APPENDIX D

Fuel Preparation

Fuel Preparation and Loading

- NAVAIR pretested lubricity additive provided by Shaeffer – could not get it to work in the concentrations recommended by the vendor. Tested Lubrizol D539 to the ratio recommended by the manufacturer – which satisfied lubricity requirements. Requested Crystal Flash to use Lubrizol
- Lubrizol provided 5 gallons of D539 to Crystal Flash.
- Crystal Flash leased 18,000 Gallon mobile "FRAC" tank and portable self-propelled 250 gpm circulating pump
- 11,500 gallons of ULSD was purchased on 9/1/11, all from same lift. Both were set up at Crystal Flash Traverse City site.
- 5,000 gallons of the ULSD was dosed with proper portion of lubricity additive and loaded in the Starboard Service Tank
- 6,500 gallons of the ULSD was loaded into the Frac tank. It was then dosed with the amount of Lubrizol D539 as specified by Lubrizol and tested by NAVAIR.
- DLA contracted tanker arrived at Crystal Flash site with 6,500 of algae fuel from Solazyme refinery in Pasadena, Texas. Fuel was added to the FRAC tank

CF Crystal Flash Energy

Frac Tank

Portable tank, typically used in “Frac” drilling processes was steam cleaned and delivered to Crystal Flash Facilities in Traverse City. Holds 18,000 gallons. Top has two manhole covers

Self-powered Circulating Pump

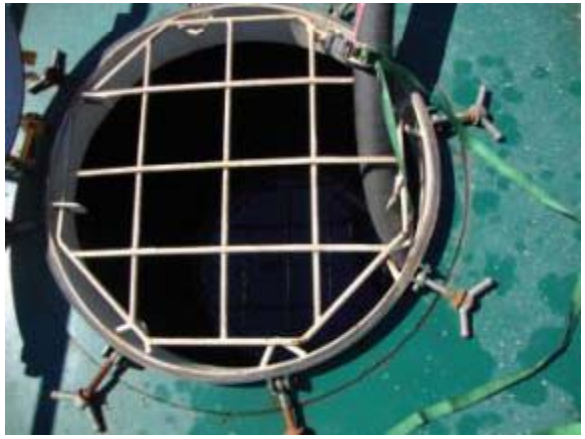
Diesel-powered pump capable of 250 gpm flow. Hoses were hooked into the tank from the forward end valve located at the bottom and also discharge hose was run to top of tank into rear manhole – so flow was from front bottom to rear top of FRAC Tank

6,500 gallons of ULSD, 2.3 Gallons of Lubrizol 539D, and 6,500 of Algae Fuel were circulated by 250 gpm portable pump for over 4 hours on 9/6/11

Suction from front, bottom of tank

Self-powered Circulating Pump

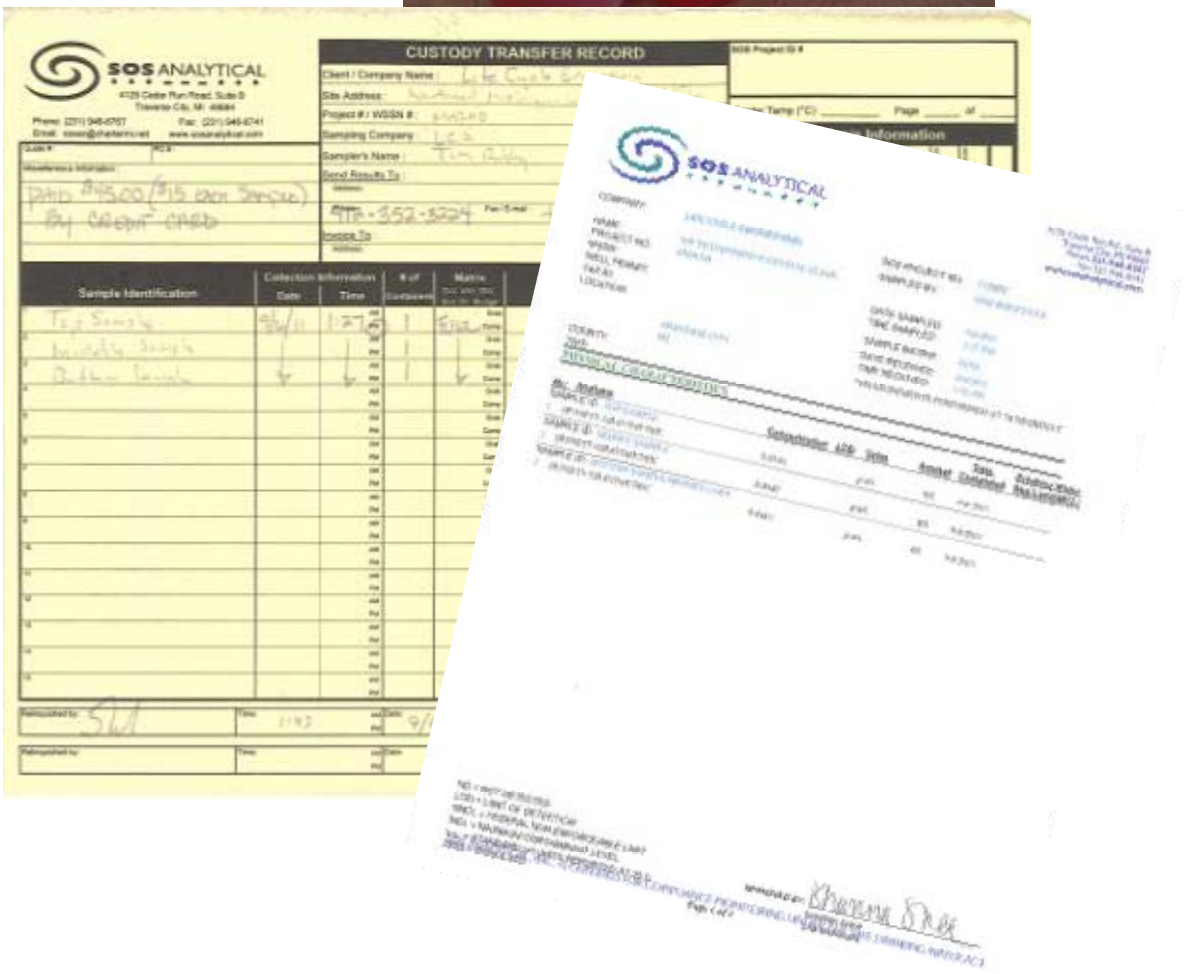
Discharge into back of tank, on top thru manhole



Fuel samples were collected using a bacon bomb (fuel thief) from top, middle, and bottom of the FRAC tank. Top and bottom drawn from back end manhole and middle drawn from center manhole

Day 1 – Blending – 9/6/11

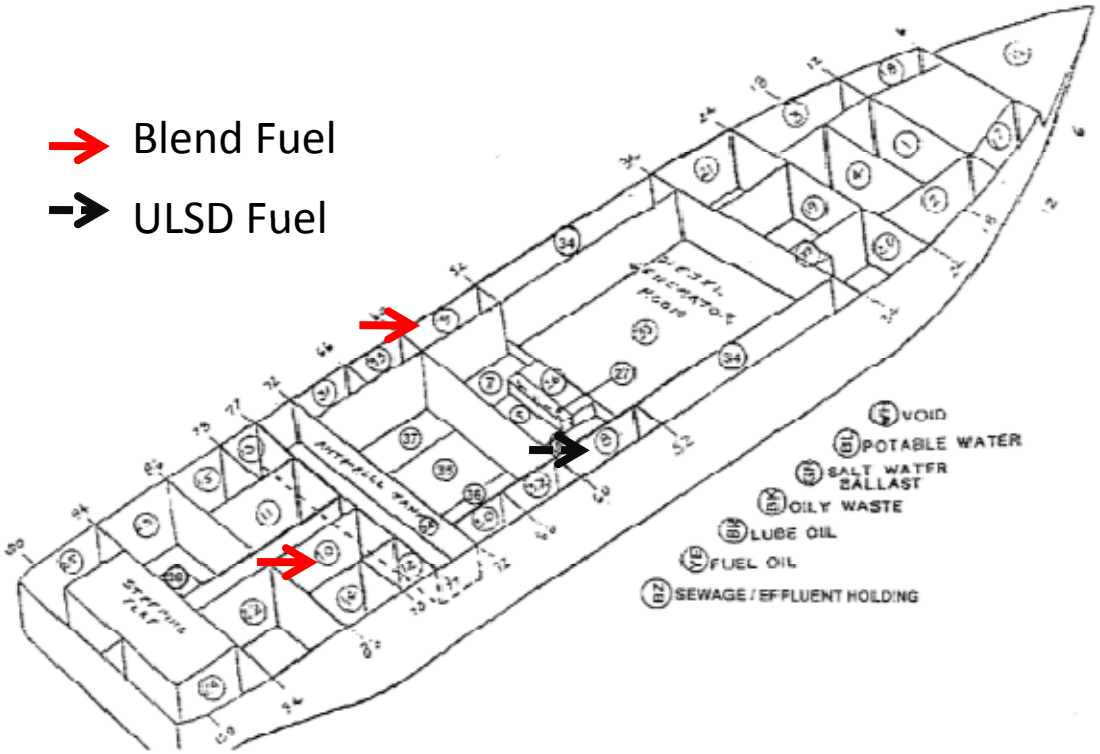
- Fuel was circulated for about 4 hours.
- Three samples were drawn and Samples collected from rear manhole at top and bottom and middle manhole from middle.
- Samples were hand delivered to SOS Analytical to perform Density Measurement. Custody of samples were transferred to SOS Analytical
- Density was reported as:
  - Top – 0.8444 g/mL
  - Middle – 0.8442 g/mL
  - Bottom - -0.8461 g/ML
- Results called into NAVAIR – determined additional mixing required as density variance too great between top and bottom



Day 2 – Blending – 9/7/11

- Fuel was circulated for about another 6 hours.
- Three samples were drawn and Samples pulled from rear manhole at top and bottom and middle manhole from middle.
- Samples were hand delivered to SOS Analytical to perform Density Measurement. Custody of samples were transferred to SOS Analytical
- Density was reported as:
  - Top – 0.8211 g/mL
  - Middle – 0.8208 g/mL
  - Bottom - -0.8220 g/ML
- Results called into NAVAIR – determined blending is acceptable for loading onto ship

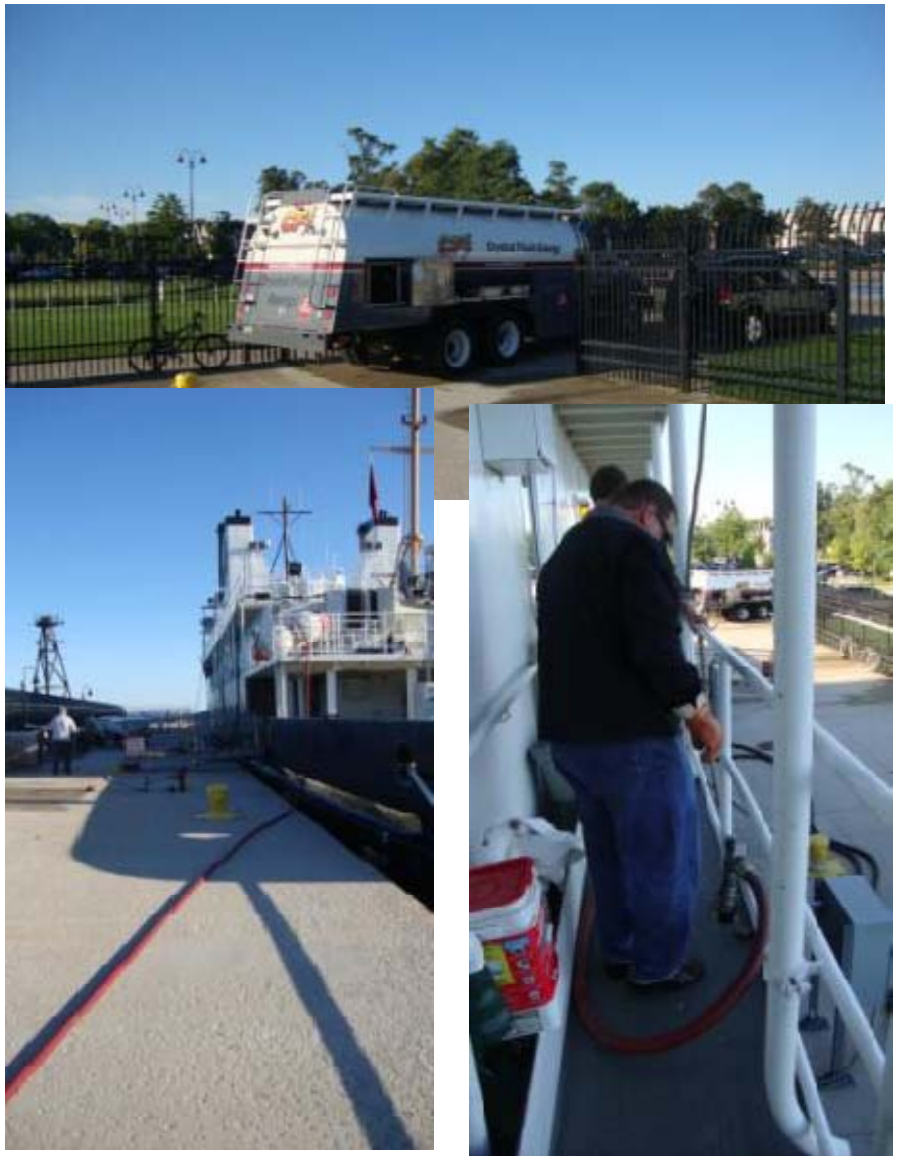
Fuel Loading



5,000 gallons of additized ULSD loaded on 9/1/11
13,000 gallons of additized Blend Fuel loaded on 9/8/11 and 9/9/11

Chief hoisting fueling flag

- 5,000 gallons of additized ULSD was loaded directly into Starboard Service Tank using sounding tube
- 5,000 gallons of additized blend fuel was loaded directly into Port Service tank using sounding tube
- Same amount loaded to maintain trim
- Remaining 8,000 gallons of blend fuel inserted in fuel tank 4-72-1



Crystal Flash Tank Truck fueling at Pier; over the water certified hose; fuel nozzle inserted into Port Service tank sounding tube

Fuel Testing

Fuel samples (2 Gallons) were collected by Crystal Flash and sent to NAVAIR:

- Neat ULSD sample
- Additized ULSD sample as delivered to ship
- Neat Algae fuel sample as delivered to Crystal Flash
- Additized ULSD/Algae blend fuel sample after density approval before ship delivery

NAVAIR Tested and reported on 9/14/11 lubricity

- Additized 50/50 blend's wear scar came in at 310um
- Additized ULSD Baseline wear scar came in at 320um

NAVAIR also tested and reported in heating value of fuel

- Additized 50/50 blend’s heating value is 43.400 MJ/kg
- Additized ULSD Baseline heating value is 42.938 MJ/kg
- Unadditized neat Algae-derived fuel heating value is 43.904 MJ/kg

Test Fuel Analyses

Certificate of Analysis

T/S SOM ULSD Control Fuel
(with Lubrizol 539D)

LIMS # 11281-04190

Conformance to F-76 Chemical and Physical Properties per MIL-DTL-16884L

Test	Parameter	Method	Units	Minimum	Maximum	Petroleum Diesel (F-76)
Lubricity, HFRR	Wear Scar	D6079	µm		460	320
Appearance at 25°C		D4176	-----	Clear & Bright		Clear & Bright
Demulsification at 25°C		D1401	minutes		10	4
Density at 15°C		D4052	kg/m^3			829
Distillation	10% Recovered	D86	°C	Report		205
	50% Recovered		°C	Report		251
	90 % Recovered		°C		357	310
	End Point		°C		385	333
	Reside + Loss		Volume %		3.0	1.5
Cloud Point		D5773	°C		-1	-18
Color		D1500	-----		3	5.8
Flash Point		D93	°C	60		59
Particulate Contamination		D5452	mg/L		10	0.2
Pour Point		D5949	°C		-6	-27
Viscosity at 40°C		D445	mm^2/s	1.7	4.3	2.3
Acid Number		D974	mg KOH/g		0.30	0.05
Ash		D482	Mass %		0.005	0.001
Carbon Residue	10% Bottom	D524	Mass %		0.20	0.07
Copper Strip Corrosion at 100 °C		D130	-----		No. 3	1a
Hydrogen Content		D7171	Mass %	12.5		13.6
Ignition Quality	Cetane Index	D976	-----	40		51
Storage Stability	Total Insolubles	D5304	mg/100 mL		3.0	0.6
Sulfur Content		D5453	mg/kg		15	10.3
Trace Metals	Ca	D7111	mg/kg		1.0	0.0
	Pb	D7111	mg/kg		0.5	0.
	Na + K	D7111	mg/kg		1.0	0.3
	V	D7111	mg/kg		0.5	0.1

Provided by: Naval Fuels & Lubricants Cross Functional Team, AIR-4.4.5.1

Certificate of Analysis

T/S SOM 50% Algae HR-76/ 50% ULSD Blend
(with Lubrizol 539D)

LIMS #11289-04207

Conformance to F-76 Chemical and Physical Properties per ASTM D975

Test	Parameter	Method	Units	Minimum	Maximum	Petroleum Diesel (F-76)
Lubricity, HFRR	Wear Scar	D6079	µm		460	310
Appearance at 25°C		D4176	-----	Clear & Bright		Clear & Bright
Demulsification at 25°C		D1401	minutes		10	3
Density at 15°C		D4052	kg/m^3			804
Distillation	10% Recovered	D86	°C	Report		218
	50% Recovered		°C	Report		270
	90 % Recovered		°C		357	297
	End Point		°C		385	320
	Reside + Loss		Volume %		3.0	1.6
Cloud Point		D5773	°C		-1	-11
Color		D1500	-----		3	4.8
Flash Point		D93	°C	60		61
Particulate Contamination		D5452	mg/L		10	1.2
Pour Point		D5949	°C		-6	-18
Viscosity at 40°C		D445	mm^2/s	1.7	4.3	2.5
Acid Number		D974	mg KOH/g		0.30	0.06
Ash		D482	Mass %		0.005	0.000
Carbon Residue	10% Bottom	D524	Mass %		0.20	0.01
Copper Strip Corrosion at 100 °C		D130	-----		No. 3	1a
Hydrogen Content		D7171	Mass %	12.5		14.1
Ignition Quality	Cetane Index	D976	-----	40		65
Storage Stability	Total Insolubles	D5304	mg/100 mL		3.0	0.2
Sulfur Content		D5453	mg/kg		15	3.9
Trace Metals	Ca	D7111	mg/kg		1.0	0.0
	Pb	D7111	mg/kg		0.5	0.0
	Na + K	D7111	mg/kg		1.0	0.3
	V	D7111	mg/kg		0.5	0.1

Provided by: Naval Fuels & Lubricants Cross Functional Team, AIR-4.4.5.1