Washington State Department of Transportation

Lynn Peterson
Secretary of Transportation

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Lynne Griffith
Assistant Secretary for
Washington State Ferries

December 9, 2014

The Honorable Judy Clibborn
Chair, Senate Transportation Committee
P.O. Box 40600
Olympia, WA 98504-0600

The Honorable Curtis King
Co-Chair, House Transportation Committee
P.O. Box 40414
Olympia, WA 98504-0414

The Honorable Tracey Eide
Co-Chair, House Transportation Committee
P.O. Box 40414
Olympia, WA 98504-0414

Mr. David Schumacher
Director, Office of Financial Management
P.O. Box 43113
Olympia, WA 98504-3113

SUBJECT: Report on Ferries Use of Re-refined Motor Oil, Proviso Sec. 221(9), Ch. 222, Laws of 2014 (ESSB 6001)

Dear Transportation Chair Clibborn, Co-Chairs King and Eide, and Director Schumacher:

The 2014 Legislature directed the Washington State Department of Transportation to evaluate the feasibility of using re-refined used motor oil processed in Washington state as a ferry fuel source. Proviso Sec. 221(9), Ch. 222, Laws of 2014 (ESSB 6001) states:

> Within existing resources, the department must evaluate the feasibility of using re-refined used motor oil processed in Washington state as a ferry fuel source. The evaluation must include, but is not limited to, research on existing entities currently using the process for re-refined fuel, any required combustible engine modifications, additional needed equipment on the vessels or fueling locations, cost analysis, compatibility with B-5 blended diesel, and meeting engine performance specifications. The department must establish an evaluation group that includes, but is not limited to, persons experienced in the re-refined motor oil industry. The department must deliver a report containing the results of the evaluation to the transportation committees of the legislature and the office of financial management by December 1, 2014.

The department pursed this matter with Emerald Services, Inc., a Washington state company with a process for making re-refined fuel. Emerald Services, Inc. provided a fuel sample report for their 50% re-

refined waste lube oil/50% ULSD blended fuel product. The department evaluated the report and found that:

1. The re-refined fuel does not comply with the EPA requirements of 40CFR 80.510(c). The issue with the re-refined fuel is the sulfur content. The sulfur content is five times the allowable limit for use in the Emission Control Area (ECA).
2. The fuel does not conform to an accepted national or international marine fuel quality standard that adequately reflects its basic composition.
3. The fuel has yet to undergo independent, systematic, comprehensive, long-term testing or in-service extended usage by a vessel operator to determine its impact on engine performance.
4. Use of the proposed fuel on a WSF engine with an EPA Certificate of Conformity would void the certificate.

Based on these findings, the department concludes that using re-refined fuel as a ferry fuel source is not feasible at this time.

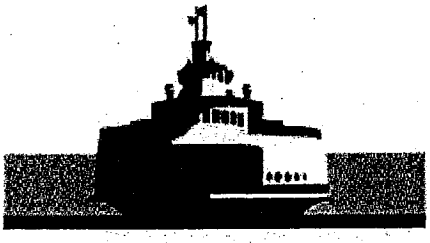
We appreciate the Legislature's interest in finding innovative approaches to meeting the Ferry System's fuel needs and regret that this approach does not appear feasible.

Sincerely,

Lynne Griffith
Assistant Secretary, Ferries Division
Washington State Department of Transportation

Attachment: Memorandum on Emerald Services, Inc., Blended Fuel Sample Report

Cc: Jean Baker
George Capacci
Doug Vaughn



WSDOT FERRIES DIVISION
VESSEL DESIGN SECTION

MEMORANDUM

TO: Cotty Fay, P.E., Chief Naval Architect, WSF

FROM: Bill van Doorn, P.E., Marine Mechanical Engineer, WSF

DATE: 17 July 2014

SUBJ: Emerald Services, Inc., Blended Fuel Sample Report

ATT: (1) Columbia Inspection, Inc., Certificate of Analysis
(2) 50/50 Blend Test Sample to ASTM D975-14 B5 Comparison

Cotty,

This memo identifies, and briefly discusses, several topics of concern regarding the fuel sample report (Attachment 1) that was submitted to WSF by Cyan Strategies on behalf of Emerald Services, Inc., for their 50% re-refined waste lube oil ("Emerald MDO") / 50% ULSD blended fuel product. It is my understanding that this product is currently being proposed by Cyan Strategies and Emerald Services, Inc., for procurement by WSF as a vessel fuel. The issues raised below should be considered very carefully before any further action is taken on the use of this product by Washington State Ferries.

(1) The proposed fuel does not comply with the EPA requirements of 40 CFR 80.510(c).

Fuels and fuel additives are regulated by the EPA under 40 CFR Part 80, including maximum allowable sulfur content. 40 CFR 80.510(c) requires that, as of June 1st, 2012, all non-road, locomotive, and marine diesel fuel in the United States have a sulfur content not exceeding 15 ppm. The sample test report for the Emerald Services, Inc., 50/50 blend (referred to as "ES-50" throughout the rest of this memo) indicates that it has a sulfur content of 0.0630 weight percent, which is equal to 630 ppm (ppm = % Wt. x 10,000). A fuel with this sulfur content exceeds what is permissible for use in Category 1 (cylinder displacement < 5 liters/cyl.) and Category 2 (5 l/cyl. < cylinder displ. < 30 l/cyl.) marine diesel engines in the United States. All main propulsion and auxiliary diesel engines onboard WSF vessels belong to one of these two categories. Category 3 engines only (cylinder displ. > 30 liters/cyl.; typical of large, slow speed propulsion engines onboard ocean-going merchant ships) may use what the EPA has defined as an "ECA Marine Fuel" when operating within U.S. emissions control areas, with a maximum allowable sulfur content of 1000 ppm. Because of this regulatory restriction, ECA marine fuel is intended, at a practical level, for ships which normally bunker and burn residual fuels. Unless used in Category 3 engines or exported, distillate grades of marine diesel fuel in the U.S. are subject to the ultra-low sulfur restrictions of 40 CFR 80.510(c). Selling or using a fuel which does not comply with the provisions of 40 CFR Part 80 is a federal violation of the Clean Air Act.

(2) The proposed fuel does not conform to an accepted national or international marine fuel quality standard that adequately reflects its basic composition.

The ES-50 blend is a highly irregular fuel with no existing, applicable single standard against which it can demonstrate compliance or conformity. National and international fuel standards (ASTM D975, ISO 8217, BS 6843-1, etc.) have been developed and revised over the years by recognized standards organizations out of the universal need for quality and consistency in fuel products, both for those that are widely used and for specialty fuels. The ES-50 test sample reflects a fuel mixture that is 50% "Emerald MDO" and 50% ultra-low sulfur diesel (ULSD). "Emerald MDO" however is essentially lubricating base oil (pre-additives) derived from the vacuum distillation of waste lube oil feed stock, replicating, with modifications, the vacuum distillation step in the original refining process. This is not marine diesel oil (MDO) as is conventionally understood and defined by recognized fuel standards; molecularly, it belongs to the lubricating oil group of hydrocarbons, not distillate diesel fuels.

Although the pre-blended ULSD component must be compliant with ASTM D975 criteria, it forms only half of the ultimate ES-50 fuel blend. The fuel sample report indicates that criteria for ISO 8217-DMB marine distillate fuel (what is typically recognized as "MDO") were used for evaluation purposes, but only a partial slate of ISO 8217-DMB fuel parameters was selected. The tested parameters are important and relevant for most types of liquid fuels, but the ISO 8217 testing slate for conventional marine distillate fuels is not the same set of parameters that ISO 8217 specifies for marine residual fuels; residual fuels, understandably, have other performance metrics which must be assessed. Every fuel type has its own potential quality issues relative to other fuels and it should be expected that a fuel blend which is composed of 50% re-refined lubricating oil would be no exception, requiring its own particular set of performance measures and quality standards.

(3) The proposed fuel has yet to undergo any kind of systematic, independent testing or in-service extended usage by a vessel operator.

It is my understanding that the ES-50 blend has yet to undergo any kind of independent, comprehensive, long-term engine performance testing by either a recognized industrial research institute (e.g. Southwest Research Institute), a diesel engine manufacturer, or a diesel engine owner or operator with the co-participation of the engine OEM. Given this and the concerns raised in (1) and (2) above, one or more WSF vessels would essentially become the lead test platform(s) for this fuel.

WSF currently uses ASTM D975 B5 biodiesel onboard all of its vessels, a fuel that has been successfully adopted fleetwide without adverse effects since its initial introduction. WSF transitioned over the past decade from No. 2 diesel fuel to B5 biodiesel (which itself consists of 95% ULSD) in response to increasing federal restrictions on permissible sulfur content in marine diesel fuel, as well as WSDOT initiatives to reduce SOx and other greenhouse gas emissions from the State's ferries. B5 is an approved fuel for use by all of WSF's diesel engine OEMs, with extensive service experience having been accumulated on the particular engine models that WSF operates by other parties as well. Emerald Services, Inc., has yet to present any diesel engine manufacturer approvals for their ES-50 fuel, let alone from an engine manufacturer with direct relevance to WSF (EMD, G.E. Transportation, MTU Detroit Diesel, Cummins, Caterpillar, and others). Given the unusual composition of this fuel, any negative effects it may have upon the wear or performance of engine cylinder liners, piston

rings, piston crowns/skirts, cylinder heads, intake/exhaust valves, fuel injectors, turbochargers, etc., as well as lube oil compatibility, would be WSF's risk to determine through actual use.

HHV and/or LHV values have also not been reported, so any kind of quantitative estimate of the effect switching to ES-50 would have upon BSFC and overall fuel consumption cannot yet be made.

A comparison of the ES-50 test sample values to the ASTM D975 specifications for B5 biodiesel is provided as Attachment 2. Again, for the reasons described in (2), discretion should be exercised when making across-the-board comparisons between the two types of fuels.

(4) Use of the proposed fuel on a WSF engine with an EPA Certificate of Conformity would void the certificate.

40 CFR Part 1040 sets forth the testing and certification requirements for a diesel engine manufacturer to obtain an EPA Certificate of Conformity for a given engine model. An EPA Certificate of Conformity is needed for any engine model that must be compliant with EPA emissions Tier requirements. ES-50 is not an EPA approved fuel for Certificate of Conformity testing or in-service compliance, and any such use (unless approved by the EPA) would void the certificate.

Cc:

Wes Sweet, Port Engineer, WSF
Shane Kelly, Port Engineer, WSF

COLUMBIA INSPECTION, INC.

CERTIFICATE OF ANALYSIS

CLIENT:		Phillips 66
SAMPLE DESIGNATED BY CLIENT:		MDO Straight Blend 50% / DSL BLEND 50%
LOCATION:		Emerald Materials Tacoma
ORIGIN:	DMB SLATE	Tacoma WA
SAMPLE DATE:		04/30/14

REPORT DATE: 05/07/14 REPORT NO: 240498

TEST	METHOD		RESULTS	SPEC. LIMITS	
API GRAVITY @ 60 °F	ISO 12185	Composite	33.2	25.6	MIN
VISCOSITY cst @ 40°C	ISO 3104	Composite	4.8	2.00/11.00	MIN/MAX
CETANE INDEX	ISO 4264	Composite	55.1	35	MIN
SULFUR, % wt.	ISO 14596	Composite	0.0630	0.10	MAX
FLASH POINT, °C	ISO 2719	Composite	77	60	MAX
MCR,, % (m/m)	ISO 10370	Composite	0.02	0.30	MAX
TOTAL SEDIMENT BY HOT FILTRATION, % wt	ISO 10307-1	Composite	<0.010	0.10	MAX
POUR POINT, UPPER C	ISO 3016	Composite	-18	0/6	W/S
WATER, % VOL.	ISO 3733	Composite	<0.05	0.30	MAX
ASH, % wt.	ISO 6245	Composite	<0.001	0.10	MAX

By:
Mark Lindsey
Lab Manager
From the office at:

Approved By: Bob Watt - Area Manger
COLUMBIA INSPECTION, INC.

5013 Pacific Hwy. E # 2., Fife, WA 98424 USA PH (253) 922-8771 Avail 24 hrs

ATTACHMENT 2_WSF MEMO_7-17-14

Date: 17 July 2014
By: W. van Doorn, P.E.
Washington State Ferries

Comparison of Emerald Services 50/50 Blend Test Sample Results (ES-50) to the Requirements of ASTM D975-14 for B5 Biodiesel:

Fuel Grade	ES-50 (1) (3)	2-D S15 (2) (3)
Flash Pt, °C, Min.	77	52
Water & Sediment, % Vol., Max.	N/A (4)	0.05
Distillation Temp., °C, 90% Vol. Recovered,		
Min.	N/A	282
Max.	N/A	338
Kinematic Viscosity, mm^2/sec @ 40°C,	4.8	
Min.		1.9
Max.		4.1
Ash, % Mass, Max.	< 0.001	0.01
Sulfur, ppm, Max.	630 ppm (5)	15 ppm
Copper Strip Corrosion Rating, Max.	N/A	No. 3
Cetane Index, Min.	55.1	40
Aromaticity, % Vol., Max.	N/A	35
Ramsbottom Carbon Residue,		
% Mass, Max.	0.02 (6)	0.35
Lubricity, HFRR @ 60 °C, Microns, Max.	N/A	520
Conductivity, pS/m, Min.	N/A	25

Notes:

(1) ES-50 values are based upon the results reported in the Columbia Inspection, Inc., Certificate of Inspection, sample date 4/30/14, report date 5/7/14.

(2) Blended diesel fuel that is comprised of 5% biodiesel and 95% No. 2-D ULSD (by volume) must meet the requirements of ASTM D975, Table 1, in accordance with Section 7.3.1.2 of that standard.

(3) Testing protocols differ between the ES-50 reported values and 1-D S15 specification values. ISO procedures, as identified in the 5/7/14 COI, were utilized by Columbia Inspection, Inc., for the ES-50 sample tests. The ASTM test methods listed in Table 1 of ASTM D975 however are the basis for determining individual fuel properties in accordance with that standard.

(4) The ES-50 COI reports total sediment as < 0.010 % weight, and total water as < 0.05 % volume.

(5) Reported as 0.0630 % weight in the ES-50 COI (ppm = % Wt. x 10,000).

(6) Reported as micro carbon residue per ISO 10370.