at 1.36 mg/l at the condenser outlet and 0.18 mg/l at the outfall. For Outfall 001, the estimated transit time between the screenwell (NPDES permit monitoring point) and the discharge point is about 11 minutes. For Outfall 002, the estimated transit time is about 13.5 minutes.[9]

APPLICATION OF STATUTORY CRITERIA

I. The State must concur on the Section 301(g) variance request:

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[9]Reference 16, Chapter 23

The Los Angeles RWQCB and SWRCB have recommended approval of SCE's section 301(g) variance request. This is documented by SWRCB Resolution 88-80 (as well as the previous SWRCB and RWQCB resolutions), and by RWQCB's inclusion of the original PMELs in the NPDES permit for ESGS.[10]

II. The pollutants for which a variance is sought must be nonconventional:

Under the WQA of 1987, a potential variance for chlorine is authorized under Section 301(g) of the Act.

III. The Modification must at a minimum result in compliance with BPT and State Water Quality Standards:

The Ocean Plan water quality objective or standard for intermittent discharges of TRC is calculated using a formula that incorporates the duration of chlorination. Another formula in the Ocean Plan calculates the maximum effluent limit for TRC based on the water quality objective and the minimum probable dilution.

The SWRCB approved minimum probable initial dilutions of 12 for ESGS Outfall 001 and 18 for ESGS Outfall 002. On September 7, 1984, SCE submitted a request for an exception to the California Ocean Plan based on minimum probable dilutions of 13 and 19 for calculating its TRC PMELs. An increase in the minimum probable dilution would increase the resultant effluent limitation for TRC.

Based on a review of bioassay results and receiving water quality data collected from 3 SCE generation stations, and a chlorine dissipation study conducted by the applicant, the LA RWQCB approved an exception to the Ocean Plan on June 24, 1985 by Order No. 85-35, and forwarded the Order to the SWRCB for approval. Based on additional biotoxicity data, on July 21, 1988, the SWRCB granted a permanent exception to the Ocean Plan by Resolution 88-80. The permanent exception to the Ocean Plan does not explicitly approve alternate minimum probable dilutions, but does approve alternate discharge limitations for TRC. The exception states that the initial dilutions are 12 for ESGS Outfall 001 and 18 for ESGS Outfall 002, and the effluent limits are 0.547 mg/l and 0.820 mg/l for 001 and 002 respectively. This was based on the SWRCB's finding that the Ocean Plan equation for calculating effluent limitations for TRC does not take into account the reduction of chlorine to a nontoxic state during initial dilution. Resolution 88-80 also concluded that the

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[10]Reference 10

alternative effluent limits (PMELs) should allow compliance with the numeric water quality objective at the edge of the ZID.

The 1990 Ocean Plan establishes a Water Quality Objective for the intermittent discharge of TRC of 0.0146 mg/l during an uninterrupted discharge of 30 minutes. This State Water Quality Objective, which must be met at the edge of the ZID, is intended to protect from both acute and chronic toxicity. Without the exception granted by the SWRCB, the effluent limitations calculated by the 1990 Ocean Plan would be 0.190 mg/l for Outfall 001 and 0.278 for Outfall 002. As stated above, however, these effluent limits do not take into account the reduction of chlorine to a non-toxic state. Based on the 1990 Ocean Plan and the SWRCB-approved exception to the Ocean Plan, the effluent limits for TRC and the Water Quality Objective at the edge of the ZID are summarized in TABLE 1.

TABLE 1
SUMMARY OF CURRENT EFFLUENT LIMITATIONS

Outfall	FAC	TRC			
	BPT (mg/l)	BAT (mg/l)	WQS (mg/l)	PMEL (mg/l)	W.Q. EXPECTED AT MIXING ZONE EDGE (mg/l)
001	0.5 daily max.; 0.2 average	0.2 instan-taneous max.	0.0146	0.574	0.0146
002	Same as 001	Same as 001	0.0146	0.820	0.0146

IV. The Modification Does Not Result in Additional Requirements on Other Point and Nonpoint Sources:

SCE's 301(g) application indicates that there are other point and nonpoint sources within 5 miles of the ESGS discharges. These include the Los Angeles Department of Water and Power's Scattergood Generating Station. SCE's 301(g) application states that the effluent from ESGS may commingle with the discharge from the Scattergood Generating Station. SCE's 1993 Receiving Water

Monitoring Report[11] identified 2 other discharges within less than 5 miles: the Los Angeles Hyperion Wastewater Treatment Plant and the Chevron Refinery. The Hyperion Plant is north of the Scattergood Generating Station (less than 1 mile north) and the Chevron Refinery is located between the El Segundo and Scattergood generating stations.

Chlorine dissipation studies conducted at the SCE's San Onofre Generating Station during the late 1970's indicated that chlorine dissipates rapidly in the receiving water from the point of discharge, usually within 30 - 100 meters of the outfall.[12] There are no other sources within 100 meters of ESGSs outfalls.

Receiving water monitoring conducted on July 21 and August 4, 1987 at the Scattergood Generating Station (which is the "model" facility for the ESGS[13]) indicated that there was no detectable TRC concentration in the receiving water outside the discharge bubble on either day. The highest TRC concentrations in the Scattergood discharge bubble were 0.04 mg/l and 0.01 mg/l on July 21 and August 4, respectively. The discharge bubble was estimated to be between 50 and 75 feet across; the edge of the ZID was estimated to be 50 feet beyond the discharge bubble. However, it is not known whether this receiving water data fully represents the PMEL conditions since the study reported only one effluent TRC concentration. On August 4, the effluent TRC concentration measured 14 minutes after initiation of chlorination was 0.01 mg/l. (The Discharge Monitoring Reports or DMRs for the Scattergood Generating Station reported maximum daily TRC concentrations of 0.02 mg/l on both July 21 and Aug. 4, 1987.)

As addressed previously, the SWRCB determined that the PMEL for TRC will result in compliance with the State Water Quality Standard (WQS) at the edge of the mixing zone. As a result,

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[11] National Pollutant Discharge Elimination system, 1993 Receiving Water Monitoring Report, El Segundo and Scattergood Generating Stations, Los Angeles County, CA, 1993 Survey; Prepared by MBC Applied Environmental Sciences.

[12]Reference 5 and 16

[13]The Southern California Edison Company and the City of Los Angeles Department of Water and Power submitted variance requests for a total of 11 power generating facilities. As a result, water quality sampling was conducted at 3 "model facilities" in order to provide representative water quality data for the facilities' discharges to three types of receiving waters - open ocean, shoreline, and harbor. The City of Los Angeles' Scattergood Generating Station, an "Open Coast" facility, is the model facility for the SCE ESGS.

there should be no effect on any other point and nonpoint sources.

As also stated previously, the ESGS's current NPDES Permit No. CA0001147 contains TRC limits of 0.574 and 0.820 mg/l for Outfalls 001 and 002, respectively. The permit was issued by the LA RWQCB, which is the authority for setting wasteload allocations in the Los Angeles region. The RWQCB has not imposed any additional requirements on other dischargers in the area as a result of the inclusion of the PMELs in the ESGS's NPDES permit.

Based on the preceding information, EPA has concluded that neither the original nor alternate PMELs for chlorine should impose additional requirements on other point and nonpoint sources.

V. The Modification Will Not Interfere with the Attainment or Maintenance of Water Quality which Shall Assure Protection of Public Water Supplies:

This facility uses ocean water as its source for cooling water, and discharges the effluent back into the ocean.[15] The Pacific Ocean is not used as a public water supply, therefore, the PMELs will not interfere with the protection of public water supplies.

VI. The Modification Will Not Interfere with the Attainment of That Water Quality Which Shall Allow Recreational Activities In and On the Water:

The PMELs will result in compliance with the Ocean Plan standard for TRC which is designed to protect water-contact and non-water-contact recreation.[16] In addition, the EPA draft human health criterion developed in December 1981 of 10.0 mg/l is well above both the original PMELs of 0.574 and 0.820 mg/l, and the alternate PMEL of 0.4 mg/l (maximum). Therefore, EPA has concluded that the PMELs will not interfere with the attainment of that water quality which shall allow recreational activities in and on the water.

VII. The Modification Will Not Interfere with the Attainment or Maintenance of That Water Quality Which Shall Assure the Protection and Propagation of Shellfish, Fish, and Wildlife:

As discussed in Section III, the SWRCB and RWQCB determined that the PMELs for TRC should result in compliance with the numeric State Water Quality Objective or Standard. The Water

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[15]Reference 10

[16]Reference 12

Quality Objective for TRC is intended to maintain water quality which results in the maintenance and propagation of fish and other aquatic life.[17]

In addition, sampling conducted in the receiving waters at the discharge of the model facility, the Scattergood Generating Station, on July 21 and August 4, 1987, detected no TRC at the edge of the ZID (see Section IV above). For both surveys, TRC was detected only within the discharge bubble at a maximum of 0.04 mg/l.[18]

As stated previously, the initial Ocean Plan exception approved by the RWQCB in 1985 (Order No. 85-35) was based on a chlorine dissipation study conducted by SCE (discussed in Section IV above), receiving water data collected at the three generating stations "most in question" (Mandalay, Alamitos, Long Beach), and NPDES-related bioassay results. The receiving water data included data on water quality, local benthic (infauna and epifauna) populations and underlying sediments, and local fish populations, collected as part of a Thermal Effects Study conducted in 1971-72. Subsequent receiving water data was also collected in 1978 and 1980 in accordance with NPDES permit requirements. The RWQCB concluded that there were no significant changes in sediment conditions between the 1971-72 data and the 1978/1980 data, and that although there were slight changes in biology, there were no changes which could not be attributed to natural variations. The results of three-spine stickleback bioassay studies at the same three generating stations "indicated that the LC50 of the effluent in all cases is beyond 100 percent effluent. Typically, 80-100% of fish tested survive in 100% (undiluted) SCE chlorinated effluents." Based on this information, the RWQCB concluded that "it is evident that granting of the exception request to allow alternative limitations for chlorine will not compromise protection of the receiving waters for beneficial uses."[19] The RWQCB's conclusion was eventually confirmed by the SWRCB in Resolution 88-80, which was based on subsequent bioassay results.

In addition to the above, EPA also reviewed the ESGS's acute and chronic toxicity test results for the years 1991, 1992, 1993, and 1994 (through June). These results are reported in the applicant's Discharger Monitoring Reports (DMRs). EPA's findings are discussed below.

Acute Toxicity Results: As set forth in the Feb. 1990 NPDES

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[17]Reference 12 and Reference 17

[18]Reference 14

[19]Reference 23

permit, the acute toxicity limits for ESGS Outfalls 001 and 002 were 0.65 TUa (6 month median) and 0.95 TUa, respectively. (The Dec. 1994 NPDES permit no longer contains acute limits.) In general, SCE conducted acute toxicity testing quarterly. Tests were conducted separately for each outfall. TRC concentrations were measured in the field at the time of sample collection, and in the laboratory prior to initiating the acute toxicity test. In general, the TRC concentrations measured in the field were always below the BAT limit of 0.2 mg/l (with one exception), and were often less than 0.1 mg/l. The laboratory concentrations were even lower.

Outfall 001: There were 3 test results for 1993. Two results were 0 TUa; the third was 0.59 TUa (November). The highest TRC concentration measured in a sample in the field was 0.1 mg/l in November 1991. FAC was measured at 0.05 mg/l in the same sample.

In 1992, 6 results were reported; two results exceeded the 0.65 TUa limit. The August and November results were both 0 TUa, and the February result was 0.59 TUa. Two tests were conducted in May: the results were 1.56 TUa and 8.70 TUa. The highest TRC concentration measured in the field was 0.125 mg/l (February). In May, the TRC and FAC concentrations measured in the field were <0.05 mg/l for the first sample, and 0 mg/l (chlorinators not operating) for the second sample.

In 1993, 4 results were reported; all results were 0 TUa. The highest TRC measured in the field was 0.1 mg/l. In 1994 (through June), only 1 result was reported. The result was 0 TUa; the chlorinators weren't operating (0 mg/l TRC) on the day the sample was collected.

In conclusion, out of 14 tests conducted, the value of 0.65 TUa was exceeded on only two occasions, both in May 1992. For one of these incidents, the effluent was not chlorinated. For the other incident, the TRC concentration was very low.

Outfall 002: In 1991, 2 test results were reported for Outfall 002. The results were 0 TUa (August) and 0.59 TUa (November). The TRC concentrations measured in the field were 0.2 mg/l (August) and 0.05 mg/l (November). The laboratory TRC concentration for the August sample was 0 mg/l.

In 1992, 3 results were reported. All results were 0 TUa. The highest TRC concentration measured in the field was 0.1 mg/l. The highest FAC concentration measured in the field was 0.4 mg/l; however, the corresponding TRC concentration was reported as 0.05 mg/l.

In 1993, 4 results were reported. Three results were 0 TUa; the third was 0.59 TUa (May). The highest TRC concentration

measured in the field was 0.21 mg/l (February), which was higher than the maximum TRC value reported for that month under the regular NPDES monitoring program.

One 1994 result had been reported at the time of this evaluation. The result was 0 TUa; field TRC concentration was 0.05 mg/l. In conclusion, out of 10 test results for Outfall 002 between January 1991 and June 1994, the limit was never exceeded.

Chronic Toxicity Results: The 1990 Ocean Plan states that the chronic toxicity parameter "shall be used to measure the acceptability of waters for supporting a healthy marine biota." In accordance with the Ocean Plan equation, the chronic toxicity limits for ESGS are 13 TUc for Outfall 001 and 19 TUc for Outfall 002. Samples are typically collected from only one of the outfalls because the other outfall is usually not discharging at the sample collection time. If both discharges are operating, then SCE composites the samples from both outfalls and conducts a single chronic toxicity test. The chronic toxicity tests are conducted monthly using the giant kelp. The giant kelp chronic test evaluates 2 effects: percent germination and germ tube length. TRC concentrations are measured at the time of sample collection. The samples are then stored for up to 24 hours before initiating the chronic toxicity test.

Outfall 001: Out of 30 available test results for 1991, there was 1 violation and 1 unknown value. The violation is indicated below.

Date	Results (TUc)	TRC Conc. in Sample
7/91	55.6	None detected
2/91	Unknown (>10)	Unknown

The other TUc values were reported as either 3.13 TUc or 5.6 TUc. Field TRC concentrations were not reported for all months. Of those that were reported, TRC concentrations were less than 0.2 mg/l with one exception of 0.38 mg/l (August). The corresponding TUc results from August were both 3.13 TUc; the corresponding FAC concentration for this month was 0.34 mg/l.

In 1992, only 6 values were reported for Outfall 001 (two values each in January, August and November). The August tests were conducted on a composited sample from both outfalls. All TUc values were 5.6 TUc. The only TRC concentration available was for November; this was reported as <0.1 mg/l.

There were no 1993 results for Outfall 001. There is only 1 1994 result for Outfall 001 (September). Both September TUc results were reported as 5.6 TUc. The TRC concentration for this month was reported as 0.3 mg/l.

Outfall 002: For 1991, there were 4 test results for Outfall 002. Two of the results were reported as 5.56 TUc, which is well within the permit limit of 19 TUc. The other 2 results did not exceed the permit limit, but the reported values were relatively high (17.9 TUc). Corresponding TRC data was not available.

In 1992, ten values were reported for Outfall 002. The August results were based on composited samples from both outfalls. All TUc values were reported as 5.56 TUc. The maximum reported field TRC concentration was 0.3 mg/l (April), although TRC data for most months was not available.

In 1993, 24 results were reported for Outfall 002. All values were 5.6 TUc except for 2 values of 17.9 TUc for germ tube length (January and February). The reported TRC concentration of the January sample (at time sample collected) was <0.1 mg/l. TRC data for February was not available. For the remaining 10 months, the highest TRC concentration reported was 0.2 mg/l (for 2 months); the remaining TRC values were reported as 0.1 mg/l or less.

During 1994 (through September), all samples were collected from Outfall 002 except the September 1994 sample. All 1994 TUc results for Outfall 002 were reported as 5.6 TUc for both germination and germination tube length, with the exception of March 1994. March's results were 5.6 TUc for germination and 10 TUc for germination tube length. In March, the TRC concentration at the time of sample collection was 0.2 mg/l. The highest TRC concentration was 0.3 mg/l in April (corresponding TUc values were 5.6 TUc). All other TRC concentrations were less than 0.2 mg/l.

Issues Potentially Impacting the Toxicity Results: A review of the toxicity data from 1991 through 1994 indicates that the toxicity results may not be fully representative of either the original PMELs or the actual discharge concentrations. The TRC concentrations measured in the field for the toxicity samples (both acute and chronic) were always well below the original PMEL concentrations, were usually below the maximum TRC value for that month, and were often even below the BAT limit. In addition, toxicity samples were held for up to 24 hours prior to conducting the toxicity tests, resulting in potentially lower TRC concentrations. (The acute toxicity data confirms that the TRC concentrations measured in the laboratory are lower than the original concentrations measured in the field.)

The highest TRC concentration measured in a chronic toxicity sample was 0.38 mg/l in August 1991 (Outfall 001). The TUc values for this month were 3.13 TUc for both germination and germ tube length, which comply with the permit limit. The next highest TRC concentration measured in the chronic toxicity samples was 0.3 mg/l in April 1992 (Outfall 002), April 1994

(Outfall 002) and September 1994 (Outfall 001). The TUc values reported for all three months were 5.6 TUc (germination and germ tube length). The remaining TRC concentrations were reported as 0.2 mg/l (3 months), less than 0.2 mg/l (4 months), or 0.1 mg/l or less (20 months).

In regard to the acute toxicity samples, the TRC values measured in the field at the time of sample collection were always less than the BAT limit of 0.2 mg/l, and were usually less than or equal to 0.1 mg/l, with one exception of 0.21 mg/l (Outfall 002 in February 1993). The February 1993 TUa value reported for Outfall 002 was 0 TUa.

However, the maximum TRC values measured during each month as part of the regular NPDES compliance monitoring for Outfalls 001 and 002 exceeded the BAT limit much more frequently than indicated by the toxicity data. Considering both Outfall 001 and 002, the maximum monthly TRC values exceeded 0.3 mg/l during at least 20 months between January 1991 and June 1994, and exceeded 0.4 mg/l during at least 8 months. The highest TRC value reported for Outfall 002 was 0.53 mg/l. For Outfall 001, the highest TRC value reported was 0.43 mg/l.

Conclusion: There were very few violations of the chronic and acute toxicity limits during the years 1991 through September 1994. There was only 1 violation of the chronic limits during this time, and there were no violations after July 1991. The acute limits were only exceeded twice; both incidents occurred in 1992. All the chronic and acute violations were for Outfall 001. Although there were no violations for Outfall 002, the TUc values for 3 months approached the limit of 19 TUc.

Based on the above, EPA concluded that the toxicity data does not provide conclusive evidence that TRC discharged at the *original* PMEL concentrations will, or will not, cause toxicity. Therefore, approval of this variance is based on a more stringent *alternate* PMEL of 0.4 mg/l, which is better supported by the toxicity data. In addition, approval of this variance will also be contingent upon subsequent whole effluent toxicity monitoring by ESGS that is more representative of the maximum TRC concentrations being discharged. The terms of approval would also include a "re-opener" clause, which will allow EPA to re-assess and revise this variance decision if subsequent monitoring at actual maximum TRC effluent concentrations indicates toxicity.

VIII. The Modification Will Not Result in the Discharge of Pollutants in Quantities That May Reasonably Be Anticipated to Pose an Unacceptable Risk to Human Health or the Environment:

The SWRCB determined (and EPA concurred) that the *original* PMELs for TRC will result in compliance with Federally-approved State Water Quality Standards (WQSs) at the edge of the mixing

zone. It therefore follows that the *original* PMELs, as well as the more conservative *alternate* PMEL, should not pose an unacceptable risk to the environment or human health. As stated earlier, the Ocean Plan sets forth WQSs for ocean waters to ensure the reasonable protection of beneficial uses and the prevention of nuisance. The Ocean Plan contains WQSs which were developed to maintain the following beneficial uses: industrial water supply; water-contact and non-water-contact recreation, including aesthetic enjoyment; navigation; ocean commercial and sport fishing; mariculture; preservation and enhancement of Areas of Special Biological Significance; preservation of rare and endangered species; marine habitat; fish migration; fish spawning; and shellfish harvesting. Additional information regarding human health and environmental impacts of chlorine follows.

1. Persistency: Chlorine is highly soluble and reactive in water. Because of its high reactivity, chlorine is not persistent and does not bioaccumulate.[20] Free available chlorine (FAC) readily oxidizes inorganic and organic compounds. FAC will quickly oxidize bromide ion naturally present in ocean waters to form bromine, hypobromous acid (HOBr) and hypobromous ion (OBr). Because saltwater contains bromide and ammonia, the presence of chlorine can produce chloramines and bromamines. Mono- and dichloramine and the mono- and dibromamine byproducts of the reaction of chlorine with ammonia may be sufficiently persistent to represent a potentially significant threat to sensitive life stages of sensitive marine aquatic life under certain site-specific conditions. However, data from the applicant's March 1994 NPDES permit renewal application (Form 2c) indicated that the ammonia concentrations in both the intake water and the effluent were below the detection limit of 0.05 mg/l.

Chlorine will also rapidly react with inorganics present in the metal cleaning and low volume waste and more slowly react with organics to form chlorinated compounds through substitution and oxidation. The possible compounds formed range from metallic oxides to chlorinated organics, including halogenated aliphatic hydrocarbons or trihalomethanes (THMs). Although chlorine is not persistent and does not bioaccumulate, many chlorinated toxic organics may be very persistent and bioaccumulative. As discussed in "Description of the Facility", however, metal cleaning and low volume wastes are limited internally and are treated before commingling with the cooling water. These waste streams comprise less than one percent of the discharge through the outfalls.

The applicant's Form 2c NPDES permit application (March 1994) indicated that bromoform, the most commonly encountered

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[20]Reference 11

trihalomethane under the existing conditions, was measured in the effluent at less than the detection limit of 0.01 mg/l for both Outfall 001 and 002. Chloroform was also reported at less than the detection limit of 0.005 mg/l for both outfalls.

Sampling of the discharge at the Scattergood Generating Station, the model facility for the El Segundo Station, was conducted on 6 days between April and August 1987 to determine levels of trihalomethanes and other priority pollutants in the effluent. The effluent was sampled during, and 30 minutes after, chlorination. The maximum concentration of bromoform detected in the effluent during chlorination was 1.0 ug/l, the minimum was nondetectable. This maximum concentration of 1.0 ug/l, which occurred on August 4, was the only result above the detection limit. Thirty minutes after chlorination, no bromoform was detected in the effluent during any of the 6 days. The detection limits ranged from 1.0 ug/l to 0.1 ug/l.

The study also analyzed for chloroform, dibromochloromethane and dichlorobromomethane. For five of the six days sampled, the chloroform concentrations were below detection limits. On the other day (July 21), the maximum chloroform concentration measured was 2.5 ug/l during chlorination. Thirty minutes after chlorination, no chloroform was detected at detection limits ranging from 1.0 ug/l to 0.1 ug/l. All results for dibromochloromethane and dichlorobromomethane were below detection limits. Detection limits for these parameters ranged from 1 ug/l to 0.1 ug/l.[21] The study also stated that all other priority pollutants listed in EPA method 624 and 625 were analyzed, but none were detected.

Additional sampling was conducted on July 21 and August 4, 1987 to monitor the receiving waters. Analysis of receiving water samples collected during chlorination revealed that bromoform, as well as chloroform, dibromochloromethane, and dichlorobromomethane, were not detected outside or inside the ZID at the Scattergood Generating Station.[22] It is noted that July 21 and August 4 correspond to the maximum levels of chloroform and bromoform measured in the effluent (as discussed above).

2. Bioaccumulation: According to the EPA criteria document for chlorine, no saltwater data on the bioconcentration of chlorine was found, or expected. Chlorine does not bioaccumulate in animal tissue and apparently is not magnified as a result of trophic transfer. As explained in the previous section, "Persistency," the breakdown product of most concern is bromo-

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[21]Priority Pollutant Data, Scattergood Generating Station, March - August 1987.

[22]Reference 14

form. Bromoform is estimated to bioconcentrate by a factor of 50 for fish tissue with a 15 percent lipid content.[23] Bromoform is unlikely to bioaccumulate to any significant extent or to biomagnify via trophic transfer.[24] Using the rationale that data collected from the Scattergood Generating Station is representative of the ESGS's effluent, and also based on review of the Form 2c for the ESGS, it is reasonably expected that there will not be any unacceptable risk to human health or the environment due to bioaccumulation of bromoform.

3. Acute Toxicity: The aquatic criterion developed in the EPA chlorine criterion document is not appropriate for use in this variance evaluation since the criterion is intended to apply only to situations of continuous exposure to chlorine.[25] Resolution 88-80 issued by the SWRCB concluded that the PMEL will result in chlorine concentrations at the edge of the mixing zone which will be in compliance with the WQS designed to protect beneficial uses. Based on the SWRCB's findings, no acute toxicity at the edge of the ZID is anticipated when ammonia concentrations remain low.

A summary of the acute toxicity results for years 1991 through June 1994 was presented in Section VII above. To summarize, ESGS's previous NPDES permit contained effluent limits for acute toxicity of 0.65 TUa for Outfall 001 and 0.95 TUa for Outfall 002 (6-month median). These values, which were derived from the Ocean Plan, were exceeded twice for Outfall 001, and were never exceeded for Outfall 002. (Since the TUa limit is based on a 6-month median, exceeding the values of 0.65 TUa or 0.95 TUa only once, or more than once but nonconsecutively, does not necessarily constitute a violation of the permit limit.) It is noted that the TRC concentrations measured in the all these acute toxicity samples were always below the BAT limit of 0.2 mg/l, with one exception of 0.21 mg/l.

With regard to human health acute toxicity, the draft EPA human health chlorine criterion document cites 10 mg/l TRC as an acceptable level.[26] This concentration is well above the concentration of chlorine expected at the mixing zone edge (0.0146 mg/l) or in the discharge (0.4 mg/l). In addition, even though drinking water is not a designated beneficial use, it is anticipated that the PMEL will allow the receiving waters to meet the drinking water standard of 0.100 mg/l for THM (see the

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[23]Reference 20

[24]Reference 16, Chapters 71 and 105

[25]Reference 1

[26]Reference 2

discussion under "Persistency" above).

Free available chlorine (FAC), which is a component of TRC, may also cause toxicity. The FAC component of TRC may be more toxic than the TRC component alone. The initial biomonitoring study conducted by SCE in 1987 as part of the variance application did not report FAC concentrations during the tests. It is unknown whether these toxicity tests represented the FAC concentrations that would be observed in the receiving water. In regard to more recent acute toxicity results, data for the years 1991 through June 1994 indicated that the effluent FAC concentrations measured at time of sample collection were all less than 0.2 mg/l. It is also noted that DMR data for years 1991 through June 1994 indicated that FAC was a significant component of the TRC measured in the effluent. As stated earlier, the TUa values representing the acute toxicity limits were only exceeded twice during this time period.

4. Chronic Toxicity: Early biomonitoring of the model facility's effluent predicted that discharges of TRC at the PMEL would meet the 1983 State Water Quality Objective (or Standard) of 1 TUc. This State Water Quality Objective is contained in both the 1983 and 1990 CA Ocean Plan and is intended to safeguard against aquatic impacts due to chronic toxicity.[27] As a condition to granting Resolution 88-80, the ESGS was required to monitor its effluent for chronic toxicity.

Using the State approved dilutions of 12 to 1 for Outfall 001 and 18 to 1 for Outfall 002, the 1990 Ocean Plan standard of 1 TUc (daily maximum), and the 1990 Ocean Plan effluent limitation equation, chronic toxicity limits of 13 TUc and 19 TUc were calculated. Monitoring data from 1991 through September 1994 showed most chronic toxicity results equal to or less than 5.6 TUc. Out of a total of 38 test results for Outfall 001 (most for 1991), only 1 test result was greater than the limit of 13 TUc. Out of 64 test results for Outfall 002, there were no violations of the limit of 19 TUc.

With regard to human health, there is no published evidence of chlorine toxicity to humans due to ingestion of water.[28] In addition, the concentration expected at the edge of the ZID (0.046 mg/l), as well as the concentrations in the effluent (0.4 mg/l), will not exceed the EPA draft human health criterion of 10 mg/l discussed in the previous section.

a. Mutagenicity: Data found in the National Institute for Occupational Safety and Health (NIOSH) Registry

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[27]Reference 12 and Reference 17

[28]Reference 18

indicate that mutagenicity due to chlorine may occur at a concentration of 20 mg/l.[29] This is significantly greater than the TRC concentrations measured, or expected, in the discharge and receiving water.

Of the chlorine-generated products which may be formed during chlorination, only bromoform and chloroform were detected in the model facility's effluent during the 1987 study. Neither were detected in the receiving waters. (The 1987 effluent study stated that it looked at all volatile and non-volatile organics listed in EPA methods 624 and 625.) Available data indicates that mutagenicity due to bromoform may occur at a concentration of 0.11 mg/l.[30] Based on SCE's data, this is well above concentrations expected in the effluent or receiving water. In addition, there are no nearby drinking water stations, thus preventing this route of exposure to humans. Therefore, in light of the low levels of chlorine and chlorine by-products expected with the PMEL, and based on all available data, mutagenicity due to chlorine cannot be reasonably anticipated to pose an unacceptable risk to human health or the environment.

b. Teratogenicity: According to the draft EPA Human Health criterion document of December 1981, there is "no evidence of teratogenic effects of free chlorine in human beings." There is no available data on the teratogenicity of halomethanes, such as bromoform.[31] Therefore, considering the low levels of chlorine expected with the PMEL, teratogenicity due to chlorine cannot reasonably be anticipated to pose an unacceptable risk to human health or the environment.

c. Carcinogenicity: Data from the NIOSH Registry indicates no conclusive evidence that chlorine acts as a direct carcinogen or as a tumor initiator. In addition, there are no drinking water intakes located in the discharge area. Therefore, due to the low levels of chlorine expected with the PMELs, and the absence of drinking water intakes, carcinogenicity due to chlorine cannot reasonably be anticipated to pose an unacceptable risk to human health or the environment. While bromoform can bioconcentrate in fish and can penetrate human skin, the risks associated with consumption of fish caught in the vicinity of the discharge or with swimming in nearby waters cannot be demonstrated to represent an unacceptable lifetime increased cancer risk even

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[29]Reference 18

[30]Reference 18

[31]Reference 8

to routinely exposed individuals.

5. Synergistic Propensities: Synergism, as defined in Casarrett and Doull's Toxicology text "is the situation in which the combined effect of two chemicals is much greater than the sum of the effect of each agent given alone (example 2+3=20)." Under the broad heading of synergistic propensities, a number of assessments can be made, including:

(1) measuring the combined effects of two or more pollutants (the sum of the effects must be greater than additivity);

(2) measuring the potential for increased toxicity of pollutants under varying physical conditions; and

(3) assessing the potential for pollutants to combine chemically and form more toxic substances.

To conduct the first assessment completely, an applicant would have to test chlorine for toxicity alone and then with each pollutant in an effluent and the receiving water. Since this is prohibitively costly, EPA has proposed that applicants review their Form 2c influent and effluent data and the latest available scientific literature to determine whether there are pollutants in significant concentrations which may contribute to synergism when present with chlorine in the same effluent or receiving stream. In the case of the three "model" facilities (Haynes, Scattergood, and Long Beach Generating Stations), EPA required the applicants to conduct additional chlorine monitoring because the literature review conducted indicated that trihalomethanes might be formed when chlorine is present in the effluent. Biomonitoring was also conducted as part of the assessments of these three generating stations. The data obtained in these studies in conjunction with data from the ESGS are used in the following assessments.

Assessment 1

Current scientific literature indicates that when chlorine is present with other pollutants, toxicological effects are not increased above additivity.[32] In addition, based upon a review of data submitted by the applicant,[33] EPA does not believe there are any pollutants in concentrations significant enough to contribute to toxicologically significant synergism in the presence of chlorine.

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[32]Reference 2

[33]Reference 9

Assessment 2

The allowable chlorine concentration is based on the California Ocean Plan Water Quality Objective (or Standard) for the scheduled and intermittent discharge of chlorine. Assuming that the PMELs were approved by the SWRCB based upon anticipated compliance with WQSs which considered the effect of physical factors, synergism in this respect has been considered. The requirement to conduct acute and chronic whole effluent toxicity tests on representative samples of the effluents following chlorination events of the appropriate duration is intended to address the inherently site-specific toxicity of the complex mixture of chlorine, bromine, ammonia, chloramines, and bromamines.

Assessment 3

According to EPA's draft Pollutant-Specific 301(g) Guidance for Chlorine (Salt Water), if the concentration of ammonia in the effluent is significant (i.e., significantly greater than the detection limit of 0.1 mg/l), there is a strong possibility that formation of chloramines and bromamines can occur. These chlorinated and brominated compounds may be substantially more toxic than ammonia under identical physical conditions which exist at the discharge site. SCE reported in its Form 2c for ESGS (March 1994) that the concentration of ammonia in both the effluent and the intake water for Outfalls 001 and 002 were below the detection limit of 0.05 mg/l. In addition, effluent monitoring conducted during 1987 at the model facility, the Scattergood Generating Station, indicated ammonia concentrations ranging from 0.05 to 0.4 ug/l.

Water quality monitoring conducted in the receiving waters at the three model facilities in 1987 showed little variability between the three generating stations and the various sampling locations (i.e., in the discharge bubbles, at the ZIDs, at the reference stations) for ammonia and bromide concentrations. Looking at the data from all three facilities, ammonia concentrations ranged from <0.1 mg/l to 0.1 mg/l in the discharge bubbles, from <0.1 mg/l to 0.2 mg/l at the ZID, and from <0.1 to 0.1 mg/l at the reference stations. Specifically at the Scattergood station, the ammonia concentrations were <0.1 mg/l in the bubble, at the ZID and at the reference station. Bromide concentrations at the three facilities varied from 64.7 to 65.9 mg/l in the discharge bubbles, from 63.8 to 66.3 mg/l at the ZIDs, and from 64.4 to 66.8 mg/l at the reference stations (i.e., seawater). No trihalomethanes were detected at the receiving water stations for the Scattergood facility.[33]

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[33]Reference 14

Form 2c (March 1994) reported that bromide concentrations in both the effluent and intake water were "<150 mg/l", and bromoform concentrations (daily maximum) in both the effluent and intake water were below the detection limit ("<.01 mg/l"). Chloroform was also reported to be less than the detection limit of 0.005 mg/l in both the effluent and intake water. The earlier Form 2c (August 1981) reported chloroform in the effluent and intake water to be "0.001 mg/l".

In conclusion, based on the following findings, it is not anticipated that the PMELs will result in synergistic effects which pose unacceptable risks to human health or the environment:

- the apparent low levels of the trihalomethanes, bromoform and chloroform, in the effluent (as reported on the applicant's Form 2c dated March 1994, and the priority pollutant monitoring conducted at the Scattergood Generating Station in 1987);

- the receiving water data from the July and August 1987 concluded that no trihalomethanes were detected in the receiving water for the model facility;

- the low concentrations of ammonia measured in the intake water and the effluent (per applicant's Form 2c dated March 1994);

- the fact that metal cleaning and other low volume wastes are treated before commingling with the once-through cooling water and comprise less than 1% of the discharge by volume;

- the applicant's recent acute and chronic toxicity data (1991 through June/September 1994);

- the State's findings, as documented in Resolution 88-80, that the PMELs will allow compliance with State Water Quality Objectives and will be adequate to support beneficial uses;

- and, the intermittent nature of the TRC discharge (maximum discharge of 4 hours per day).

CONCLUSION

Based on all available information, EPA concluded that the *alternate modified effluent limit of 0.4 mg/l* TRC for Outfalls 001 and 002 should comply with the requirements of Section 301(g), as amended. EPA's decision is contingent upon the special terms and conditions listed below.

301(g) VARIANCE TERMS AND CONDITIONS

In accordance with the findings above, EPA proposes to approve the request by SCE for a Section 301(g) variance for total residual chlorine for the ESGS contingent upon the following terms and conditions:

(1) The effluents from Outfall 001 and Outfall 002 must meet an alternate proposed modified effluent limitation (PMEL) of 0.4 mg/l total residual chlorine (instantaneous maximum) based on daily sampling at Outfall 001 and Outfall 002 during periods of chlorination.

(2) The effluent from Outfall 001 must meet a chronic toxicity limit of 13 TUc (daily maximum). The chronic toxicity tests must be representative of actual discharge conditions (at a minimum) or of the alternate PMEL of 0.4 mg/l. This means that, at a minimum, the effluent samples must be chlorinated in the laboratory to levels consistent with the maximum TRC effluent concentration measured during the previous 3 months' chlorination events.[34] Alternatively, the sample may be chlorinated to the alternate PMEL (unless the maximum TRC concentration from the previous 3 months exceeds this limit). All other procedures shall be consistent with the monitoring requirements in the Ocean Plan and NPDES permit. This requirement to chlorinate samples in the laboratory applies only if the recorded effluent chlorine concentrations exceed the BAT limit of 0.2 mg/l during the previous 3 months.

(3) The effluent from Outfall 002 must meet a chronic toxicity limit of 19 TUc (daily maximum). The chronic toxicity tests must be representative of actual discharge conditions (at a minimum) or of the alternate PMEL of 0.4 mg/l. This means that, at a minimum, the effluent samples must be chlorinated in the laboratory to levels consistent with the maximum TRC effluent concentration measured during the previous 3 months' chlorination events. Alternatively, the sample may be chlorinated to the alternate PMEL concentration (unless the maximum TRC concentration from the previous 3 months exceeds this limit). All other procedures shall be consistent with the monitoring requirements in the Ocean Plan and NPDES permit. This requirement to chlorinate samples in the laboratory applies only if the recorded effluent chlorine concentrations exceed the BAT limit of 0.2 mg/l during the previous 3 months.

(4) In the event the effluent chronic toxicity limitations are exceeded at either Outfall 001 or Outfall 002, SCE shall increase the monitoring frequency at the subject outfall to monthly in

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[34]The NPDES Permit reissued on December 5, 1994, requires chronic toxicity tests to be conducted quarterly.

accordance with the NPDES permit. If the chronic toxicity limit is exceeded again during the accelerated monitoring period, SCE shall initiate a TRE. The TRE shall be conducted in accordance with EPA's most current TIE/TRE manuals.

(5) SCE shall conduct a chlorine residual receiving water study, as set forth in the NPDES permit reissued in December 1994, in order to assess the impacts of chlorine and chlorine by-products within the receiving waters during periods of maximum chlorination. (See Monitoring and Reporting Program No. 4667 for Southern California Edison Company, El Segundo Generating Station (CA0001147), Section III.E.).

(6) This 301(g) approval can be reviewed and revised by EPA at any time if subsequent information indicates that the alternate PMEL will not result in compliance with all 301(g) criteria. This includes subsequent chronic toxicity test results, TIE/TRE findings that indicate that the discharge of TRC at concentrations greater than the BAT limit of 0.2 mg/l results in toxicity, and receiving water data.

REFERENCES

1. Ambient Aquatic Life Water Quality Criteria for Chlorine, Office of Research and Development, USEPA. January 1985.

2. Ambient Water Quality Criterion for the Protection of Human Health: Chlorine (Final Draft), Office of Water Regulations and Standards, USEPA. December, 1981.

3. Application for 301(g) Variance, El Segundo Generating Station, Southern California Edison Company.

4. "A Biological Screening Program for Assessing Toxicity of Chlorinated Power Plant Effluent", Jo Ellen Hose, Ph.D., Vantuna Research Group, Occidental College, Los Angeles, California. October 1987.

5. "Calculation of Minimum Initial Dilution for Alamitos, Long Beach, Mandalay, and San Onofre Units 2 and 3 Generating Stations, Southern California Edison Company." March 3, 1982.

6. "Calculation of Whole Effluent Toxicity Limits Using Methodology Specified in the Technical Support Document for Water Quality Based Toxics Control."

7. EPA approval of Water Quality Control Plan, Ocean Waters of California (California Ocean Plan):

   (a) Judith E. Ayres to Don Maughan. June 25, 1987.
   (b) Daniel W. McGovern to Don Maughan. June 28, 1990.

8. Halomethanes, Ambient Water Quality Criteria, Criteria and Standards Division, Office of Water Planning and Standards, USEPA/5-80-051/October 1980.

9. NPDES Permit Application, Form 2c, El Segundo Generating Station, March 8, 1994.

10. NPDES Permit No. CA0001147, El Segundo Generating Station, Los Angeles Regional Water Quality Control Board.

11. "Pollutant-Specific Section 301(g) Guidance Document (Draft) for Chlorine (Salt Water)", Office of Water Enforcement and Permits, USEPA. February 1986.

12. State Water Resources Control Board Resolution No. 88-88, Granting an Exception to the Water Quality Control Plan, Ocean Waters of California, for Nine Southern California Electric Generating Stations: Haynes, Harbor, Scattergood, Alamitos, El Segundo, Long Beach, Mandalay,

Ormond Beach, and Redondo Beach. July 21, 1988.

13. EPA concurrence with State Water Resources Control Board Resolution No. 88-88, Daniel McGovern to Don Maughan, February 15, 1989.

14. "Total Chlorine Concentrations in the Surface Receiving Waters at Haynes, Long Beach, and Scattergood Generating Stations", WESTEC Services, San Diego, California. September 16, 1987.

15. Discharge Monitoring Reports: Toxicity Data and TRC/FAC Data for El Segundo Generating Station, Southern CA Edison. January 1991 through June 1994.

16. Water Chlorination Environmental Impact and Health Effects, Volume 4, Book 2, ed. by Robert L. Jolley et al., Ann Arbor Science, 1983, Chapters 23 ("Dispersion of Chlorine at Seven Southern California Coastal Generating Stations"), and 71 ("Bioconcentration of Bromoform by American Oysters"); Volume 5, Chapter 105 ("Halogenated Compounds Discharged from a Coastal Power Plant").

17. Water Quality Control Plan, Ocean Waters of California, State Water Resources Control Board. 1983, and as amended March 22, 1990.

18. NIOSH Registry of Toxic Effects of Chemical Substances, July 1987. Quarterly update.

19. "Improved Methodology for a Sea Urchin Sperm Cell Bioassay for Marine Waters", P.A. Dinnel et al., Arch. Environ. Contamin. Toxicol., 16:23-32 (1987).

20. "Calculation of a Bioconcentration Factor for Bromoform." SAIC, McLean, VA.

21. Toxicity Data for January 1994 through September 1994 provided by letter from Coastal Resources Associates, Inc. to Southern California Edison Company, dated October 12, 1994.

22. Chlorination information provided by Southern California Edison Company by letter dated September 26, 1994.

23. Letter dated July 24, 1985, from LA RWQCB to SWRCB requesting SWRCB approval of RWQCB Order No. 85-35 to the SWRCB for concurrence.

Attachment B

El Segundo Generating Station

Memorandum,
Date: January, 1979
Subject: Initial Dilution and California State Ocean Plan

Jan 1979 A

ROBERT C. Y. KOH, PH.D.
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PASADENA, CALIFORNIA 91125

MEMORANDUM

TO: Bob Grove, Ralph Komai

FROM: Robert C. Y. Koh, E. John List

SUBJECT: Initial Dilution and California State Ocean Plan

This memo is in response to your request for suggestions concerning the application of the 1978 Amendments to the California Ocean Plan regarding initial dilution for SCE's waste heat discharges.

The Ocean Plan specifically requires the estimation of "Minimum Initial Dilution" for ocean discharges. Initial dilution is defined in the Ocean Plan as that process which results in the rapid and irreversible turbulent mixing of wastewater with ocean water around the point of discharge. Minimum initial dilution is the lowest average initial dilution within any single month of the year.

It should be remarked that the 1978 Amendments pertaining to the estimation of minimum initial dilution are aimed at determining the effluent limitations through a back calculation based on i) the estimated dilution, ii) background concentrations of pollutants, and iii) water quality objectives. It should further be pointed out that this concept represents a quite rational approach in water quality control and can be expected to work well for the numerous wastewater (sewage) outfalls which are in relatively deep water.

Unlike sewage outfalls, SCE's outfalls are single outlet structures characterized by large ports (equivalent diameter $\sim$ 20 ft) located in shallow water ($\sim$ 30 ft) discharging large flowrates. The concept of minimum initial dilution becomes much more difficult to define in this case.

The State Board has recognized this and addresses the question in Footnote 6, page 11, of the Water Quality Control Plan 1978.

> "For shallow water submerged discharges, surface discharges, and nonbuoyant discharges, characteristic of cooling water wastes and some individual discharges, turbulent mixing results primarily from the momentum of discharge. Initial dilution, in these cases, is considered to be completed when the momentum induced velocity of the discharge ceases to produce significant mixing of the waste, or the diluting plume reaches a fixed distance from the discharge to be specified by the Regional Board, whichever results in the lower estimate for initial dilution."

In the following, we shall first review, in some detail, the historical development of the concept of dilution. Then we will suggest several methods whereby initial dilution can be defined and estimated for SCE's outfalls.

Initial Dilution

The term dilution, as has been used in the literature on waste disposal, traditionally denotes the reciprocal of the volume concentration of discharged waste in the receiving water (Rawn and Palmer, 1930). Thus, if c is volume concentration, and S is dilution, then

$$S = \frac{1}{c} = \frac{\text{total volume of a sample}}{\text{volume of discharged waste in the sample}}$$

and S = 1 for an undiluted sample.

To the extent that it is possible to take as small a sample as desired, one can define dilution at a point. In general, dilution is a function of space and time and can take on any value larger than or equal to unity. It should be noted that a dilution of 10 implies the mixture of 9 parts of water with 1 part wastewater (not 10 parts to 1 part). The primary reason for using dilution rather than concentration is probably a matter of convenience.

Initial dilution for wastewater discharged through a sewage outfall is the term used to denote the dilution which results due to the mixing which occurs during the buoyant rise phase of the plume. The mixing which results after the plume rise is sometimes referred to as subsequent dilution, physical dilution, or further dilution. It should be noted that the term initial dilution is not precisely defined since not only is it difficult to mark the point where initial dilution ends and subsequent dilution begins, sometimes it is not even possible to designate a phase of motion as strongly influenced by the discharge momentum and buoyancy.

From the above discussion, it is clear that initial dilution can rationally be defined only rather loosely. The common accepted interpretation is that part of the dilution which results from motions which are significantly influenced by the difference in density between the discharge and the ambient water and the discharge momentum. The State interpretation, in this sense, agrees with common practice.

Dilution, as defined by the reciprocal of the volume concentration, is a function of both position and time. Within a steady rising plume, the dilution at a fixed location varies with time. It is possible to define a time-averaged dilution $\overline{S}$ by

$$\overline{S} = \frac{1}{\overline{c}}$$

where $\overline{c}$ is the time-averaged volume concentration. $\overline{S}$ is then a function only of position, and will vary across the plume cross-section. It has generally been found that a minimum in $\overline{S}$ occurs at the center of the plume cross-section. This value of $\overline{S}$ is commonly referred to as centerline dilution, which, of course, still varies with distance along the plume.

There is also another often utilized notion for a measure of the mixing, viz. that of average dilution. The term average dilution, as

commonly used in sewage disposal, refers to an averaging process based on the flux of the waste material. For this reason, it is sometimes more explicitly referenced as flux-weighted-averaged dilution. Thus, if $\overline{c}$ and $\overline{u}$ are the time-averaged concentration and axial velocity in the plume, then the flux-weighted-averaged dilution $\overline{S}_a$ is defined as

$$\overline{S}_a = \frac{\int_A \overline{u} dA}{\int_A \overline{c}\,\overline{u}\, dA}$$

where A is a plane normal to the plume axis. It should also be noted that dilution values should not be directly averaged. Rather the averaging should be performed on the concentration values and the reciprocal taken on the result.

The above definitions of centerline and average dilutions apply to a plume such as is formed above an outfall. These definitions are the commonly accepted ones found in the literature on waste disposal.

So far as the State definition of minimum initial dilution is concerned it refers to "the lowest average initial dilution within any single month of the year." While the 1978 Ocean Plan itself does not specify the meaning of the word "average," the draft "Guidelines for Implementation of the Table B Toxic Materials Limitations in the Water Quality Control Plan for Ocean Water of California 1978" for the plan (page 5) implies that the intended meaning is in fact the flux-weighted average.

Estimation of Initial Dilutions

Initial dilution results from that part of mixing which occurs due to the momentum and buoyancy of the discharge. For large discharges in shallow

water such as SCE's outfall, there is no clearly definable zone within which this type of mixing occurs. Before "initial dilution" can be estimated, it is therefore first necessary to choose a rational basis upon which it can be defined. Several possible alternatives follow:

Minimum initial dilution is the smallest monthly average dilution

i) anywhere on the surface

ii) beyond some distance (such as 10 depths, 10 discharge diameters, or perhaps 1000 ft) away from the outfall structure (as suggested by the State)

iii) beyond the point where either the jet velocity or the density difference becomes less than some specified fraction of the discharge value.

Among these, it is believed that only the second one is both reasonable and workable. It basically delineates (albeit somewhat arbitrarily) an initial mixing zone within which the initial dilution is supposed to occur. This is by no means unreasonable when one considers the fact that i) this has been how sewage discharge permits have been implemented in the past, and ii) this is how the California Thermal Plan has been worded. As to what distance, the Ocean Plan has left this open for debate (see Footnote 6)) but to us it seems reasonable to follow the Thermal Plan and choose 1000 ft.

Having chosen what we believe to be a reasonable and workable definition of minimum initial dilution, there remains the task of estimating its value for the various SCE discharges. There are only three possible ways: i) by means of a mathematical model, ii) by means of laboratory experiments, and iii) by actual field measurements. It is our opinion that no mathematical model exists which can reliably estimate the mixing in this type

of discharge. As to laboratory experiments, there have been several studies aimed at shallow discharges (see e.g. Jirka, Abraham and Harleman (1975)). The range of parameters covered and the details of the reported measurements will probably be insufficient to permit estimation for all of SCE's discharges. Moreover, as was noted in the laboratory tests for SONGS Unit 1, some mixing is occurring within the discharge structures. This type of mixing can only be evaluated with specific hydraulic model tests. On the other hand, Edison's coastal plants have all been under operation and field measurements are available from monitoring efforts. We, therefore, recommend that the evaluation of initial dilution be based primarily on the field data. In some cases, such as SONGS Unit 1, where laboratory data do exist, this could supplement the field information.

The procedure for analyzing the monitoring data might be formulated as follows:

i) assemble all surface temperature monitoring data for a given discharge along with natural temperature, distance from discharge and any other environmental variables such as current, time, etc.

ii) obtain (ΔT, ΔT_o, distance, environmental variables) as n-tuple data points.

iii) partition datasets containing values of $\Delta T_o/\Delta T$ according to distance and environmental variables

iv) estimate statistical distributions for $\Delta T_o/\Delta T$ using all data, as well as partitioned data.

Based on the distributions thus obtained, it should be possible to give not only a statistical description of the expected "initial dilution" but also its dependence on the environmental variables. For any new discharges of SONGS 1 form it will be necessary to perform hydraulic model studies.

Jirka, G. H., Abraham, G., Harleman, D.R.F., "An Assessment of Techniques for Hydrothermal Prediction," Ralph M. Parsons Laboratory for Water Resources and Hydrodynamics, Rept. No. 203, July 1975.

Rawn, A. M. and H. K. Palmer, "Predetermining the Extent of a Sewage Field in Sea Water," Trans. ASCE, Vol. 94, pp. 1036-1060, 1930.

Attachment C

El Segundo Generating Station

Memorandum,
Date: April 13, 1979
Subject: Initial Dilution

ROBERT C. Y. KOH, PH.D.
CIVIL ENGINEER
1201 EAST CALIFORNIA BOULEVARD (138-78)
PASADENA, CALIFORNIA 91125

MEMORANDUM

TO: Bob Grove, Rob Reid, Ralph Komar April 13, 1979

FROM: Robert C.Y. Koh, E. John List

SUBJECT: Initial Dilution

This memo is a sequel to our previous memo entitled "Initial Dilution and California State Ocean Plan" originally prepared in January 1979. In that previous memo, we explained in some detail the meaning of the term "dilution" as well as the concept of the flux-weighted-average dilution. We also attempted to interpret the term "Minimum Initial Dilution" as used in the Ocean Plan for the submerged discharges of Edison's coastal power plants' cooling systems.

In this present memo, we will use a combination of actual field data and new laboratory results to estimate the mixing processes in the immediate vicinity of the discharges. We will show how the flux-weighted-average-dilution (henceforth called simply average dilution) is expected to increase with distance from the outfalls.

While the purpose of this memo is still to address the question of initial dilution at the SCE plants' discharges, we would like to reiterate that, due to the shallowness of the discharges, the definition of initial dilution is somewhat nebulous. We would recommend that a meeting be held with the water resources control boards to discuss and clarify the matter.

It should further be noted that use of the EPA computer model PLUME is not appropriate for the type of discharges employed by SCE. The model was developed for application to an entirely different class of problems and the predictions it would give for the present situation would be irrelevant.

Shallow Coastal Discharges

Cooling water from Edison's coastal power plants is discharged via large submerged single outlet outfalls. Figure 1 shows schematically a typical example of such a discharge structure. Also shown in the figure are idealized flow patterns which are expected to occur. It is important to understand the flow patterns to

appreciate the various mechanisms at play in the mixing processes.

A certain amount of mixing usually occurs within the discharge structure itself. This is because the structure has a significantly larger cross-sectional area than that of the outfall pipeline. Ocean water is induced to flow into the structure over a portion of the outlet opening. The discharged fluid therefore is diluted somewhat even before it exits the structure. The degree to which this occurs depends on the internal hydraulics within the discharge structure and would vary from plant to plant. This phenomenon is shown schematically in Figure 1.

After exiting the structure, the effluent mixes with the ocean water during its vertical motion. However, the vertical distance is limited by the water surface. Moreover, the cross-sectional area of the rising plume is quite large. Thus, this part of the mixing may not penetrate to the center portion of the plume.

Upon encountering the water surface, the discharge turns and becomes a radial jet spreading horizontally in all directions. Further mixing occurs along the lower boundary of the spreading layer. In Figure 1, dashed lines are placed to represent schematically the zone beyond which the radial spreading phenomenon becomes the dominant one.

Approach to Estimate the Mixing

The flow in the discharge structure and the rising plume (within the dashed lines in Figure 1) is very complex and depends very much on the geometrical configuration of the discharge structure. No mathematical model exists to predict the mixing adequately. We shall utilize available field measurements to estimate the dilution obtained in this region.

The mixing in the radial spreading region (beyond the dashed lines in Figure 1) is also quite complex. However, recently a set of laboratory experiments have been performed and we will utilize the findings to estimate the dilution in this part.

Field Data

Monitoring data at the various SCE plants were supplied to us via Mr. Bob Grove of SCE. The data includes measured temperatures in the intake and discharge conduits in the plants as well as the ambient temperature and the maximum temperature measured in the surface boil. The data received were first screened by rejecting all data where the ambient temperature as reported differed from the intake

temperature by more than 2°F since this would imply either a stratified condition in the ocean or that the ambient temperature was not properly defined (a difficult task). For each of the accepted data point, a dilution S_1 was calculated by

$$S_1 = \frac{T_{disc} - T_{amb}}{T_{max} - T_{amb}}$$

where T_{max} = maximum measured temperature in the discharge boil

T_{disc} = discharge temperature

T_{amb} = ambient temperature

The results of this calculation are summarized in Table 1.

Table 1 Statistics of dilution S_1 for SCE plants.

Plant	No. of data pts	Mean S_1	Median S_1	Max S_1	Min S_1
SONGS 1	7	3.4	2.1	8.6	1.8
Huntington Beach	15	1.8	1.5	3.4	1.1
Redondo 1-6	9	2.9	2.5	5.8	2.0
Redondo 7-8	9	1.6	1.6	2.4	1.3
Elsegundo 1-2	13	3.3	2.6	12.5	1.0
Elsegundo 3-4	8	7.5	3.8	18	2.1
Ormond Beach	6	1.8	1.5	2.4	1.1

It can be readily observed that there is a fair degree of variation. This is not unexpected since i) ambient temperatures are difficult to determine, ii) there could be some stratification in the receiving water, and iii) there are always errors in measurements. Among the estimates for S_1, the median is a more robust estimator of the expected value of S_1 and it is seen from Table 1 that S_1 is greater than unity for all the plants. Part of the reason is undoubtedly the mixing which occurs within the discharge structure. It was found both in the laboratory (Koh, 1973), and verified in the field, that the internal hydraulics in the discharge structures tends to promote mixing within the structures by drawing in some ambient water over a portion of the outlet opening (see Figure 1).

Interpretation of S_1

Referring to Figure 1, the discharged effluent while originally issued vertically upward, must of necessity turn and spread out horizontally in a radial direction. The dilution S_1, estimated in the previous section on the basis of field data, can be interpreted as the dilution which represents an average value in the surface water above the discharge. The original vertical momentum is changed, by virtue of the water surface, first to a pressure force via an increase in surface elevation and then to horizontal momentum promoting radial spreading and mixing. These are all shown schematically in Figure 1. In the next section we will estimate the dilution which occurs in the radial spreading phase by presenting some new results from a laboratory investigation.

Radial Surface Jets

The dynamics and mixing which result from a radial heated jet were investigated in the laboratory by Chen as part of his doctoral thesis. He has kindly provided us with some of his results which are shown in Figures 2 through 5. Figure 2 shows schematically the laboratory setup used. Figure 3 shows the decay of surface ΔT with radial distance. Figure 4 shows the growth of the jet in the vertical direction and Figure 5 gives the vertical profile of ΔT.

From Figure 3, it is noted that the surface ΔT decreases effectively linearly with radial distance. To estimate how fast this occurs for the SCE discharges, it is necessary to estimate the radius r_j of the radial jet (see Figure 2). Referring to Figure 1, this radius might be estimated to be on the same order as the depth.

From Figure 4, it is seen that the jet grows in thickness initially and then gradually tends to approach a constant thickness. The point at which this tendency becomes manifest varies among his experiments. Physically, this is explained by the interplay of the radial momentum against the buoyancy in the discharged fluid. The growth phase is where the momentum is dominant and promoting a jet-like behavior accompanied by jet mixing. For all of the experiments, the jet-like behavior appears to last for several initial radii r_j.

Relation of Surface Dilution to Flux-Weighted-Average Dilution

The ΔT values presented in Figure 3 are surface values. Below the surface, the temperature differences decrease as shown in Figure 5. The vertical distribution of ΔT is reasonably well approximated by a linear profile.

Unfortunately, no velocity measurements were actually made in the laboratory investigation. Based on analogy with other research in jets and plumes, it is reasonable to assume that the velocity profile would also be well approximated by a linear profile. The ΔT and velocity profiles would then be as shown schematically in Figure 6 below. To relate ΔT_s the surface value of

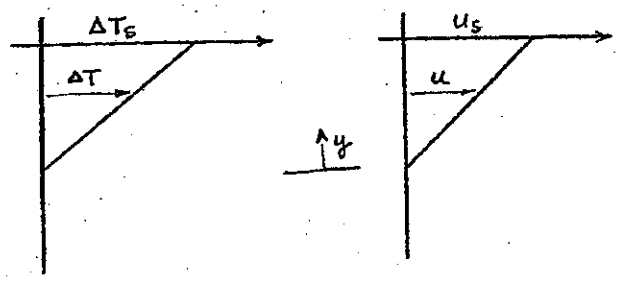

Fig. 6

ΔT to the average dilution, we must integrate the profiles. Thus, letting S_2 be the average dilution, we have by definition

$$S_2 = \frac{\Delta T_j \int u \, dy}{\int u \Delta T \, dy}$$

where ΔT_j is the uniform temperature difference at the radial source and the integrals extend over the plume thickness. Assuming linear profiles and choosing $y = 0$ at the lower boundary of the plume,

$$S_2 = \Delta T_j \frac{\int_0^h d \frac{y}{h} u_s \, dy}{\int_0^h \frac{\Delta T_s}{h} \frac{u_s}{h} y^2 dy} = \frac{\Delta T_j u_s \int_0^1 x \, dx}{\Delta T_s u_s \int_0^1 x^2 dx} = \frac{3}{2} \frac{\Delta T_j}{\Delta T_s}$$

But $\Delta T_j / \Delta T_s$ is the dilution at the surface. Hence the average dilution is 1.5 times the surface dilution. (Note that the factor 1.5 is a result of the shape of the vertical profile of ΔT and velocity. For other shapes slightly different from linear, this factor would also be slightly different.)

Initial Dilution for the Ocean Plan

For application to the Ocean Plan, the above discussion will be synthesized. We will use the median measured value of S_1 as the dilution which occurs as a result of the mixing in the structure and the vertical rise. After that, we will assume that the effluent spreads out radially as if by a radial jet. We appeal to Figure 4 and choose $r/r_j = 3$ as the point where we will designate as the location to calculate "initial dilution." (This is necessarily somewhat arbitrary but note that since r_j is expected to be on the order of the depth, $r/r_j = 3$ implies we are only about 100 ft away from the boil.) Finally we will

convert ΔT to a value for the average dilution as required by the Ocean Plan. The results of this estimation is shown summarized in Table 2.

Table 2

Plant	Estimated Initial Dilution
SONGS 1	10
Hunt Bch	7.5
Redondo 1-6	12.5
Redondo 7-8	8
Elsegundo 1-2	13
Elsegundo 3-4	19
Ormond Bch	7.5

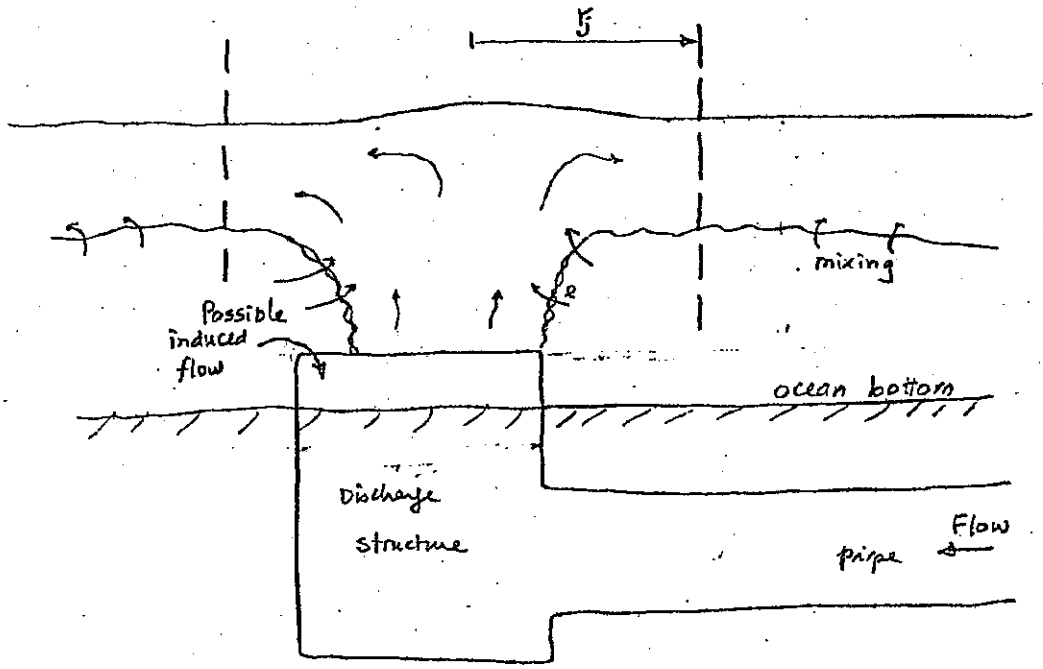
mixing
Possible
induced
flow
ocean bottom
Discharge
structure
Flow
pipe

Fig. 1

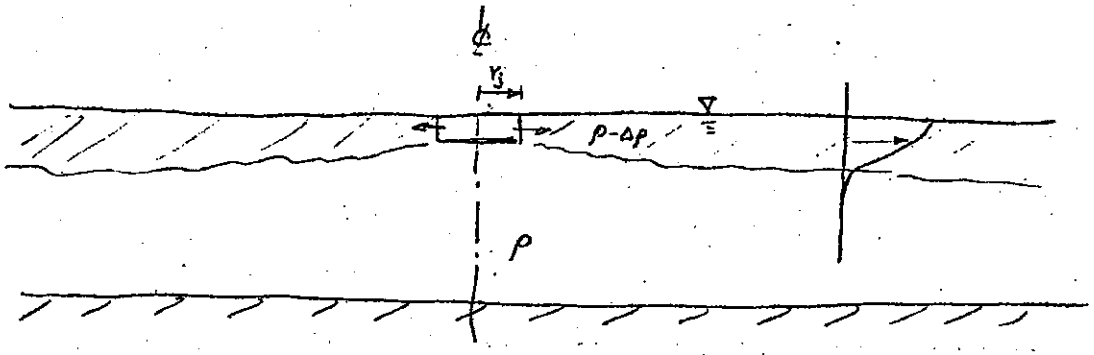

Fig. 2

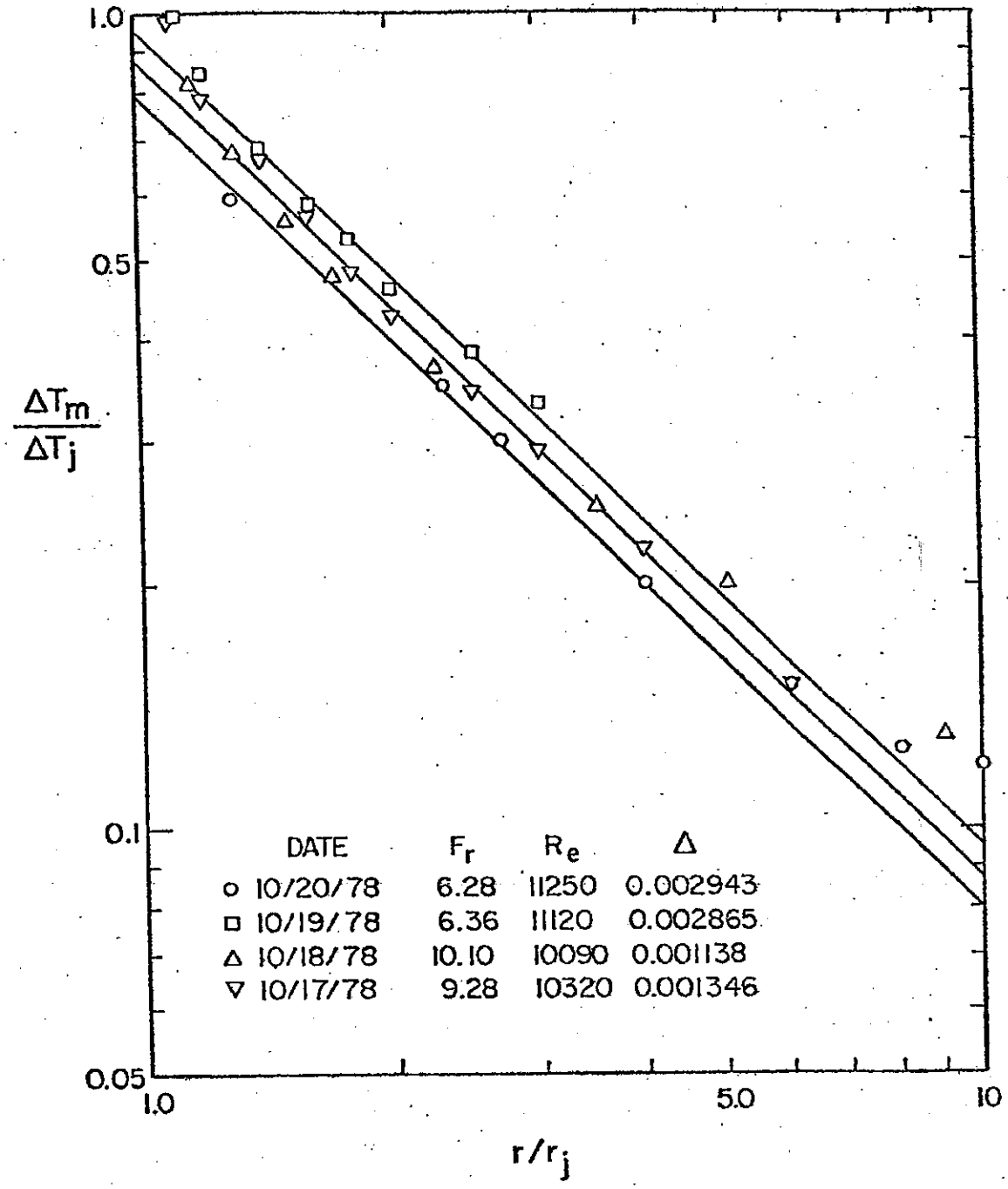
1.0
0.5
0.1
0.05
$\frac{\Delta T_m}{\Delta T_j}$
DATE
F_r
R_e
Δ
o 10/20/78 6.28 11250 0.002943
□ 10/19/78 6.36 11120 0.002865
△ 10/18/78 10.10 10090 0.001138
▽ 10/17/78 9.28 10320 0.001346
1.0
5.0
10
r/r_j

Fig. 3

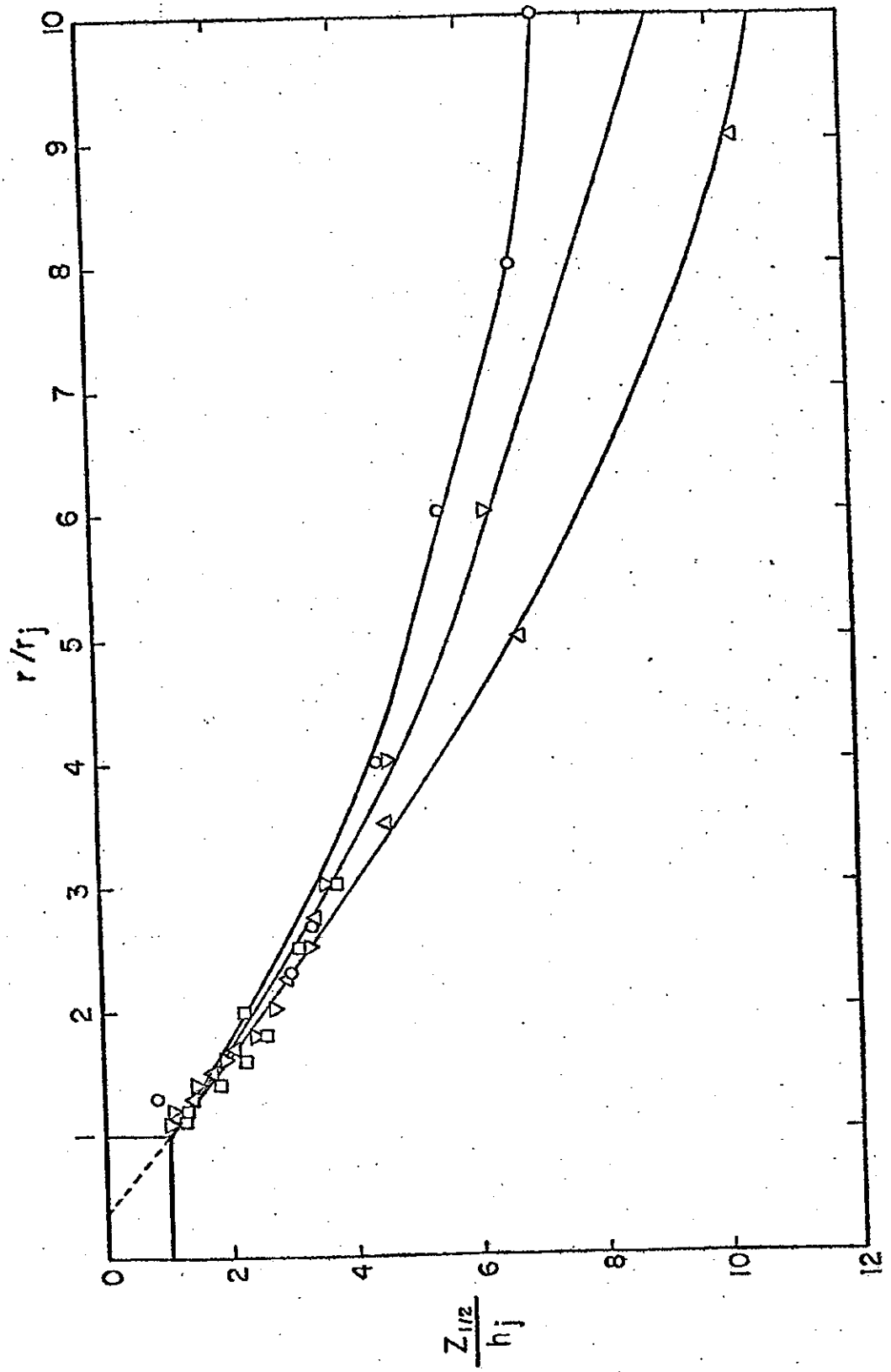

Fig. 4

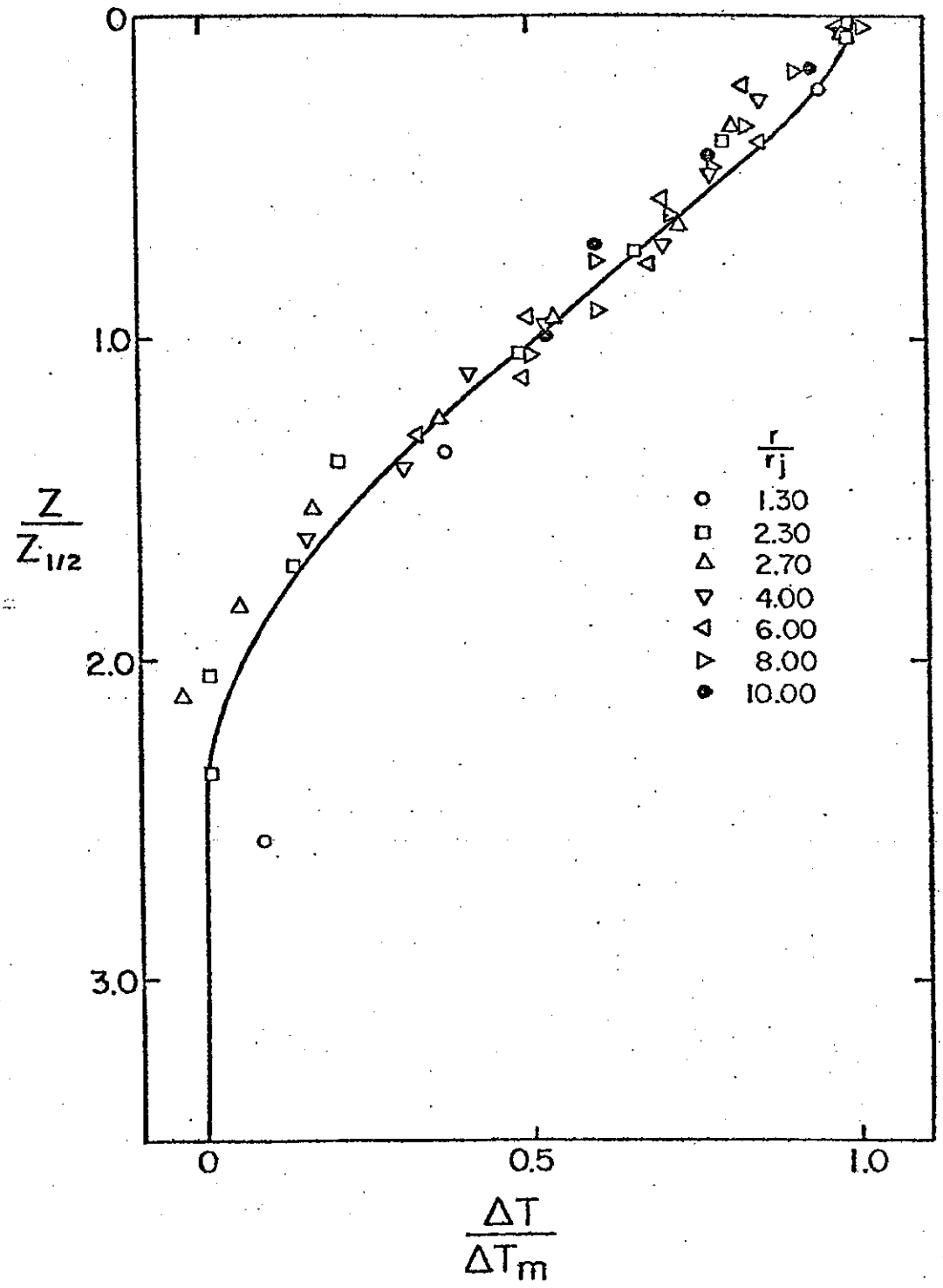

Fig. 5

Attachment D

El Segundo Generating Station

Memorandum,
Date: May 4, 1984
Subject: Minimum Initial Dilution Ratios For Power Generating Stations: Alamitos, Haynes, Long Beach, Harbor, El Segundo, Ormand Beach, Redondo Beach, Scattergood, and Mandalay

State of California

Memorandum

To : Robert P. Ghirelli
Executive Officer
Los Angeles Regional Board

Date : MAY 4 1984

From : STATE WATER RESOURCES CONTROL BOARD

Subject: MINIMUM INITIAL DILUTION RATIOS FOR POWER GENERATING STATIONS: ALAMITOS, HAYNES, LONG BEACH, HARBOR, EL SEGUNDO, ORMAND BEACH, REDONDO BEACH, SCATTERGOOD, AND MANDALAY

We have reevaluated the procedure proposed by Southern California Edison (SCE) to determine initial dilution ratios. The proposed method is hereby approved with the following exceptions:

1. Surface dilution ratios should be multiplied by 1.5 (not 2.12) to obtain flux-weighted initial dilution ratios.

2. The definition of initial dilution as used by SCE is not consistent with the "Water Quality Control Plan for Ocean Waters of California" (Ocean Plan), 1983. Therefore, the flux-averaged dilution ratios should be reduced by 1.0.

The approved initial dilution ratios are:

Alamitos/Haynes	= 4.5	El Segundo Units 1-4	= 11.5
Long Beach	= 3.2	Ormand Beach	= 6.5
Mandalay	= 2.6	Redondo Beach Units 1-6	= 11.5
Harbor	= 3.1	Redondo Beach Units 7-8	= 7.0
Scattergood	= 6.5		

Discussion

The zone of initial dilution (ZID) is bounded by an irregular curve defined by a specific isotherm. Receiving water limitations can be exceeded within the ZID. However, we wish to ensure that the flux-weighted average concentration of pollutants emitting from the ZID is within Ocean Plan limitations.

According to the "Table B Guidelines, Ocean Waters of California", 1978, initial dilution is complete when turbulent entrainment due to momentum ceases and "lateral spreading increases". If the extent of the ZID is properly chosen, centerline velocities are approximately equal to the lateral spreading velocities; the plume has degraded to a spreading front. Therefore, the flux-weighted

average should be obtained along the isotherm which defines the ZID, not along a plane perpendicular to the plume centerline.

- Since the surface dilution ratios are constant along any isotherm, horizontal averaging yields a trivial solution. The average (flux-weighted or not) of a constant is the same constant. Adopting SCE's assumed linear thermal and velocity vertical profiles yield a factor of 1.5 which should be used to convert surface dilution ratios to flux-weighted dilution ratios.

- SCE defined surface dilution S as:

$$S_1 = \frac{Tdisc - Tamb}{Tx - Tamb} \quad (1)$$

Where: Tx = measured surface temperature at a distance of x
Tdisc = discharge temperature at origin
Tamb = ambient surface temperature

The Ocean Plan defines dilution Dm as:

$$Dm = \frac{Tdisc - Tx}{Tx - Tamb} \quad (2)$$

These two expressions differ by unity. Therefore, the dilution ratios proposed by SCE should be reduced by 1, or:

$$Dm = S_1 - 1 \quad (3)$$

- Combining the two corrections presented above results in:

$$Dm = 1.5\ S_1 - 1 \quad (4)$$

or

$$Dm = \frac{1.5}{2.12}\ Sa - 1 \quad (5)$$

Where: Sa = surface dilution ratios as proposed in SCE's February 26, 1982 letter

Formula (4) was used to convert proposed surface dilution ratios to Ocean Plan-consistent flux-weighted dilution ratios for Alamitos, Haynes, Long Beach, Mandalay, and Harbor.

Formula (5) can also be used to convert the proposed average surface dilution ratios (Sa) to Ocean Plan-consistent dilution ratios for the same five generating stations.

The remaining stations (El Segundo, Ormand Beach, Redondo Beach, and Scattergood) were already properly averaged. Therefore, they were corrected to Ocean Plan-consistent dilution ratios using formula (3).

Your staff should refer technical questions to Ken Smarkel of the Division of Technical Services at ATSS 485-9552.

Michael A. Campos
Executive Director

Attachment E

El Segundo Generating Station

Letter,
Date: September 12, 1979
Subject: Initial Dilution Factors

September 12, 1979

Mr. Larry Walker, Executive Director
State Water Resource Control Board
P.O. Box 100
Sacramento, California 95801

Dear Mr. Walker:

Subject: Initial Dilution Factors

Reference is made to your August 2, 1979 letter requesting information which was utilized in estimating initial dilution factors for the outfalls at our El Segundo, Ormond Beach, Huntington Beach, San Onofre, and Redondo Beach generating stations.

As you are aware, our approach (flux-weighted-average-dilution) uses temperature data recorded at the condensor (inlet and outlet), at the surface above the outfall structure, and of ambient ocean water. The attachment is the requested information used in predicting the dilution factors for the aforementioned generating stations. The majority of the data was collected during 1971-72 in conjunction with our thermal effects study. Data for the San Onofre facility was collected during 1976-78 for our Environmental Technical Specifications program for the Nuclear Regulatory Commission.

The data was screened prior to use in the calculation of the average dilution(S_1). The rationale used for screening the data is contained on pages 3 and 4 of the attached memorandum to our July 18, 1979 submittal.

If you have any further questions regarding this matter do not hesitate to contact Mr. Craig Baker of my staff at (213) 572-1826.

Sincerely,

ORIGINAL SIGNED

Ira Thierer
Environmental Affairs

cc: Mr. Raymond Hertel
RWQCB - Los Angeles Region
Mr. Leonard Burtman
RWQCB - San Diego Region
Mr. James Anderson
RWQCB - Santa Ana Region

CLE:smc
1CLE627.B

bcc: J. A. Stipanov
M. E. Mikulka
A. R. Strachan
R. S. Grove

San Onofre Unit 1

DATE	TIME	TIDE	M.W.	INPLANT (°F) INT.	DISC.	T	FIELD (°F) AMBIENT	MAX	T
01-12-76	12:00	-	450	-	-	-	56.1	65.8	9.7
03-09-76	12:00	-	450	-	-	-	57.0	63.3	6.3
05-12-76	12:00	-	450	-	-	-	63.3	67.0	3.7
07-14-76	12:00	-	450	-	-	-	71.2	73.6	2.4
09-09-76	12:00	-	330	-	-	-	70.3	72.3	2.0
05-04-77	12:00	-	450	61.3	83.9	22.6	61.0	73.2	12.2
07-06-77	12:00	-	450	63.3	84.3	21.0	64.4	70.0	15.6
09-02-77	12:00	-	450	72.7	95.9	23.2	71.6	84.0	12.4
11-03-77	12:00	-	450	66.8	89.1	22.3	65.0	71.0	6.0
01-18-78				63.5	84.2	20.7	60.8	68.0	7.2
03-07-78	12:00	-	450	62.9	83.4	20.5	61.0	73.6	12.6
05-04-78	12:00	-	450	63.9	84.0	20.1	61.3	68.2	6.9
07-10-78	12:00	-	450	66.2	86.1	19.9	67.1	76.1	9.0
09-13-78	12:00	-	450	70.8	93.5	22.8	68.7	75.0	6.3
11-16-78	12:00	-	450	65.3	86.6	21.3	63.5	66.2	2.7
08-14-71	11:30	-	430	70.0	86.4	16.4	74.0	80.0	6.0
	14:00	-	430	67.5	84.3	16.8	74.0	80.0	6.0

CLE:smc
1CLE638.B

Huntington Beach

DATE	TIME	TIDE	M.W.	INPLANT (°F) INT.	DISC.	T	FIELD (°F) AMBIENT	MAX	T
08-13-71	09:03	-	850	72.1	97.0	24.9	77.0	95.0	18.0
	10:17	-	850	72.7	96.8	24.1	77.0	93.0	16.0
10-21-71	18:00	0	690	63.5	83.3	19.8	62.0	73.0	9.0
	23:50	3	640	61.7	86.9	25.2	62.0	70.0	8.0
10-22-71	04:00	2.5	620	61.7	87.8	26.1	61.0	69.0	8.0
	10:30	5.5	790	63.0	87.8	24.8	61.0	73.0	12.0
02-10-72	13:14	-0.2	700	-	-	-	55.0	67.0	12.0
	20:03	3.4	700	-	-	-	55.0	66.0	11.0
02-11-72	00:05	2.5	500	-	-	-	55.0	67.0	12.0
	06:21	5.6	500	-	-	-	54.0	65.0	11.0
05-30-72	12:34	3.3	550	62.2	83.0	20.8	62.0	70.9	8.9
	15:22	2.6	550	60.2	82.2	22.0	62.5	77.6	15.1
	22:44	5.5	450	63.0	81.9	18.9	62.0	77.1	15.1
05-31-72	06:16	-0.5	375	62.1	77.0	14.9	62.0	72.0	10.0
	13:25	3.3	550	63.0	82.9	19.9	62.5	74.5	12.0
08-29-72	06:10	1.7	375	65.8	75.2	9.4	69.0	74.6	5.6
	12:50	5.7	675	69.4	91.0	21.6	71.0	77.8	6.8
12-01-72	06:00	5.6	300	61.8	80.6	18.8	62.0	80.8	18.8
	13:00	0.3	650	62.0	85.8	23.8	63.0	82.6	19.6
	19:16	3.6	600	62.3	83.3	20.0	62.0	78.5	16.5
12-02-72	00:01	2.0	350	62.2	77.9	15.7	62.0	73.6	11.6
	06:29	5.8	500	62.0	77.4	15.4	61.0	70.8	9.8

CLE:amc
1CLE638.B1

Redondo 1-6

DATE	TIME	TIDE	M.W.	INPLANT (°F) INT.	DISC.	T	FIELD (°F) AMBIENT	MAX	T
08-10-71	18:00	-	300	67.0	97.3	25.3	76.0	90.0	14.0
11-16-71	08:00	5.5	470	61.0	85.0	24.0	57.0	70.0	13.0
	15:15	0.0	400	62.0	84.0	22.0	57.5	70.0	12.5
11-17-71	02:05	2.0	320	62.0	79.0	17.0	57.0	70.0	13.0
	08:00	6.0	400	61.0	80.0	19.0	56.5	73.0	16.5
02-15-72	09:20	6.0	280	70.0	-	-	56.0	66.0	10.0
	15:40	-1.0	230	61.0	83.0	22.0	56.0	63.0	7.0
	22:00	4.5	230	61.0	-	-	57.0	62.0	5.0
02-16-72	04:20	0.5	120	-	-	-	56.5	63.0	6.5
	09:30	5.5	220	-	-	-	56.5	65.0	8.5
05-17-72	07:15	-0.8	50	62.0	69.0	7.0	60.0	64.6	4.6
	14:50	3.6	210	60.0	77.0	17.0	62.0	64.6	2.6
	20:50	2.5	150	59.0	72.0	13.0	60.5	65.9	5.4
05-18-72	00:50	4.9	150	63.0	74.0	11.0	61.5	65.6	4.1
	08:50	-0.4	210	61.0	74.0	13.0	60.5	64.8	4.3
08-16-72	06:45	2.6	110	71.0	78.0	7.0	71.0	74.5	3.5
	14:10	4.7	160	72.0	87.0	15.0	71.0	76.7	5.7
	21:35	1.5	190	74.0	92.0	18.0	72.5	80.2	7.7
08-17-72	04:35	2.2	100	71.0	81.0	10.0	72.0	75.9	3.9
	09:55	3.6	200	70.0	84.0	14.0	72.5	75.5	3.0
11-07-72	09:45	5.9	390	74.0	90.0	16.0	64.0	73.3	9.3
	16:15	-0.1	320	77.0	92.0	15.0	63.0	73.8	10.8
	23:00	2.7	290	75.0	89.0	14.0	63.0	71.9	8.9
11-08-72	08:40	5.8	320	77.0	82.0	15.0	63.0	70.5	7.5

CLE:smo
1CLE638.B2

Redondo 7-8

DATE	TIME	TIDE	M.W.	INPLANT (°F) INT.	DISC.	T	FIELD (°F) AMBIENT	MAX	T
08-10-71	18:00	-	460	-	-	-	76.0	82.0	6.0
11-16-71	08:00	5.5	440	57.0	69.0	12.0	57.0	62.0	5.0
	15:15	0.0	430	60.0	70.0	10.0	57.5	65.0	7.5
	02:05	2.0	400	60.0	71.0	11.0	57.0	64.0	7.0
	08:00	6.0	400	58.0	68.0	10.0	56.5	63.0	6.5
02-15-72	09:20	6.0	730	54.0	71.0	17.0	56.0	67.0	11.0
	15:40	-1.0	730	56.0	72.0	16.0	55.0	67.0	14.0
	22:00	4.5	730	55.0	72.0	17.0	58.0	68.0	10.0
02-16-72	04:20	0.5	700	56.0	72.0	16.0	56.5	68.0	11.5
	09:30	5.5	690	55.0	71.0	16.0	56.5	66.0	11.5
05-17-72	07:15	-0.8	240	56.0	63.0	7.0	61.0	64.0	3.0
	14:50	3.6	320	56.0	66.0	10.0	62.0	66.0	4.0
	20:50	7.5	320	58.0	66.0	8.0	60.5	65.2	4.7
05-18-72	00:50	4.9	280	57.0	64.0	7.0	61.5	64.0	2.5
	08:50	-0.4	280	56.0	62.0	8.0	60.5	63.0	2.5
08-16-72	06:45	2.6	500	60.0	72.0	12.0	71.0	74.0	3.0
	14:10	4.7	800	61.0	81.0	20.0	72.5	76.5	3.5
	21:35	1.5	830	60.0	80.0	20.0	72.5	77.5	5.0
08-17-72	04:35	2.2	830	64.0	84.0	20.0	72.0	79.0	7.0
	09:55	3.6	830	59.0	78.0	19.0	72.5	74.0	1.5
11-07-72	09:45	5.9	810	64.0	82.0	18.0	64.5	74.5	10.0
	16:15	-0.1	810	63.0	83.0	20.0	64.0	76.1	12.1
	23:00	2.7	810	63.0	81.0	18.0	64.0	74.1	10.1
11-08-72	08:40	5.8	810	60.0	79.0	19.0	64.0	74.0	10.0

CLE:amo
1CLE638.B3

El Segundo 1-2

DATE	TIME	TIDE	M.W.	INPLANT (°F) INT.	DISC.	T	FIELD (°F) AMBIENT	MAX	T
11-13-72	16:00	3.5	-	-	-	-	60.8	67.0	6.2
	18:00	2.8	-	-	-	-	62.0	70.1	8.1
	19:00	2.3	-	-	-	-	66.0	63.2	-2.8
	22:00	1.0	-	-	-	-	63.4	69.0	5.6
	23:00	1.5	-	-	-	-	63.2	70.0	6.8
11-14-72	02:00	3.2	-	-	-	-	60.8	66.0	5.2
	04:00	4.0	-	61.0	79.0	18.0	61.0	88.0	7.1
	05:00	4.6	-	61.0	79.0	18.0	61.2	66.8	5.6
	08:00	3.7	-	61.0	84.0	23.0	60.6	70.5	9.9
	09:00	3.1	-	61.0	84.0	23.0	60.6	69.0	8.4
	11:00	2.2	-	61.0	88.0	27.0	60.5	70.7	10.2
08-01-72	11:15	3.5	300	68.0	81.0	13.0	68.0	75.0	7.0
	12:30	4.2	325	68.0	80.5	12.5	68.0	69.0	1.0
	15:00	5.0	325	70.0	82.0	12.0	68.5	7.3	4.5
	16:10	4.4	330	69.0	82.0	13.0	70.0	75.0	5.0
	17:20	2.3	280	67.0	85.0	18.0	69.0	74.0	5.0
	21:00	2.0	170	67.0	79.0	12.0	69.0	69.0	0.0
	21:50	1.3	130	64.0	74.0	10.0	71.0✓	70.0	-1.0
	23:50	1.5	40	61.5	65.0	3.5	68.0 ✓	65.0	-3.0
08-02-72	02:20	7.2	40	65.0	67.0	2.0	67.5 ✓	67.0	-0.5
	04:20	3.0	40	67.5	66.0	3.5	67.5 ✓	-	-
	07:00	2.7	90	66.0	73.0	7.0	67.5	69.0	1.5
	08:50	7.7	155	67.0	71.0	4.0	68.0	71.0	3.0
	09:40	3.0	150	67.0	72.5	5.5	68.0	70.0	2.0
05-23-72	09:10	3.2	250	-	-	-	63.5	67.0	3.5
	13:30	1.5	240	-	-	-	63.5	69.0	5.5
	15:00	2.3	210	-	-	-	63.5	67.0	3.5
	17:20	3.7	170	-	-	-	63.5	67.0	3.5
	18:50	4.5	220	-	-	-	64.0	68.0	4.0
	21:20	4.5	300	-	-	-	64.0	68.0	4.0
	24:00	3.0	160	-	-	-	64.0	66.0	2.0
05-24-72	01:30	1.7	190	-	-	-	63.5	67.0	3.5
	03:30	0.5	210	-	-	-	63.5	69.0	5.5
	06:00	1.2	150	-	-	-	64.0	65.0	1.0
	08:00	2.3	40	-	-	-	64.0	67.0	3.0

CLE:zmo
1CLE638.84

El Segundo 3-4

DATE	TIME	TIDE	M.W.	INPLANT (°F) INT.	DISC.	T	FIELD (°F) AMBIENT	MAX	T
11-13-72	16:00	3.5	-	-	-	-	60.8	65.8	5.0
	18:00	2.8	-	-	-	-	62.0	72.0	8.0
	19:00	2.3	-	-	-	-	66.0	68.0	7.0
	22:00	1.0	-	-	-	-	63.4	70.0	6.6
	23:00	1.5	-	-	-	-	63.2	67.0	3.8
11-14-72	02:00	3.2	-	-	-	-	60.8	67.0	6.2
	04:00	4.0	-	-	-	-	61.0	65.1	4.1
	05:00	4.6	-	-	-	-	61.2	65.4	4.2
	08:00	3.7	-	-	-	-	60.6	67.0	6.4
	09:00	3.1	-	-	-	-	60.6	67.0	6.4
	11:00	2.2	-	-	-	-	60.5	70.0	9.5
08-01-72	11:15	3.5	320	67.0	85.0	18.0	68.0	73.0	5.0
	12:30	4.2	325	68.5	86.0	17.5	68.0	69.0	1.0
	15:00	5.0	325	69.0	90.0	21.0	67.5	71.0	2.5
	16:10	4.4	335	68.0	93.0	25.0	70.0	76.0	6.0
	19:20	2.3	280	68.0	93.0	25.0	69.0	71.0	2.0
	21:00	2.0	215	65.5	86.0	20.5	69.0	75.0	6.0
	21:50	1.3	250	65.0	84.0	19.0	71.0	-	-
	23:50	1.5	310	61.5	83.5	22.0	68.0	70.0	2.0
08-02-72	02:20	2.2	240	65.0	78.0	13.0	67.5	71.5	4.0
	04:20	3.0	220	64.5	79.5	15.0	67.5	66.0	-2.5
	07:00	2.7	220	65.5	81.0	15.5	67.5	69.0	1.5
	08:50	2.7	225	67.5	84.5	17.0	68.0	76.0	8.0
	09:40	3.0	300	67.5	87.0	19.5	68.0	74.5	6.5
05-23-72	09:10	3.2	220	-	-	-	63.5	66.0	2.5
	13:30	1.5	220	-	-	-	63.5	65.0	1.5
	15:00	2.3	220	-	-	-	63.5	67.5	3.5
	17:20	3.7	220	-	-	-	63.5	69.0	5.5
	18:50	4.5	220	-	-	-	64.0	67.0	3.0
	21:20	4.5	280	-	-	-	64.0	68.0	4.0
	24:00	3.0	145	-	-	-	64.0	66.0	2.0
05-24-72	01:30	1.7	145	-	-	-	63.5	65.0	1.5
	03:30	0.5	145	-	-	-	63.5	69.0	5.5
	06:00	1.2	145	-	-	-	64.0	64.0	0
	08:00	2.3	220	-	-	-	64.0	64.5	0.5

CLE:amo
1CLE038.B5

Ormond Beach

DATE	TIME	TIDE	M.W.	IMPLANT (°F) INT.	DISC.	T	FIELD (°F) AMBIENT	MAX	T
12-17-71	10:00	4.5	700	-	-	26.0	53.0	69.5	16.5
	13:00	1.0	700	-	-	26.0	53.0	71.5	18.5
	15:00	-0.5	700	-	-	26.0	53.0	70.5	17.5
02-23-72	12:00	-0.5	700	-	-	27.2	56.0	72.8	16.8
	16:00	1.6	700	-	-	28.4	56.0	70.9	14.9
05-23-72	12:30	1.5	700	-	-	23.0	59.0	69.8	10.8
	15:30	2.5	700	-	-	25.0	59.0	69.8	10.8
08-10-72	12:00	4.8	700	-	-	24.0	58.0	71.5	13.5
	15:00	2.2	700	-	-	23.0	58.0	72.6	14.6
09-21-72	09:30	-	720	64.4	90.4	26.0	63.0	82.0	19.0
	13:00	-	720	62.6	88.6	26.0	64.0	80.0	16.0
12-05-73	10:00	2.1	1220	56.3	78.7	22.4	55.5	66.0	10.5
	13:00	1.0	1200	56.3	78.7	22.4	57.0	66.0	9.0
	17:00	3.0	1200	57.0	79.4	22.4	56.5	69.0	12.5
09-09-75	09:00	3.6	1240	57.1	83.0	25.9	62.0	70.0	8.0
	11:00	5.4	1240	56.5	82.3	25.7	61.1	70.0	8.9
	15:00	3.5	1240	59.7	85.5	25.8	59.7	82.8	23.1

CLE:smc
1CLE638.B6

Attachment F

El Segundo Generating Station

Memorandum,
Date: February 4, 1985
Subject: Initial Dilution Ratios for Scattergood and El Segundo Power Generation Facilities Cooling Water Discharge

State of California

Memorandum

ATTACHMENT 6

To : Robert Ghirelli
Executive Officer
Los Angeles Regional Board

Date : FEB 4 1985

From : STATE WATER RESOURCES CONTROL BOARD
DIVISION OF WATER QUALITY

Subject: Initial Dilution Ratios for Scattergood and El Segundo Power Generation Facilities Cooling Water Discharge

At the request of the Los Angeles Department of Water and Power and Southern California Edison, we have reviewed the initial dilution ratios for the Scattergood and El Segundo Power Generation Facilities.

The approach defined by the submitted Robert Koh and John List memorandum of April 13, 1979 seems well suited to the two subject discharge structures (see attached staff memorandum). The initial dilution ratios based on this method are hereby approved with one exception. The definitional discrepancies discussed in my May 4, 1984 memorandum to you concerning these and seven other thermal discharges still exist. Therefore, the requested values need to be reduced by unity. The approved initial dilution ratios are:

Scattergood	9.7
El Segundo Units -	12.0
El Segundo Units 3-4	18.0

If you have any questions, please contact Ken Smarkel of the Division of Water Quality at (916) 324-7970 (ATSS 454-7970).

Michael A. Campos
Executive Director

Attachment

JOHN I CHIANG
rcd 1 1 1985 Rec'd

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