SOUTHERN CALIFORNIA
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Brian Katz
Vice President

October 19, 2006

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555-0001

Subject: **Docket Nos. 50-361 and 50-362**
Proposed Change Number (PCN) 567
Emergency Diesel Generator Fuel Oil Volume Requirements
Response to NRC Request for Additional Information
San Onofre Nuclear Generating Station, Units 2 and 3

Reference: Letter from Brian Katz (SCE) to NRC (Document Control Desk) dated June 2, 2006, Subject: Docket Nos. 50-361 and 50-362; Proposed Change Number (PCN) 567; Emergency Diesel Generator Fuel Oil Volume Requirements; San Onofre Nuclear Generating Station, Units 2 and 3

Dear Sir or Madam:

Southern California Edison (SCE) submitted the referenced license amendment request to increase the required amount of stored diesel fuel oil to support a change to Ultra Low Sulfur Diesel (ULSD) fuel from the California diesel fuel presently in use. Nuclear Regulatory Commission staff has subsequently requested additional information to facilitate their review of the referenced request.

The SCE response to the request for information is enclosed. This response should be considered as Supplement 1 to our PCN-567 submittal.

The No Significant Hazards Consideration and Environmental Evaluation provided with PCN-567 remain bounding.

Should you have any questions or require additional information, please contact Mr. A. E. Scherer at (949) 368-7501.

Sincerely,

Brian Katz

P.O. Box 128
San Clemente, CA 92674-0128
949-368-9275
Fax 949-368-9881

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Enclosures:

1. Notarized affidavit
2. Licensee's Response to Request for Additional Information
3. Engineering Change Package (ECP) 040301409-3 (Description of Change)
4. EMD Maintenance Instruction (MI) 1760 Rev. G, "Lubricating Oil for EMD Engines"
5. ESI letter dated 12/4/01 for low Aromatic Fuels (including 1P-94 Pointers)

cc: B. S. Mallett, Regional Administrator, NRC Region IV
N. Kalyanam, NRC Project Manager, San Onofre Units 2 and 3
C. C. Osterholtz, NRC Senior Resident Inspector, San Onofre Units 2 and 3
S. Y. Hsu, California Department of Health Services, Radiologic Health Branch

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Application of SOUTHERN CALIFORNIA EDISON, ET AL. for a Class 103 License to Acquire, Possess, and Use a Utilization Facility as Part of Unit No. 2 of the San Onofre Nuclear Generating Station	)))))	Docket No. 50-361 Amendment Application Number 244

SOUTHERN CALIFORNIA EDISON, ET AL., pursuant to 10 CFR § 50.90, hereby submit Supplement 1 to Amendment Application Number 244 to Facility Operating License NPF-10. This change is a request to revise the Technical Specification required quantities of emergency diesel generator fuel oil for Ultra Low Sulfur Diesel fuel. Supplement 1 responds to a request for additional information.

In accordance with 10 CFR § 50.30(b), the following affirmation is provided:

Brian Katz states that he is Vice President of Southern California Edison, is authorized to execute this oath on behalf of Southern California Edison and, to the best of his knowledge and belief, the facts set forth in this letter are true.

Respectfully submitted,

Brian Katz
Vice President
Southern California Edison

State of California
County of San Diego

Subscribed and sworn to (~~or affirmed~~) before me on this 19th day of October, 2006,

by Brian Katz,
personally known to me ~~or proved to me on the basis of satisfactory evidence~~ to be the person who appeared before me.

Dawn A. Farrell
Notary Public

DAWN A. FARRELL
Commission # 1623106
Notary Public - California
San Diego County
My Comm. Expires Nov 20, 2009

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Application of SOUTHERN CALIFORNIA EDISON, ET AL. for a Class 103 License to Acquire, Possess, and Use a Utilization Facility as Part of Unit No. 3 of the San Onofre Nuclear Generating Station	))))))	Docket No. 50-362 Amendment Application Number 229

SOUTHERN CALIFORNIA EDISON, ET AL., pursuant to 10 CFR § 50.90, hereby submit Supplement 1 to Amendment Application Number 229 to Facility Operating License NPF-15. This change is a request to revise the Technical Specification required quantities of emergency diesel generator fuel oil for Ultra Low Sulfur Diesel fuel. Supplement 1 responds to a request for additional information.

In accordance with 10 CFR § 50.30(b), the following affirmation is provided:

Brian Katz states that he is Vice President of Southern California Edison, is authorized to execute this oath on behalf of Southern California Edison and, to the best of his knowledge and belief, the facts set forth in this letter are true.

Respectfully submitted,

Brian Katz

Brian Katz
Vice President
Southern California Edison

State of California
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Dawn A. Farrell

Notary Public

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ENCLOSURE 2
SOUTHERN CALIFORNIA EDISON RESPONSE
TO NRC REQUEST FOR ADDITIONAL INFORMATION
PCN-567

Question 1:

The June 2 application states in paragraph 4.0 on page 4 of 9 of Enclosure 2:

"*Both the day tanks and the storage tanks minimum diesel fuel requirements have been re-calculated with the worst case lower heating value (LHV) of the new ULSD fuel which is lower on a per gallon basis than of the existing diesel fuel. These calculations conservatively assume that the diesel fuel inventory is entirely ULSD fuel with the worst case LHV.*"

However, the email dated 08/15/06, in paragraph 4.1) ULSD fuel energy content, it says:

"*Fuel specifications provided by our current fuel vendor, ARCO, indicates that ULSD fuel has the same typical specific gravity (American Petroleum Institute, API 38) as CARB fuel. Per Att 1 in calculation M-0016-008 'DG Onsite Fuel Oil Requirements,' diesel fuels with the same specific gravity have the same heating values.*"

and also in paragraph 4.8) EDG performance with ULSD fuel, it states:

"*The EDG performance issues in Ref 2, AR011101320, addressed the change in heating value of CARB diesel fuel. As the heating value is proportional to the API gravity, the ULSD fuel has an equivalent heating value to that of CARB fuel. As a result there will not be any anticipated changes to engine performance from the introduction of ULSD fuel.*"

Is there a contradiction here?

Response
Yes. There is a contradiction in what Southern California Edison (SCE) sent in the 8/15/06 e-mail, which was an early in-house evaluation. The updated evaluation is documented in Engineering Change Package (ECP) 040301409-3 (Enclosure 3) which, while still containing the same first sentence quoted above

for paragraph 4.1), goes on to explain that the SCE calculation conservatively assumes that the new Ultra Low Sulfur Diesel (ULSD) fuel will have the worst case API value of 42. It is true that given the same API value, both California Air Resources Board (CARB) and ULSD fuel heating values are the same.

Enclosure 3 also contains the same statement quoted above from paragraph 4.8) that "...the ULSD fuel has an equivalent heating value to that of CARB fuel," a statement which is repeated in paragraph 5), "Conclusion:" for ULSD, "...the energy content is the same as the currently used CARB fuel." These statements should be understood in the context of Reference 3 to Enclosure 3, namely, that once ULSD is in full-time refinery production, the API gravity is expected to be comparable to the CARB fuel it is replacing.

API values ranging from 30-42 are acceptable for San Onofre Nuclear Generating Station (SONGS) diesel performance. Testing at SONGS shows that the CARB fuel API value ranges between 37-39. ARCO has stated that the new ULSD fuel API is currently ranging higher than CARB, but within specification, and is expected to levelize at values comparable to CARB once mass production of ULSD fuel is started. Not knowing for sure what the API values will be for delivered ULSD fuel in future, the SCE calculation conservatively assumes the lowest heating value (LHV) at API 42. An upper limit of API 42 is the industry standard, and is not expected to be exceeded for the ULSD fuel supplied to SONGS. In addition, the SCE calculation assumes that the diesel tanks are full of ULSD fuel, which is very conservative in the beginning. However, in reality there will be a mixture of CARB and ULSD fuels until the whole inventory is replaced with ULSD fuel over time.

As long as the API value is the same, both CARB and ULSD fuel have the same heating value. However, SCE has used API 42 as the worst case for the ULSD fuel in calculating the required inventory of diesel fuel to be conservative.

Question 2:

Does the lower heat value affect the rating (4700 kW with a 0.8 pf) of the Diesel Generators (DGs)? If so, will the lower rating be sufficient to supply the peak loading of the DGs during the design basis events?

Response
No. Peak loading during a design basis event is less than the nominal full load rating of the Emergency Diesel Generator (EDG). See excerpt below from a previous evaluation and vendor input. Note that EDG governor response to load demands is instantaneous.

EDG Performance with CARB Fuel

The ability of the EDGs to control and maintain engine load is primarily a function of the engine governor control system. The heating value of the fuel burned in the engine has only a minor effect on how well the engine control system compensates for major changes in engine load. To date there have been no engine performance issues with the EDGs running on EPA clear which has almost a 3% lower heating value than diesel fuel used for factory testing. The heating value of the low aromatic CARB fuel is approximately 0.5% less than the EPA clear. Engine System Inc. (ESI) has stated (Enclosure 5) that the governor control system will adjust the fuel rack to compensate for any changes in the BTU content of the fuel and has provided a letter (Enclosure 5) endorsing the use of low aromatic fuels in our EDGs.

In order to maintain the current level of performance, a very minimal increase in fuel consumption will be required. The fuel injection system and the engine control system are fully capable of providing additional fuel supply, so that the EDGs can maintain design basis loading.

Fuel rack scale ranges from 1.96 (zero fuel) to 0.62 (full fuel). Past data collection on fuel rack position during various loads (2G002 16 cylinder) are:

1.62 900 rpm idle
1.5 180 amps
1.3 320 amps
1.1 470 amps
0.93 705 amps (full EDG rated capacity of 4.7 MWe)

As per calculation M-0016-008, the largest EDG load during a small break LOCA used for the determination of fuel consumption is 4.5 MW. The rack positions stated above are typical to within 0.07 of rack position for all the engines. The above data indicates that there is approximately 30% of fuel rack travel still available for increasing fuel delivery to the engine for sustained loads or transient loads. On a load increase, fuel injection will advance and start earlier for a quicker engine response. The fuel circulating pump (attached at accessory end) provides fuel oil to the fuel injection header for combustion as well as providing excess fuel for cooling to the injectors by circulating the fuel through the injectors and fuel header. The EMD fuel system will always be able to provide enough fuel for intermittent and sustained engine load changes. EDG performance will not be compromised with the use of CARB fuel.

The same argument applies for using ULSD fuel and ULSD/CARB fuel mixture, as the largest EDG load during a small break LOCA used for the determination of

diesel fuel consumption is 4.5 MW per Updated Final Safety Analysis Report Table 8.3.1.

Question 3:

Do you need the concurrence from the DG manufactures(EMD) regarding the sulfur content compatibility with the engine lubricating oil? Will the concurrence from the ULSD supplier (ARCO) suffice?

Response
SCE has generic concurrence from the manufacturer. The SONGS EDGs meet engine manufacturer specifications as spelled out in Maintenance Instruction (MI) 1760 Rev. G (Enclosure 4). SCE would be unable to obtain any concurrence from the fuel vendor, whoever they may be, when it comes to lube oil compatibility within a certain type of engine. Such recommendations can only be within the purview of the engine vendor, as compatibility is a function of the engine operational characteristics. SONGS EDGs use Mobilgard 450 NC, which has a Total Base Number (TBN) of approximately 10 and the ULSD has 15 ppm of sulfur. EMD MI 1760 contains a graph, identified as Fig. 1, that indicates the SONGS EDGs are within a safe operating band for lube oil and fuel oil compatibility.

NRC Information Notice (IN) 96-67 was an example of how the interaction of incompatible lube oil and fuel oil can affect an engine. By the use of MI 1760, SCE has addressed this issue prior to adopting the use of ULSD.

Below is an excerpt from previous evaluations justifying the use of CARB fuel:

> CARB Fuel Oil Compatibility with Engine Lubricating Oil.
>
> The introduction of low-sulfur EPA clear diesel fuel created the need for changes in some engine lubricants. Internal combustion byproducts in the form of ash deposits in the combustion chamber area were found in some engine applications due to lower amounts of sulfur in the new diesel fuel and high amounts of alkaline reserve still in the lubricants. Total Base Number (TBN) is used to measure the amount of alkaline reserve in lubricating oil. With high sulfur diesel fuels, a high TBN number was required to prevent the formation of corrosive acids (sulfuric acid) that could be formed as a combustion byproduct. With a lower amount of sulfur in the diesel fuel, a corresponding decrease in TBN was needed in some diesel engines to prevent said ash deposits from forming.
>
> EMD has provided guidance on the compatibility of lubricating oils and diesel fuel oils with varying amounts of sulfur content (Enslosure 4). Lubricating oil that will be in the engine sumps at the time of converting to the CARB fuel will

be Mobilgard 450 NC which has a stated TBN number of 10. This TBN value meets the manufacture's recommendations for both EPA clear and CARB fuel. The manufacturer has indicated that if an imbalance between sulfur levels in the fuel and TBN in the lubricating oil exists, ash deposits will form only if the engine is run extensively. Proper maintenance of fuel injection equipment will also reduce the likelihood of ash formation, if such an imbalance were to occur. At SONGS, we typically run the EDGs only for testing purposes and we monitor fuel injector condition under the EDG predictive maintenance program. With SONGS EDGs meeting manufacturer criteria for fuel and lubricating oil compatibility and not operating in a condition that could potentially result in forming combustion chamber ash, the implementation of CARB fuel is acceptable for this aspect of engine operation.

The same argument applies for using ULSD fuel and a ULSD/CARB fuel mixture.

Question 4:

Finally, the staff would like to have a supplement, under oath and affirmation, the broad contents of the email. You can say in the supplement that the following items were considered and give couple of sentences of explanation for each. These nine have been taken from your email. In addition you need to provide the responses to the above questions.

1) ULSD fuel energy content
2) ULSD fuel chemistry
3) ULSD fuel lubricity and effects on engine components
4) Conductivity of ULSD fuel
5) Compatibility of ULSD fuel with underground storage tank liner
6) Fuel transfer system components
7) ULSD compatibility with engine lubricating oil
8) EDG performance with ULSD fuel
9) Long-term storage of ULSD/CARB fuel

Response
SCE has considered the following items in determining the suitability of ULSD for the SONGS EDGs.

1) ULSD fuel energy content

SCE has considered and evaluated ULSD fuel energy content and has used the worst case Low Heating Value (LHV) associated with API 42 (upper limit) in calculating the required fuel oil inventory. The upper limit of

API 42 is the industry standard and is not expected to be exceeded at SONGS. See technical considerations section 4.1 in ECP 040301409-3 (Enclosure 3).

2) ULSD fuel chemistry

SCE has considered and evaluated ULSD fuel chemistry and has performed necessary testing to assure SONGS meets the criteria of Technical Specification Surveillance Requirement 3.8.3.3. See technical considerations section 4.2 in ECP 040301409-3 (Enclosure 3).

3) ULSD fuel lubricity and effects on engine components

SCE has considered and evaluated ULSD fuel lubricity and effects on engine components and has concluded that internal engine components are not adversely affected. See technical considerations section 4.3 in ECP 040301409-3 (Enclosure 3).

4) Conductivity of ULSD fuel

SCE has considered and evaluated conductivity of ULSD fuel. The acceptable ULSD fuel chemistry properties that can affect fuel handling and design of the SONGS EDG fuel system makes use of ULSD acceptable for use in the SONGS EDGs. See technical considerations section 4.4 in ECP 040301409-3 (Enclosure 3).

5) Compatibility of ULSD fuel with underground storage tank liner

SCE has considered and evaluated the compatibility of ULSD fuel with the underground storage tank liner and has concluded that ULSD or a mixture of ULSD and CARB fuel will not have any adverse effect on the liner, and is therefore acceptable for use and storage in the underground fuel oil storage tanks. See technical considerations section 4.5 in ECP 040301409-3 (Enclosure 3).

6) Fuel transfer system components

SCE has considered and evaluated fuel transfer system components and has concluded that ULSD or a mixture of ULSD and CARB fuel will not hinder the ability of the fuel transfer system components to transfer fuel oil. See technical considerations section 4.6 in ECP 040301409-3 (Enclosure 3).

7) ULSD compatibility with engine lubricating oil

SCE has considered and evaluated ULSD compatibility with engine lubricating oil and has concluded that the use of ULSD fuel or a mixture of ULSD and CARB fuel with SONGS EDG current lubricating oil Mobilgard 450 NC, meets the compatibility criteria in EMD Maintenance Instruction MI 1760 (Enclosure 4). See technical considerations section 4.7 in ECP 040301409-3 (Enclosure 3).

8) EDG performance with ULSD fuel

SCE has considered and evaluated EDG performance with ULSD fuel and has concluded that heating value is proportional to the API value for both CARB and ULSD fuel and as a result there will not be any anticipated changes to engine performance from the introduction of ULSD fuel. See technical considerations section 4.8 in ECP 040301409-3 (Enclosure 3).

9) Long-term storage of ULSD/CARB fuel

SCE has considered and evaluated long-term storage of ULSD/CARB fuel, and a series of tests was performed, validating the conclusion that the use of ULSD or mixture of ULSD and CARB fuel will not have an impact on fuel storage practices at SONGS and poses no new diesel fuel aging issues that are not monitored in the diesel fuel oil testing program. ULSD or a mixture of ULSD and CARB is acceptable at SONGS. See technical considerations section 4.9 in ECP 040301409-3 (Enclosure 3).

ENCLOSURE 3
ENGINEERING CHANGE PACKAGE
(ECP) 040301409-3

AR 040301409: Ultra Low Sulfur Diesel Fuel
Description of Change/Engineering Evaluation [redacted]

1) PURPOSE

The purpose of this technical evaluation is to justify the acceptability of using Ultra Low Sulfur Diesel (ULSD) fuel oil in the Emergency Diesel Generators at SONGS Unit 2 and 3. This evaluation also covers all the identified technical issues resulting from the addition (mixing) of ULSD fuel to existing California Air Resources Board (CARB) diesel fuel.

2) BACKGROUND

SONGS converted to CARB fuel in 2002 to meet State of California emissions requirements (Ref #2, AR 011101320). CARB fuel was formulated to have a lower aromatic content, which has the effect of reducing the sulfur content in the fuel and increasing the API gravity (reducing the specific gravity). In June 2006, the State of California will require all diesel engines operated in the state to be using ULSD fuel as required by California Code of Regulation Section 2281-2285. ULSD as the name implies is reduced in sulfur content (nominally 150ppm for CARB to < or = 15ppm for ULSD) so that emission particulates can be reduced.

3) PROCESS DESCRIPTION

There will be no deviation from normal diesel fuel filling and storage operations. State regulators only require that ULSD diesel fuel be in use by June 2006 and does not require existing inventories to be replaced. As a result, the ULSD fuel will be added to the storage tanks as needed during normal fuel inventory management activities.

4) TECHNICAL CONSIDERTIONS

4.1) ULSD fuel energy content

The conversion over to CARB fuel required a change to Technical Specification 3.8.3 (PCN-531) for increased fuel inventory requirements due to the reduced Lower Heating Value (LHV) of the CARB fuel. Fuel specifications provided by our current fuel vendor, ARCO, indicates that ULSD fuel has the same typical specific gravity (American Petroleum Institute, API 38) as CARB fuel. However, acceptance of ULSD fuel is based on values of API ranging from 30 to 42. The worst case heating value, based on API 42, is used in Calculation M-0016-008, Rev.3 (ECN A41549) and M-0016-006, Rev.1 (ECN A41735). This calculation results shows that the minimum storage volume is increased in both the day tank and the storage tank compared to what is in the Technical Specification. A PCN567 has been prepared and will be issued to NRC for approval. Since we are increasing the minimum volume on conservative side, we can implement the increased volume surveillance by administrative means until we received NRC approval.

ENCLOSURE 3
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Per our current fuel vendor ARCO, the current chemical formulation of ULSD and CARB are identical with the only different property being a reduced level of sulfur content in ULSD (Ref 1). Variations in specific gravity or variations in fuel quality, thermally induced volumetric changes, atmospheric conditions, engine wear etc. and their effect on diesel fuel consumption are captured in the 10% additional fuel margin maintained in the storage tanks per ANSI N195-1976/ANS 59.51.

4.2) ULSD fuel chemistry

SONGS is required to meet the criteria of Tech Spec 3.8.3.3 for establishing whether diesel fuel to be used in the EDGs is of the appropriate grade and does not contain contaminants that could be detrimental to engine performance. Tech Spec Basis 3.8.3.3 basis criteria for fuel chemistry are based on the fuel properties specified in Table 1 of ASTM D975-81, API gravity per ASTM D287-82, and particulates per ASTM 2276-83.

ULSD fuel, treated (with stabilizer and biocide) and untreated used in the liner soak test (see section 4.5) was tested at Saybolt Labs for compliance with SO123-III-6.6, "Diesel Fuel Oil Testing Program". All of the fuel test results were within the specifications of SO123-III-6.6, and the results were consistent with new CARB fuel currently delivered to SONGS. Results also indicate that there is no difference between treated and untreated fuel (stabilizer and biocide added by SONGS). Comprehensive results on ECD fuel (ECD is Emission Control Diesel and is a trademark name for ULSD from ARCO our current fuel supplier) as tested at Saybolt Labs are in AR 030600847-03. The table below is a comparison of a typical sample of CARB fuel (see ref 1) and treated ULSD after being used in the liner soak tests and indicates that no changes to the SONGS current diesel fuel oil program are warranted.

Test Limit	Method	CARB fuel	ECD Fuel	Limit
Water and Sediment	ASTM D1796	0%	0%	≤0.05%
Kinematic Viscosity	ASTM D445	2.458	2.642	1.9 - 4.1
Particulate Contamination	ASTM D2276-83A	0.6 mg/L	<1mg/L	≤10 mg/L
API Gravity	ASTM D287-82	38.5	39.7	30 - 42
Flash Point	ASTM D93	144°F	150 F	≥125°F
Cloud Point	ASTM D2500	+14°F	20 F	≤25°F
Distillation Temperature	ASTM D86	614.7°F	624 F	540 - 640°F
Ash	ASTM D482	<0.001 wt%	<0.001%	≤0.010 wt%
Carbon Residue	ASTM D524	0.08%	.11%	≤0.35%

Test Limit	Method	CARB fuel	ECD Fuel	Limit
(10% bottoms)				
Sulfur	ASTM D4294	0.017 wt%	<0.015%	≤0.50 wt%
Copper Strip Corrosion	ASTM D130	1A	1A	≤No. 3
Cetane Index	ASTM D976 (calc)	52.0	52	≥40
Accelerated Stability (not T.S.)	Octel F21-61	1	1	<7

4.3) ULSD fuel lubricity and effects on engine components

Diesel fuel in the fuel system of the EDGs is used to lubricate moving parts within the fuel system and provide cooling to the fuel injectors. The lubricity of a given diesel fuel is directly related to the amount of sulfur contained in the fuel with lubricity decreasing with lower amounts of sulfur. Although sulfur content of ULSD is ten times lower than CARB fuel, the lubricity characteristics of the fuel remains comparable due to a lubricity additive being added to the fuel during the refining process. California Code of Regulations Section 2284 Title 13 gives minimum lubricity requirements for ULSD. In particular, the code specifies a maximum wear scar diameter of 520 microns when performing lubricity tests per ASTM D 6079-2 the High Frequency Reciprocating Rig (HFRR) test. Per ref 2, Southwest Research Institute performed this test with CARB fuel and obtained larger wear scars (.605 and .550 microns) that were evaluated by SONGS personnel and found acceptable for SONGS EDGs. Per ASTM D975-01a, wear scars above 600 microns might not prevent excessive wear.

ARCO has added a lubricity specification to their ULSD fuel. This specification is provided to assure compliance with minimum lubricity requirements in the California regulations. ARCO's specification is a minimum of 3100g, according to ASTM test method D 6078, scuffing load ball-on-cylinder lubricity evaluator (SLBOCLE) which also allows their ULSD to meet the state requirements of 520 microns per ASTM D6079-2. The 3100g value is also recognized in ASTM D 975-01a (standard specifications for diesel fuel oils) as providing sufficient lubricity in all cases. All ULSD that SONGS will purchase is going to provide lubricity that meets or exceeds the lubricity requirements of SONGS EDGs.

Nitrile elastomer seals in the fuel system can be affected by a reduction in sulfur content in diesel fuel. The associated problems with sulfur reduction in the fuel oil are hardening and subsequent loss of sealing capability. This issue was addressed in Ref 2, AR 011101320, and an action to remove nitrile seals in the fuel system and replace them with

Viton was performed. Viton is not affected by changes in fuel sulfur content and all seals in the SONGS EDG fuel system are Viton.

ULSD fuel will not have a substandard lubricity quality due to the requirements in California state law, nor can it have an adverse affect on engine elastomer seals. As a result, internal engine components in the EDGs will not be adversely affected and no further testing of the fuel is required for use in SONGS EDGs.

4.4) Conductivity of ULSD fuel

Diesel fuel conductivity as stated in ref 2 is primarily an issue in colder climates where ambient air humidity is low, typically below 50% relative humidity. Fuel blends in colder climates tend to be blended with kerosene to improve low-temperature handling which increases volatility and propensity to form mist or vapor that can be detrimental in a electrostatic discharge. Such cold weather conditions will not happen here and such fuel blends are not available here at SONGS and are not a concern related to use of ULSD fuel. Even though ARCO has a conductivity fuel additive in their ULSD, fuel specifications for ULSD fuel on the West Coast do not have conductivity specifications or pour point specifications (temperature at which wax precipitates out of the fuel—typically minus 30F) like ULSD fuel blends have in the Midwest and East Coast (this is a change since the issuance of ref 2). Fuel refiners process ULSD fuel to meet handling requirements in their respective marketing areas.

Other fuel characteristics that have an effect on the safe handling of diesel fuel are consistent with existing fuel characteristics of CARB fuel . Such properties like distillation temperature, which effects volatility, and flash point that can affect safe handling of diesel fuel, are unchanged from existing SONGS diesel fuel. Furthermore, SONGS diesel fuel and storage system is designed to ANSI N195 -1976 standard, which is referred to in Reg Guide 1.137. Paragraph (g) section 7.5 of the Reg Guide 1.137 clearly states that the ".. cathodic protection system should be designed to prevent the ignition of combustible vapors or fuel oil present in the fuel oil systems..." Fuel transfer operations at SONGS are performed with the use of grounding cables between the fuel truck and a station ground. The fuel transfer connection point is a metal-to-metal contact, which prevents the possible electrical potential build-up between our equipment and the delivery equipment. The acceptable ULSD fuel chemistry properties that can affect fuel handling and design of SONGS fuel system makes the introduction and use of ULSD acceptable for use in SONGS EDGs.

4.5) Compatibility of ULSD fuel with underground storage tank liner

SONGS underground fuel oil storage tanks have a 125 mil thick interior lining made of Bridgeport Glass Armor GA 27, two-part epoxy coating. This lining was an environmentally mandated tank upgrade. The compatibility of the tank lining with ULSD fuel was assessed in AR 030600847. Liner soak testing by the coating test vendor (PO 8D023922) was performed in the same manner as the liner testing in ref 2. This testing

was done as specified in American Petroleum Institute (API) Recommended Practice 1631 which includes:

ASTM D790: Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Insulating Materials
ASTM D2794: Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact) Testing
ASTM D2583: Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
ASTM D543: Standard Test Method for Resistance of Plastics to Chemical Reagents
ASTM D4541: Standard Test Method for Pull-Off Strength of Coatings using Portable Adhesion Testers

The final results of the testing indicates that "the immersed Glass Armor 27 showed no significant change or degradation following immersion in either treated or untreated (with stabilizer and biocide) ECD-1". Since the chemical formulation of ULSD and CARB are the same, with the same coating testing results, a mixture of the two fuels will have the same properties of either fuel individually and will not adversely affect the tank liner. ULSD or a mixture of ULSD and CARB will not have and adverse effect on SONGS underground storage tank liner and is therefore acceptable for use and storage in the underground fuel oil storage tanks.

4.6) Fuel transfer system components

The fuel oil transfer system is constructed primarily of carbon steel (ASME SA-106 Grade B) schedule 80 material. The fuel transfer pumps are made of primarily the same grade of carbon steel, with some of the pump internals constructed of bronze (ASTM-B-584-937), which is used for pump shaft bushings and cast housings. The wetted metallic surface areas of the fuel transfer pump and piping are not subject to any type of credible attack from the diesel fuel itself.

Fuel transfer pumps do contain some nitrile seals, at the suction bell housing and in the pump columns (2 joints). The nitrile seal in the suction bell housing is well below the usable fuel level in the storage tank, so its failure could never affect pump suction. The two nitrile "O" rings in the pump column joints are within a machine-fit flange and see very low to no pressure. Failure of these "O" rings is unlikely due to low pressure in the pump column and static nature of the column joint. Any leakage at these joints would be captured in the pump performance monitored in the IST program. As a result, these seals were not replaced in preparation for the introduction of CARB fuel and the introduction of ULSD fuel does not warrant their replacement. The redundancy of the fuel transfer system, robust design and individual pump scrutiny provided by the IST monitoring program makes the fuel oil transfer system extremely reliable and fully capable of transferring ULSD fuel or any other mixture of fuel oil consisting of CARB and ULSD. ULSD fuel will not hinder the ability of the fuel transfer system to transfer fuel oil.

4.7) ULSD compatibility with engine lubricating oil

An important function of engine lubricating oil is to provide chemical protection to vital engine components exposed to engine combustion byproducts. Internal combustion byproducts in the form of ash deposits in the combustion chamber can be generated by the use of lubricating oil that is not compatible with the fuel oil. In particular, lubricating oil with large alkaline reserves or Total Base Number (TBN) used in conjunction with low sulfur fuels can form ash deposits in the combustion chambers.

The engine manufacturer, Electro Motive Diesel (EMD), has assessed compatibility issues with the wide variety of fuels and lubricants available on the market. The results of this compatibility study are captured in Maintenance Instruction 1760 which provides guidance on acceptable fuel sulfur content and TBN levels in lubricating oil when used in the same engine. The use of ULSD fuel, or a mixture that includes CARB fuel, with our current lubricating oil Mobilgard 450 NC, meets the compatibility criteria in MI 1760. ULSD fuel is therefore acceptable to use with SONGS current lubricating oil.

4.8) EDG performance with ULSD fuel

As stated previously in section 4.1 the API specific gravity for ULSD fuel has a nominal value of 38-40. This normal API 38-40 (range 30-42 see reference #3) value is typically the same as that of our currently used CARB fuel. The EDG performance issues in Ref 2, AR 011101320, addressed the change in heating value of CARB diesel fuel. As the heating value is proportional to the API gravity, the ULSD fuel has an equivalent heating value to that of CARB fuel. As a result there will not be any anticipated changes to engine performance from the introduction of ULSD fuel.

4.9) Long-term storage of ULSD/CARB fuel

Long-term storage properties of ULSD fuel are substantially similar to that of CARB fuel. As stated in section 4.2, ULSD fuel meets all the requirements in SO23-III-6.6 "Diesel fuel oil Testing Program". The current fuel oil testing program includes a test that is an accelerated fuel oil stability test (Analytical Method F21-61) which is used to determine fuel stability, a critical fuel quality for long-term storage. Program limits are to obtain a value less than 7. Testing results per AR 030600847 indicate that treated and untreated ECD (ULSD) fuel tested both to a value of 1. Per ref 2 this is the identical test value obtained for both treated and untreated CARB fuel.

For the purpose of determining the compatibility of ULSD and CARB fuel when mixed together, a series of tests were performed. Per AR 050300024-02, Southwest Research Institute (SWRI) performed ASTM Method D6468-Standard Test Method for High Temperature Stability of Distillate Fuels. This test was recommended by SWRI as the test that would provide the best indication of fuel compatibility. Samples of ECD (ULSD) and CARB were prepared for testing in the various stated combinations below with the following results:

Sample	% Reflectance, filter pad rating
ECD - Untreated	100
ECD - Treated	99
CARB - Untreated	99
CARB - Treated	100
50/50 ECD - CARB - Untreated	99
50/50 ECD - CARB - Treated	99
90/10 CARB - ECD- Untreated	99
90/10 CARB – ECD- Treated	100

The fuel samples were aged for 180 minutes at 150 deg C; Samples were then filtered and the average amount of filterable insolubles was estimated by measuring the light reflectance of the filter pads. The results indicate no difference (within the precision of the method) between any of the results. This would indicate no differences in thermal stability or possible storage stability of the raw fuels vs. a 50/50 mixture or 90/10 mixture of the fuels. This test information supports concurrence by the fuel vendor that CARB and ULSD are fully compatible because they are the same fuel formulations. This information supercedes information previously on the subject of mixing fuels that is contained in AR 040301409. As a conservative measure, the first ULSD fuel addition will be into a single fuel storage tank and accelerated testing performed on the fuel to assure their will be no complications with mixing of fuels. The use of ULSD or a mixture of ULSD and CARB will not have an impact on fuel storage practices here at SONGS and poses no new diesel fuel ageing issues that are not monitored in the diesel fuel oil testing program. ULSD or a mixture of ULSD and CARB is acceptable for use at SONGS.

5) CONCLUSION

This evaluation of ULSD fuel with or with out the presence of CARB fuel and the past evaluation performed for the use of CARB fuel indicates that there will be no negative impact on the SONGS EDGs with the introduction of ULSD fuel. SONGS EDG will be able to perform their design basis function using ULSD fuel or a mixture of CARB and ULSD.

Critical issues that could have affected SONGS EDG have been analyzed and determined to have no negative impact on the engine or the fuel storage and transfer systems. The fuel chemistry meets all fuel oil requirements and in particular the energy content is the same as the currently used CARB fuel. The similarities of the ULSD to CARB and preventative measures performed on the engine to allow the use of CARB, apply equally to the use of ULSD. As a result, there are no new required actions needed to make the EDG system ready for the introduction and use of ULSD. Based on past experience with CARB fuel, the similarities of ULSD and CARB, and the evaluations performed on ULSD and various mixtures of CARB and ULSD, the introduction and use of this fuel has been found acceptable for use at SONGS.

References

Ref 1; Letter from Ken Kimura (British Petroleum/Global Fuels Technology) to Doug Foote (SCE/SE)dated 9Feb05, regarding ARCO ECD vs ARCO CARB fuel (included)

Ref 2; ENGINEERING EVALUATION FOR THE USE OF CALIFORNIA AIR RESOURCES BOARD (CARB)DIESEL FUEL OIL IN THE EMERGENCY DIESEL GENERATORS AT SONGS UNIT 2 AND 3. Dated 12March02. ECP 011101320 (not included)

Ref.3; Series of e-mail exchange between Mr. Ken Kimura (British Petroleum/Global Fuels) , Bharat Mehta (SCE/DEO) and Gene Sherman (SCE/Chemistry), dated 11/08/2005, regarding API values expected and used to accept/reject the fuel (included).

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Page 1 of 1

bp

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TERM USED
ECD = ULSD

Global Fuels Technology
6 Centerpointe Drive, 6-592
La Palma, California 90623-1066
United States of America

Telephone: +1 (714)670-5021

February 9th, 2005

Mr. Doug Foote
SONGS SCE
PO Box 128 (D3E)
San Clemente, CA 92672
Via e-mail to footeda@songs.sce.com

Re. ARCO ECD® vs. ARCO CARB

Dear Mr. Foote:

In regards to your inquiry about the compatibility of ARCO ECD® and ARCO CARB Diesel, BP manufactures both products using the same proprietary formulation certified by the California Air Resources Board. The only changes in the formulation are the sulfur content and the addition of a lubricity specification with a maximum 520μ result on the HFRR test method. These changes meet the 2007 diesel fuel regulation for ultra low sulfur diesel fuel. A lubricity additive is injected into the fuel to compensate for the lubricity degradation associated with a lower sulfur diesel fuel. A conductivity additive is also utilized to reduce the potential for static ignition in a lower sulfur diesel fuel. Changes in the refinery operation were required in order to produce the ultra low sulfur product such as changes in the management of feedstocks and more severe process operations to name a few. However, the net result produced a diesel fuel that is more thermally stable with better storage stability. ECD® has been available since 2001 with conversions being made from normal tank turnover. The certificates of analysis of recent production of both products are included for your information. Small differences currently exist due to the batch processing of ECD®. Process optimization will occur in 2006 when ECD® goes into full-time production under the 2007 diesel rule.

If you have any questions or comments, please do not hesitate to call me at (714)670-5021.

Best Regards,

Ken Kimura
BP
Global Fuels Technology
Fuel Product Development
www.ecdiesel.com

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Rev.0

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page 10 of 13

BHARAT
MEHTA/SONGS/SCE/EIX
11/08/2005 12:09 PM

To "Kimura, Ken" <Ken.Kimura@bp.com>
cc footeda@songs.sce.com, mccannll@songs.sce.com, shermaee@songs.sce.com
bcc
Subject RE: EDG/diesel fuel change from CARB fuel to ULSD fuel

Ken, Thanks....this is in line with values we are using in the calculation with API 42 as worst case scenario for fuel rejection by our Chemistry division.

Bharat Mehta 11/8/05

"Kimura, Ken" <Ken.Kimura@bp.com>

"Kimura, Ken"
<Ken.Kimura@bp.com>
11/08/2005 11:20 AM

To <mehtabo@songs.sce.com>
cc <footeda@songs.sce.com>, <mccannll@songs.sce.com>, <shermaee@songs.sce.com>
Subject RE: EDG/diesel fuel change from CARB fuel to ULSD fuel

Today, the API Gravity has been between 39 and 40 in the batch process. Once the refinery is optimized to full time ULSD production, it should be in the 37 - 38 API range. Estimated BTU values are 127,800 - 129,600 Net BTU/Gal. Again, we will know better come June 2006 when ULSD production is running full-time and optimized. I hope this helps in the mean time.

Ken
Global Fuels Technology
(714) 670-5021

-----Original Message-----
From: mehtabo@songs.sce.com [mailto:mehtabo@songs.sce.com]
Sent: Tuesday, November 08, 2005 9:09 AM
To: Kimura, Ken
Cc: footeda@songs.sce.com; mccannll@songs.sce.com; shermaee@songs.sce.com; mehtabo@songs.sce.com
Subject: RE: EDG/diesel fuel change from CARB fuel to ULSD fuel

Ken, Thanks for your input. We have to take the worst case scenario in calculation and anything beyond that must be rejected by Chemistry (administrative controlled). At present, chemistry can accept ULSD fuel up to API 42, and therefore, we must use that as the worst case scenario to figure out what the heating value is and how much storage is required.

Can you give me the range of BTU values and API values for ULSD fuel you will be supplying.

Bharat Mehta 11/8/05

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"Kimura, Ken" <Ken.Kimura@bp.com>

To: <shermaee@songs.sce.com>, <mehtabo@songs.sce.com>

11/08/2005 07:58 AM

cc: <footeda@songs.sce.com>, <mccannll@songs.sce.com>

Subject: RE: EDG/diesel fuel change from CARB fuel to ULSD fuel

Hello Bharat/Gene, it will be very premature to make those changes on the basis of today's ULSD fuel for the simple fact that all ULSD production today is made on a batch basis which makes it difficult to optimize operations. Some batches may show lower BTU content today but should go back to normal once ULSD operations are operating full-time.

Ken
Global Fuels Technology
(714) 670-5021

-----Original Message-----
From: shermaee@songs.sce.com [mailto:shermaee@songs.sce.com]
Sent: Friday, November 04, 2005 2:51 PM
To: mehtabo@songs.sce.com
Cc: Kimura, Ken; footeda@songs.sce.com; mccannll@songs.sce.com
Subject: Re: EDG/diesel fuel change from CARB fuel to ULSD fuel

Bharat,
I'm not sure that your statement, "The main reason appears that ULSD

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Rev. 0

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fuel has lower heating value (BTU/HR) compared to the existing CARB fuel" is correct. My understanding is that ARCO's ULSD has about the same heating
value as their CARB. You might want to contact Ken Kimura (British Petroleum Global Fuels) at 714-670-5021.

Gene S. 87429

BHARAT MEHTA/SONGS/SCE/EIX

To

GENE MALCOLM

11/04/2005 12:55 PM

cc

DOUGLAS FOOTE/SONGS/SCE/EIX@SCE, ART KNEISEL/SONGS/SCE/EIX@SCE, SHERMAN/SONGS/SCE/EIX@SCE, MCGAWN/SONGS/SCE/EIX@SCE, ROBERT KELLER/SONGS/SCE/EIX@SCE

CHUCK DUBE/SONGS/SCE/EIX@SCE, PATRICK SHAFFER/SONGS/SCE/EIX@SCE, KEVIN FLYNN/SONGS/SCE/EIX@SCE, PAUL SCHOFIELD/SONGS/SCE/EIX@SCE, PAUL BLAKESLEE/SONGS/SCE/EIX@SCE, JENIFER REDRICK/SONGS/SCE/EIX@SCE, MEHRDAD HOJATI/SONGS/SCE/EIX@SCE, NEAL QUIGLEY/SONGS/SCE/EIX@SCE, BHARAT MEHTA/SONGS/SCE/EIX@SCE, PARVIZ VALANDANI/SONGS/SCE/EIX@SCE, BRUCE RAUSCH/SONGS/SCE/EIX@SCE, JOHN HIRSCH/SONGS/SCE/EIX@SCE, MARYJANE JOHNSON/SONGS/SCE/EIX@SCE, JACK RAINSBERRY/SONGS/SCE/EIX@SCE, ROBERT HECKLER/SONGS/SCE/EIX@SCE

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Enclosure 3
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Subject

EDG/diesel fuel change from CARB fuel to ULSD fuel

Review of calculation M-0016-008 (DG onsite fuel oil requirements) shows that prior to using ULSD fuel, diesel fuel storage volume will have to be increased from what it is in the Technical Specifications 3.8.3 at the present time. The main reason appears that ULSD fuel has lower heating value (BTU/HR) compared to the existing CARB fuel, which will require more volume to do the same job.

Therefore, a PCN against the Tech. Spec. is required and AR051100242 has been generated. Once the PCN is issued, other affected documents such as TLU Calculations, Operating Procedures changes, Chemistry Procedure changes, DBD/UFSAR changes and other evaluation and impacted documents will be revised as part of the ECP 040301409-3, either as part of the ECP or as an SPI assignments.

Technical Specification change requires NRC approval prior to using ULSD fuel in June 2006 or earlier. ECP and other documents changes can proceed in parallel to Technical Specification changes, to meet June 2006 date.

Once the PCN is issued for NRC approval, we will have a 10% ECP meeting to make sure we have captured all other design bases documents including calculations and procedural impacts.

Per my discussion with Jack Rainsberry, Malcolm McGawn is assigned to help process Tech. Spec. changes. I will work with Malcolm and others as required to draft the PCN for this effort.

Please let me know if any questions or need more information.

Bharat Mehta 11/4/05

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ENCLOSURE 4
EMD MAINTENANCE INSTRUCTION (MI) 1760 Rev. G
"Lubricating Oil for EMD Engines"

(Best available quality)

ATTACHMENT-III

M.I. 1760 *REV. G

Maintenance Instruction

Technical Publications

ELECTRO-MOTIVE

LUBRICATING OIL FOR EMD ENGINES — MARINE, POWER, AND DRILLING RIG —

The necessity for properly lubricating the dynamic components of any engine is readily apparent. The recommendations, suggestions, and comments included in this Maintenance Instruction are offered as a guide in the selection of a suitable engine lubricating oil.

OIL QUALITY

It must be recognized that the only real measure of quality in a lubricating oil is its actual performance in the diesel engine. This is apparent because of the impossibility of establishing limits on all physical and chemical properties of oils which can affect their performance in the engine over a broad range of environmental influences.

Oil quality is the responsibility of the oil supplier, a term applicable to refiners, blenders, and rebranders of engine lubricants. As there are a substantial number of commercial lubricants marketed today, engine manufacturers and consumers cannot completely evaluate the entire spectrum of products available. As a result, the selection of a suitable, heavy duty lubricant must be made in consultation with a reliable oil supplier capable of making product recommendations commensurate with the engine builders specifications and specific environmental influences as well as furnishing such a product on a consistent quality level.

OIL TYPE

An SAE 40, heavy duty additive type engine lubricant conforming to the following specifications should be used in all EMD engine applications:

PROPERTY	ASTM TEST DESIGNATION	NEW, UNUSED OIL LIMITS
Viscosity: Saybolt Universal Seconds at 210° F (98.9 ° C)	D88 or D445	70-85 (12.9-16.8 cSt)
Viscosity Index	D567	60-100
Flash Point	D92	420° F Min. (216° C)
Fire Point	D92	475° F Min. (246° C)
Pour Point	D97	40° F Max. (4.5° C)
Zinc Content (†)		10 ppm Max.
Total Base Number (††)	D-664 D-2896	5-17 7-20

*This bulletin is revised and supersedes previous issues of M.I. 1760, 1762, and 1763. Areas of change are indicated by vertical bars.

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NOTE

† Zinc additive compounds, such as zinc dithiophosphate, must not be present in lubricant for EMD engines. Oils containing more than 10 ppm zinc are considered excessively contaminated with zinc dithiophosphate or similar additive compounds which will not satisfactorily lubricate the silver bearings in EMD engines.

†† Certain oils in this TBN range will not provide adequate performance if fuels with sulfur content in excess of 0.5% must be used. For further recommendations in this regard refer to the section on high sulfur fuels.

In addition to the above properties, the oil formulation should have a high resistance to oxidation, a low tendency toward the formation of harmful carbonaceous and/or additive ash deposits, and must be non-corrosive to silver metal at 285° F (140° C) (EMD L.O. 201 test). Oils with sufficient alkaline reserve (TBN) and highly effective detergent-dispersant systems should be employed in line with fuel quality and/or service demands.

QUALIFICATION TESTS FOR ENGINE LUBRICATING OILS

The diesel engine lubricating oil must satisfactorily lubricate the entire engine under all conditions expected to be encountered. While the condition and performance of the engine in actual service provides the criteria in reaching a final judgment of oil suitability, there are several laboratory tests which are useful in making preliminary evaluations of a product, namely:

1. Physical and chemical properties (as previously noted).

2. Corrosion of metals:

   a. Silver and copper – EMD No. L.O. 201 method.
   b. Lead S.O.D. Method No. 5321-I (modified).

3. Overall evaluation of oxidation stability by the EMD L.O. 201 method, including:

   a. Viscosity increase characteristics
   b. Retention of alkalinity (additive concentrate)
   c. Development of insolubles.

DEVELOPMENT PROGRAM REQUIREMENTS FOR NEW OIL FORMULATIONS

1. Laboratory Evaluations

   The supplier of the lubricant base stock and the supplier of the additive concentrate are expected to conduct complete laboratory and bench test qualifications by ASTM and EMD methods. EMD will review and monitor such tests and if all results are in good agreement and within acceptable limits, the oil formulation will be considered worthy of 2-567 engine evaluation to determine its silver lubricity characteristics.

2. 2-567 Silver Lubricity Test

   The purpose of this test is to determine that the laboratory qualified oil formulation will satisfactorily lubricate the silver wrist pin bearing. This test evaluation is also expected to be conducted and or contracted by the oil or additive supplier with review and monitoring of the results by EMD.

3. Full Scale Field Test

   Upon successful completion of the laboratory and silver lubricity tests, an oil formulation will be considered worthy of full scale field test evaluation. Field tests should be conducted in a minimum of three (3) EMD engines, preferably in heavy duty service, for a period of not less than one year.

   During the field evaluation and its conclusion, EMD will review the oil and engine performance data generated by the supplier(s).

   After successful completion of the field test program the oil will be considered satisfactory for limited use, but should be closely monitored during the following two years of commercial introduction.

Oil formulations established and proven by this development program must remain exactly the same with no subsequent changes in their make-up.

If an oil or additive improvement program is desireable or necessary, the revised formulation must be evaluated by going through the complete development program.

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USE OF ONE OIL

The use of a single brand name lubricant is recommended. This recommendation of long standing is substantially supported by observations of performance of many units with a single oil compared to performance of units with mixed oil products.

MIXING OF LUBRICATING OILS

EMD has continually recommended that lubricating oils should not be mixed. The combining of lubricants with different additive and base stock components creates a chemical mixture which cannot be readily evaluated in the laboratory, and its field performance cannot be reliably predicted.

RECLAIMED OILS

Considered as a general category, reclaimed oils are not recommended for lubrication of EMD engines.

HIGH SULFUR FUELS

EMD strongly recommends the use of distillate fuels with sulfur content of les than 0.5% in order to realize optimum life expectancies of both the engine and the lubricating oil. It should also be noted, that scheduled maintenace programs are based on fuel sulfur levels of .5% or less and other properties as shown in M.I. 1750.

In applications where fuel of recommended sulfur level cannot be obtained, it may be necessary to make specific engine modifications (contact your local EMD Service Representative) and follow the lubricating guidelines mentioned in this section, in order to achieve reasonable performance and wear rates.

In addition, EMD considers the use of high alkaline reserve lubricants as mandatory where high sulfur fuels must be employed. Specifically, the use of lubricants with new oil total base number of 10 to 17 by ASTM D-664 (13 to 20 by ASTM D-2896) are recommended under these conditions.

EMD guidelines for lubricant alkalinity as a function of fuel sulfur content are shown in Fig. 1 for values up to and exceeding 1%. It should be noted that extensive operation at low sulfur levels with high base number oils is not recommended due to excessive formation of additive ash deposits. Conversely, operation with low base number oils and high sulfur fuels will not provide adequate engine protection.

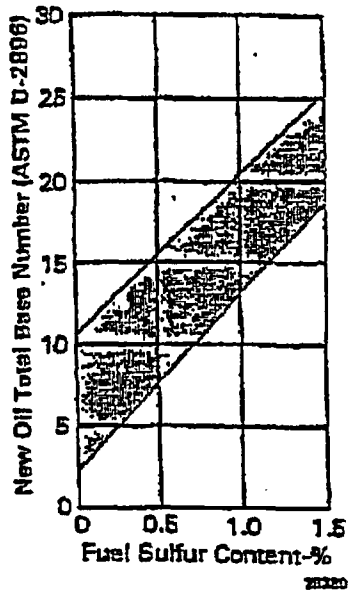

Fig.1 – Recommended Alkalinity Level Of New Lube Oil Vs. Fuel Sulfur Content

It is emphasized that the use of high sulfur fuels results in significant reductions in both engine wear life and lubricant life. Recommendations offered in conjunction with the use of high sulfur fuels are essential in minimizing these effects, but are limited in what they accomplish. As a result, the user of high sulfur fuels must anticipate shorter intervals between engine overhauls as well as more frequent oil changes under such conditions.

FILTER CHANGES

Regular monitoring of lube oil filter tank pressure should be used to determine filter condition. Replacement of oil filter elements should be made according to the Scheduled Maintenance Program unless pressure monitoring or laboratory analysis of the lubricating oil dictates earlier replacement.

Replacement elements must be of the EMD type or equivalent in all respects. Elements intended for use with other types of engines are not suitable.

Where highly dispersant oils are employed, carbonaceous matter may be suspended so finely in the oil that it is essentially unfilterable. In such situations, it might appear that an extension of the filter replacement interval may be justified. Caution should be exercised when contemplating such action since filter materials have not yet been developed that will tolerate prolonged exposure to lubricants at high temperature without deterioration and or possible disintegration of the filter media.

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INTERPRETATION OF LUBE OIL SAMPLE ANALYSIS

LUBE OIL ANALYSIS	BASIS FOR ANALYSIS	NORMAL No Action Required	BORDERLINE Take Extra Oil Samples	HIGH Correct Condition	RECOMMENDED ACTION Shut Down Engine. Drain Lube Oil. Change Filters. Change Filters Only.
Fuel Leak	Viscosity & Flash Point — Check for dilution if flash point less than 400° F or oil viscosity drops 15% or more at 100° F.	0 to 2%	2 to 5%		Borderline — find and fix fuel leak.
				Above 5%	High — check main bearings per maintenance manual.
Water Leak	Free Water	None		Any	Resample with dry container. Find and fix leak. Check main bearings per maintenance manual.
	Chromate Inhibitor	0 to 20 ppm	20 to 40 ppm	Above 40 ppm	Find and fix water leak. Check lube oil filter tank pressure.
	Boron Inhibitor	0 to 10 ppm	10 to 20 ppm	Above 20 ppm	
Air Filtration	Silicon	0 to 5 ppm	5 to 10 ppm	Above 10 ppm	Improved air filter maintenance required. Anti-foam agent present in new oil.
Excessive Oxidation	TBN (D-664) TBN (D-2896) Viscosity Rise pH Pentane Insolubles			*Min TBN (D-664) 0.5 (D-2896) 1.0 Max. Vis. Rise in SUS @ 100° F. 30% Min. pH 5.0 Max. Pent. Insol. 2%	Change Oil. If short oil life persists, check lube oil quality, fuel sulfur content, oil cooler efficiency, engine temperature controls, power output (governor and rack settings), engine condition (worn rings, cracked pistons, poor combustion), oil filtration, or oil pump suction leak.
Contaminated fuel (cracking catalyst)	Aluminum, Silicon, and/or Magnesium		Above 5 ppm		Check fuel cleanliness. Notify fuel supplier. If engine smokes, check injector calibration and tip erosion. Check if piston rings are excessively worn.
Oil Contamination	Zinc	0 to 10 ppm	Above 10 ppm becomes more dangerous with increasing values.		Check if oil is contacting galvanized or zinc painted surfaces. Check if make up oil in stock is within specifications. Notify lube oil supplier. Check for silver bearing failures.
	Silver	0 to 1 ppm	1 to 2 ppm	Above 2 ppm	Check if oil contains zinc or is corrosive to silver. Check for broken piston cooling tubes, inefficient oil cooler, or improper temperature control. Feel sides of piston pins for signs of distress. Measure piston to head clearance with lead readings. ‡ Oil draining is not mandatory. Check strainers and bottom of oil pan for debris. Consider turbo bearing condition.

30124

M.L. 1760

6-1-232

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Page 4 of 6
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Abnormal Wear Or Corrosion (Rapid increases within normal range should be considered borderline condition).	Chromium (Not applicable if chromate coolant inhibitor is used)	0 to 10 ppm	10 to 20 ppm	Above 20 ppm	Check for rapid wear of rings & liners.
	Copper	0 to 75 ppm	75 to 150 ppm	Above 150 ppm	Measure piston to head clearance with lead readings to locate worn piston thrust washers. ‡ Check connecting rod bearing blade thrust faces for distress.
			High iron and copper increase oxidation rates		
	Iron	0 to 75 ppm	75 to 125 ppm	Above 125 ppm	Check for rapid wear of rings & liners.
	Lead	0 to 50 ppm	50 to 75 ppm	Above 75 ppm	Most likely lead flash is dissolving off bearings. Premature lead removal, before bearings are broken in, can lead to bearing distress. Inspect and replace upper con rod bearings in service less than 6 months if lead flash has been removed from the unloaded area of the fishback bearing surface on turbocharged engines. If con rod bearings require replacement, wrist pin bearings should also be checked and replaced if lead flash has been removed.
In Combination	Copper Iron Lead		[illegible] Two out of three elements [illegible] in borderline or high range [illegible]		Check [illegible] bushing distress. Check [illegible] gear bearing clearances. Check main and con rod bearings per maintenance manual. Oil draining is mandatory.
In Combination	Tin	0 to 20 ppm	20 to 40 ppm	Above 40 ppm	1. When in combination with iron or chrome rise, check for piston distress. 2. When in combination with lead or copper rise, check for bearing distress.

* In applications where fuel sulfur content is 0.5 to 1.0%, the TBN level should not be allowed to drop below 1.0 (D664) or 2.0 (D-2896); and where fuel sulfur content is greater than 1.0%, TBN should not be allowed to drop below 3.0 (D-664) or 4.0 (D-2896).

‡ Due to carbon buildup on both the fire face of the cylinder head and the crown of the piston during service life, lead wire readings should not be used as a basis for power assembly changeout. Lead wire readings may continue to be used to indicate wear trends. Significant clearance increases should be investigated as possible component failures.

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LUBRICATING OIL CHANGES

Oil change intervals prescribed in the applicable Scheduled Maintenanced Program are based on average operating conditions with quality fuels of less than 0.5% sulfur content.

When oil change intervals are overextended, serious and costly engine problems may result. This can occur if the additive concentrate is depleted beyond acceptable limits, and the lubricant loses essential properties including alkalinity, detergency, and dispersancy. In the absence of vital reserves of these properties, the lubricant no longer provides satisfactory protection of the engine in limiting harmful deposit formations from oxidized oil and other contaminants, or adequate control of the corrosive products of combustion.

Oils which have experienced severe additive depletion will result in accelerated engine wear, stuck or broken piston rings, liner scuffing, and corrosive attack and or frictional failure of vital bearing surfaces.

Regular laboratory analysis of the lubricant is a valuable means of judging the condition of the lubricant, and is of equal value in reflecting the condition of the engine. Both engine and oil condition must be given careful consideration when planning to extend oil change intervals beyond those recommended.

In addition, EMD strongly advises the conscientious use of laboratory analysis where high sulfur fuels must be used. The degree of satisfactory performance in such applications is heavily dependent on the establishment of proper oil change intervals under the actual service condition and high end of the fuel sulfur range that can be expected. Therefore, an expeditious well planned program of frequent analysis is most essential in establishing a safe oil change interval for a given lubricant under these conditions.

Under no circumstances should a set time interval for oil changes with high sulfur fuels be arrived at without first establishing such an interval by careful laboratory analysis and/or close consultation with the oil supplier.

Among the key parameters for judging the need for an oil change, total base number (TBN) is one of primary importance. When this or other key indicators approach or reach prescribed minimum, or condemning limits, appropriate action must be taken. To assist maintenance personnel in the interpretation and recommended actions associated with the regular laboratory analysis of the engine lubricating oil, a summary of guidelines has been included in this Maintenance Instruction. While some variations from guideline values may exist due to method or analysis techniques employed, significant deviations from the normal lubricant history should still be detectable, and the proper evaluation of such indicators as a means of implementing preventive maintenance can serve well in avoiding potential engine damage of a more serious nature.

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ENCLOSURE 5
ESI LETTER DATED 12/04/01
LOW AROMATIC FUELS
(including 1P-94 Pointers)

(Best available quality)

Engine Systems, Inc.

Nuclear Parts & Service

Tuesday, December 04, 2001

Southern California Edison Company
Attn: Doug Foot
P.O. Box 128
San Clemente, CA 92672

Reference: Low Aromatic Fuels

With reference you your question with regards to running Low Aromatic fuels in your EMD 20-645-E4 engines. The engine governor control system will adjust fuel injector rack to compensate for lower BTU rated fuels. The fuel injector will supply additional fuel to each cylinder to carry rated loads. See Pointers 1P-94 for Low Sulfer & Low Aromatic Fuels.

Should you have any questions or need additional information, please don't hesitate to call me @ 252-407-8520 or Email darryl.hartley@kmtc.com..

Sincerely,

Darryl Hartley
Customer Service Manager

1P-94

POWER POINTERS

ELECTRO-MOTIVE

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EXHAUST VALVE SEAT SERVICE LIMIT REVISION

The service limit for the maximum valve seat runout, listed in the Service Data at the end of Section 2 in current and previous editions of EMD Engine Maintenance Manuals, is not valid. The old limit may be shown as *0.05 mm (.002")* or *0.038 mm (.0015")*. The correct current limit should read as **0.064 mm (.0025")**.

Please mark your copies of Engine Maintenance Manuals to reflect this limit revision.

LOW SULFUR/ LOW AROMATIC FUELS

Effective in October of 1993,the United States Environmental Protection Agency (EPA) mandated regulation changes in the sulfur and aromatic hydrocarbon content in the Diesel fuel used by trucks on U.S. highways. Nationwide, fuel sulfur content was changed to 0.05% maximum from the 0.2% to 0.3% that had been the norm. Additionally, in California, fuel aromatic hydrocarbon content was limited to 10% (with some leeway allowed if a refiner could show equivalent emissions performance) where previous levels had been 35% to 40%. Though the new rules do not extend to fuel used in locomotive or power product applications, refining and distribution considerations dictate that inevitably much of the fuel available to operator's of such equipment will meet the new standards.

The commuter railroad, serving the San Francisco bay area, experienced fuel leaks at the injector nut seals on F40PH locomotives delivered in 1985 and 1987 after changing to the new "California" fuel. The leaks were caused by shrinkage of the Nitrile rubber seal (used in injector assemblies at the time of delivery of these locomotives) due to the reduction in the fuel aromatic content. The fuel aromatics act to swell and harden the Nitrile elastomer. Conversely, with reduction in aromatic content the seal contracts and because it is no longer pliable, its sealing function is lost. The resulting fuel dilution of the lubricating oil is the signal that injector seal failure has occurred.

Problems with the new fuel have not been limited to locomotives. Many truck fleets have noted similar fuel system leaks with Nitrile seals: the leaks disappear and do not recur with seal replacement, even if the new seals are Nitrile rubber. Truck fuel system leakage has been noted nationwide, perhaps as a result of fueling in California or of the effects of the refining and distribution constraints noted above.

There are two reasons why EMD does not expect the commuter railroad experience to be repeated nationwide, particularly on railroads or power product operations which have no California contact:

- First; the California fuel is not the low-sulfur fuel in use nationwide. The latter does not have a required aromatic hydrocarbon reduction and, therefore, the *swelling-hardening-contraction* sequence with Nitrile seals described above is unlikely to occur. We do not expect the fuel sulfur reduction alone to have any adverse effects in the EMD engine.

- Second; the EMD injector nut seal material was changed in March of 1989 from Nitrile rubber to a Fluoroelastomer (of which Viton is a trade name), which is unaffected by fuel aromatics. Most of the other seals in fuel contact are also Fluoroelastomer material.

Customers are cautioned not to use old EMD stock or competitive aftermarket injectors which contain Nitrile rubber seals in this new fuel environment.

EMD POLICY ON MULTIGRADE ENGINE OILS

. se of a high quality lubricating oil in EMD engines is required in order to maximize reli-
·ility and performance. Over the years, the most reliable lubricating oil used in our engines
.s been SAE 40 weight. EMD continually built knowledge and found success with the
·aight weight oil. However, with the introduction of multigrade oils, EMD understood the
ed for change and recognized the use of multigrade oils for engine operation. EMD also
derstands our customers' needs for lube oil and fuel oil savings, which are being realized
h the use of multigrade oils. EMD has accepted the challenge presented to us by the
ustry change to multigrade oils and looks forward to a reliable future with these oils.

EMD has and will continue to recognize SAE 20W-40 multigrade engine oils that suc-
cessfully complete the required development program, including the field test approval
process.

To date, SAE 20W-40 multigrade oil field tests have accumulated a significant number of
operating hours in EMD engines with satisfactory results. (These hours have been accu-
mulated on both 645 and 710 engines).

In addition to field test experience, in use service by major North American owner/opera-
tors in the last three years has not shown any oil related adverse effects on EMD engines,
with the exception of one product.

This product did not provide adequate engine break-in performance, but EMD believes
this problem is correctable and we are working with the supplier to this end.

The use of SAE 20W-40 multigrade engine oils is directionally consistent with EMD's
policy to provide more fuel efficient and lower emission signature engines to the markets
we serve.

ould be noted, however, that there are EMD service concerns about SAE 20W-40 multi-
e oils in high shear applications. Current lab tests for oils are not able to duplicate all
ne shear rates and interface temperatures which would help to predict the safety margin
current designs. As a result, field tests and in service use experience are the only mea-
to evaluate multigrade oils today.

) encourages the oil industry to develop instrumentation to provide a complete map of
able shear and temperature characteristics for multigrade oils, so that less emphasis is
ed on field test requirements. Independently, EMD is also investigating the feasibility of
ig a high speed rotating test stand to qualify current and future multigrade oils.

nould be noted that, EMD has continually recommended that lubricating oils should not
mixed. The combining of lubricants with different additive and base stock components
ates a chemical mixture which cannot be readily evaluated in the laboratory and its field
formance cannot be readily predicted. Please refer to M.I. 1752 for instructions to mini-
ze potential risk if mixing of oils is unavoidable.