

10 CFR 50.90

RS-08-094
July 23, 2008

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

LaSalle County Station, Units 1 and 2
Facility Operating License Nos. NPF-11 and NPF-18
NRC Docket Nos. 50-373 and 50-374

Subject: Response to Request for Additional Information Related to Technical
Specification 3.8.3, "Diesel Fuel Oil and Starting Air"
(TAC Nos. MD8674 and MD8675)

Reference: Letter from P. R. Simpson (Exelon Generation Company, LLC) to U. S. NRC,
"Request for a License Amendment to Technical Specification 3.8.3, 'Diesel Fuel
Oil and Starting Air' to Relocate Stored Fuel Oil Volumes to Licensee Control,"
dated May 2, 2008

In the referenced letter, Exelon Generation Company, LLC (EGC) requested an amendment to Appendix A, Technical Specifications (TS), of Facility Operating License Nos. NPF-11 and NPF-18 for LaSalle County Station (LSCS), Units 1 and 2. The proposed change modifies TS Section 3.8.3, "Diesel Fuel Oil and Starting Air," to replace the numerical volume requirements for stored diesel fuel oil inventory with requirements that state that volumes equivalent to seven-days and six-days of fuel oil are available. EGC requested to move the diesel fuel oil numerical volumes equivalent to seven-day and six-day supplies to the TS Bases.

During the NRC's acceptance review of the Reference document, the NRC found that additional information was required to support its review. The requested information is provided in the attachment to this letter.

The information provided in this letter does not affect the No Significant Hazards Consideration, or the Environmental Consideration provided in Attachment 1 of the original license amendment request as described in the referenced submittal.

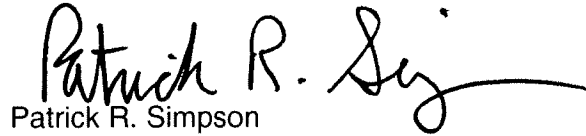
In accordance with 10 CFR 50.91(b), "State consultation," EGC is providing the State of Illinois with a copy of this letter and its attachment to the designated State Official.

There are no regulatory commitments contained within this letter. Should you have any questions concerning this letter, or require additional information, please contact Mitchel Mathews at (630) 657-2819.

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I declare under penalty of perjury that the foregoing is true and correct. Executed on the 23rd day of July, 2008.

Respectfully,

A handwritten signature in black ink, appearing to read "Patrick R. Simpson", with a long horizontal flourish extending to the right.

Patrick R. Simpson
Manager - Licensing
Exelon Generation Company, LLC

Attachment: Response to NRC Request for Additional Information

Question #1

Below Table 1 (Page 3) it is stated that "The proposed numerical volumes requirements are based on calculating the maximum required fuel consumption (lbm) over the American Petroleum Institute (API) gravity range allowed by SR 3.8.3.2 converted to a single volumetric value (gallons) at an API gravity of 30 at a nominal temperature of 60 °F." Some commercially available ULSD is in the API gravity band of 27 to 39. Provide the bases for using an API gravity of 30, and provide justification as to why it is a conservative value.

Response

Exelon Generation Company's, LLC (EGC's) calculation considered all ultra-low sulfur diesel fuel oil (ULSD) across the allowable API gravity band of 27 to 39. This evaluation determined that the maximum mass of fuel would be required when considering the properties of ULSD at an API gravity of 27 at 50 °F. Since measured fuel oil storage tank level is converted to gallons, and fuel is ordered by the gallon, the maximum required mass of fuel was converted to gallons using an API gravity of 30 at 60 °F. Figures 1 through 4 below demonstrate that for the Division 1, 2, and 3 Diesel Generators at LaSalle County Station (LSCS), there is a significant conservative margin between the Technical Specifications (TS) limits of usable fuel oil proposed in TS Bases Table B3.8.3-1, and the actual amount of usable fuel oil required to meet the associated diesel generator's safety function. Furthermore, Figures 1 through 4 show that the proposed TS limits are conservative across the entire band of API gravities allowed by the LSCS Diesel Fuel Oil Testing Program.

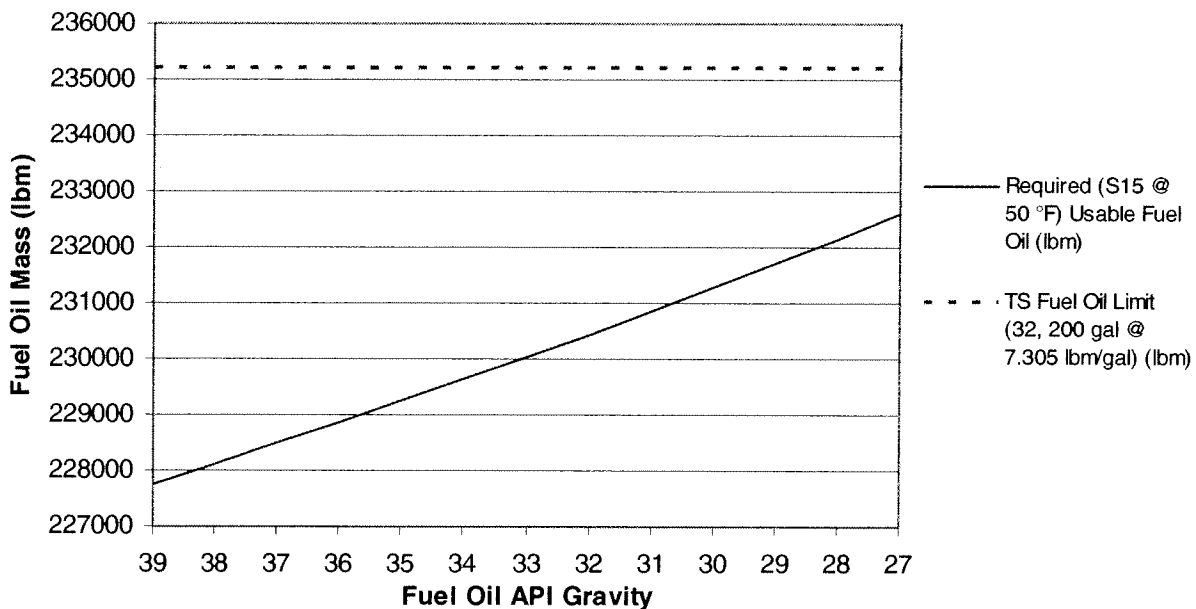


Figure 1: Division 1 and 2 Diesel Generator 7 Day Usable Fuel Oil Requirements

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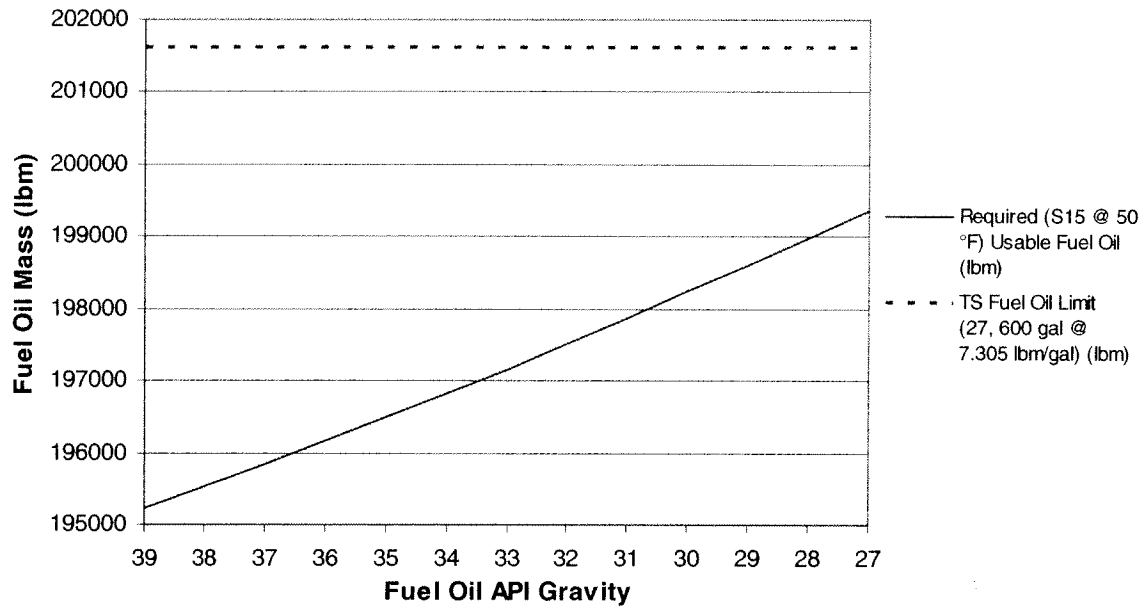


Figure 2: Division 1 and 2 Diesel Generator 6 Day Usable Fuel Oil Requirements

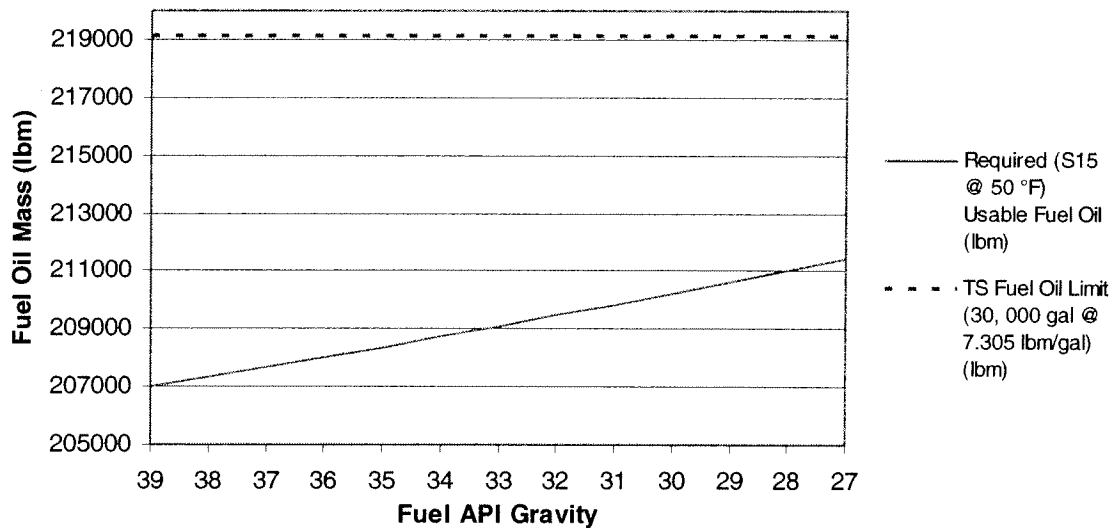


Figure 3: Division 3 Diesel Generator 7 Day Usable Fuel Oil Requirements

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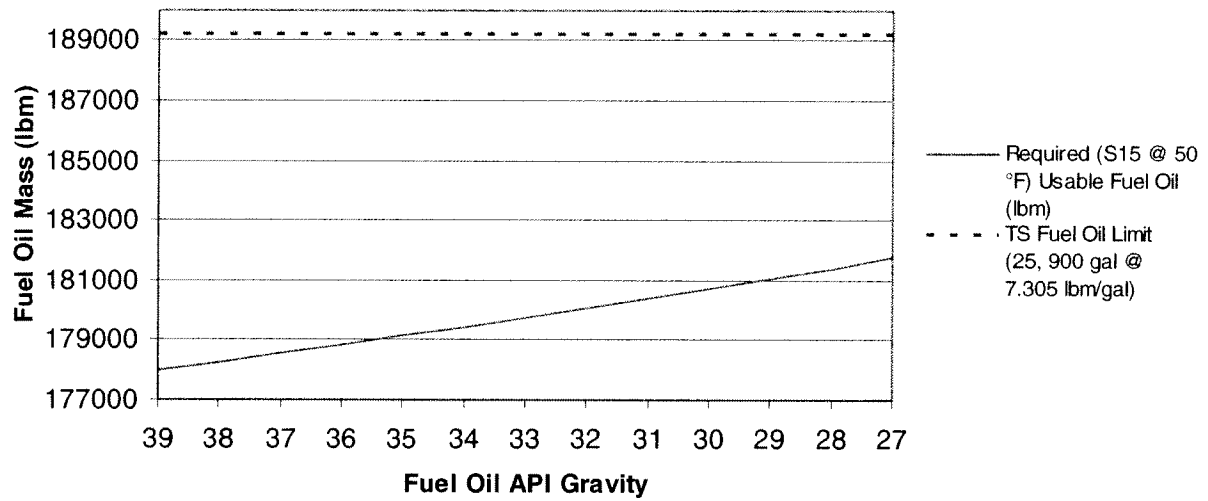


Figure 4: Division 3 Diesel Generator 6 Day Usable Fuel Oil Requirements

Question #2

In Section 3.0 (page 4 of 11) it is stated that "EGC in its evaluations used a 1% reduction in energy content for ULSD compared to the diesel fuel that was used as the basis in the design of LSCS." Provide the bases for the 1% reduction value, and provide justification as to why it is a conservative value.

Response

It is well-known that the National Bureau of Standards developed a correlation between fuel oil API Gravity and energy content in 1933. This relationship is shown in Table 1. At LSCS, required fuel oil storage values were calculated using the most limiting API gravity, and therefore the most limiting fuel energy content. As long as the fuel oil placed in the storage tanks is within the API gravity band allowed by the LSCS Diesel Fuel Oil Testing Program, the calculations of fuel consumption and required stored volume remain valid.

Table 1: Typical Gross Heat Content of Diesel Fuel from Bureau of Standards, Miscellaneous Publication No 97; Thermal Properties of Petroleum Products, April 28, 1933

API	Gross Heat Content (BTU/gal)
44	133500
42	134700
40	135800
38	137000
36	138200
34	139400
32	140600
30	141800
28	143100
26	144300
24	145600
22	146800
20	148100
18	149400
16	150700
14	152000
12	153300
10	154600

Additionally, to determine the impact of the use of ULSD or S15 at all of its nuclear stations, EGC conducted an evaluation of the heat content of ULSD. To assess the impact on heat content, or the gross heat content (higher heating value (HHV)) of S15, fuel from different regions of the United States was collected from various stations and diesel fuel oil suppliers, and analyzed using ASTM methodology. The purpose of these analyses was to determine the actual heat content of the ULSD. The results of these analyses were compared to the gross heat content of typical diesel fuel oil. Table 1 shows the gross heat content of typical fuel oil as provided by the Bureau of Standards.

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Table 2 shows the results of the heat content analyses of ULSD fuel samples from across the United States.

Table 2: Ultra-Low Sulfur Diesel Fuel Oil (S15) Sample Heat Content Results

ULSD (S15) Fuel Sample	API Gravity	S15 Gross Heat Content (BTU/Gal)	ULSD (S15) Fuel Sample	API Gravity	S15 Gross Heat Content (BTU/Gal)
1	41.8	134500	15	36.4	137471
2	38.6	136221	16	36.3	138174
3	38.1	136843	17	36.1	135833
4	37.9	136924	18	36	134619
5	37.8	137357	19	35.8	138211
6	37.8	136648	20	35.7	138700
7	37.7	137171	21	35.3	139600
8	37.7	139167	22	35.3	136023
9	37.6	138404	23	34.7	139250
10	37.5	137238	24	34.7	141394
11	37.5	133786	25	34.5	138504
12	37.4	137050	26	34	141711
13	37	137721	27	32.3	138878
14	36.4	136930	28	32.1	139763

The heat content of the samples in Table 2 was compared to typical heat content values of legacy fuels found in Table 1. This comparison is shown graphically in Figure 5 below.

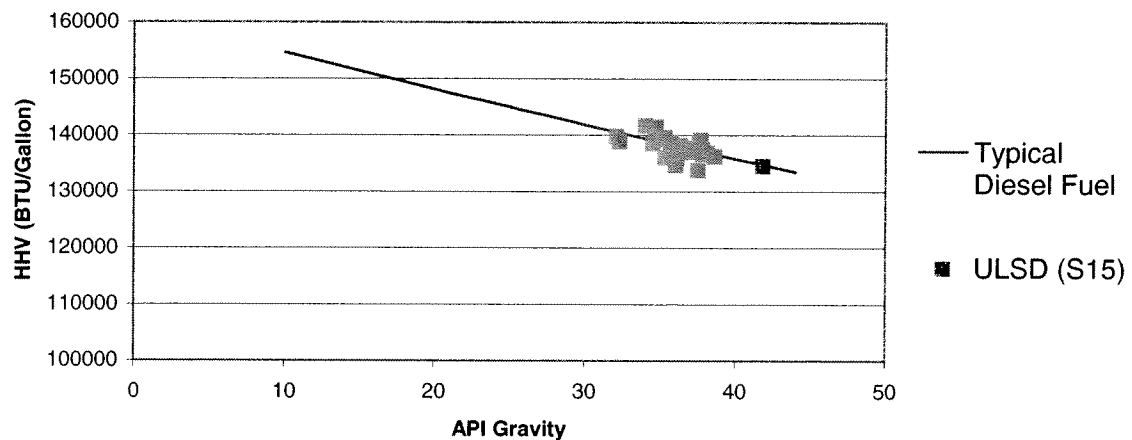


Figure 5: Typical Diesel Fuel Gross Heating Value Compared ULSD (S15) Heating Value

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The collected S15 gross heat content data shows some variations for the similar API gravity. The data scatter in Figure 5 is likely due to differences in base oil stock and refining processes among fuel oil refineries, as well as testing accuracies. The tests were performed in accordance with either ASTM D-4809 or ASTM D-240. The Table 2 data shows that the gross heat content results for all the samples as a function of API gravity is consistent with the predictions of ASTM D-4868 and NBS Publication 97 data shown in Table 1. This analysis supports the claim that the heat content of S15 fuel is only marginally different than that of the older fuels with higher sulfur content.

Moreover, literature from Exxon Mobile Corporation and BP, the preferred suppliers for the fuel oil delivered to LSCS, report that S15 fuel is expected to have approximately a 1% reduction in fuel economy caused when compared to higher sulfur content (S500) fuel. Corporate publications from Marathon Oil Corporation and Chevron Corporation confirm that a 1% reduction in fuel economy is typical (this information is available on the respective company websites). Figure 5 demonstrates that the results of analyses performed by EGC are consistent with these claims.

Question #3

In Section 4.0 (page 6 of 11) it is stated that "The TS requirements for fuel oil inventory at LSCS have been determined using fuel oil consumption rates as provided by the specific engine manufacturer." Are these fuel oil consumption rates provided by the manufacturer applicable for ULSD fuel? If so, it should be stated in the request.

Response

The diesel engines at LSCS were purchased in the late 1970s and early 1980s, and data provided by the specific engine manufacturer would not reflect the use of ULSD fuel oil. As stated in the amendment request, fuel oil consumption rates provided by the specific engine manufacturer were conservatively modified to account for a 1% reduction in fuel oil energy content to account for the use of ULSD.

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Question #4

Provide the calculation(s) that determined the fuel oil volumes in Table B3.8.3-1.

Response

The Technical Specification 3.8.3 Bases 7 day and 6 day Onsite Usable Fuel Storage Volume Requirements were determined as follows:

Division 1 and 2 EDG 7 Day Onsite Usable Fuel Storage Requirement

The new Technical Specification 3.8.3 Bases 7 day onsite usable fuel storage requirements for the Division 1 and 2 EDG is calculated as follows:

The Division 1 and 2 EDG fuel bounding required pound-mass is 247444 pounds for ULSD S15 API Gravity 27 fuel at 50 °F per Table 3 below. This is the total mass in the combined storage tank and day tank (unusable plus usable fuel mass). Table 3 states the Division 1 and 2 EDG fuel mass required to support 7 days of continuous EDG operation at rated load or rated bhp is 232600 pounds, which is the bounding usable fuel mass.

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Table 3: Total Division 1 and Division 2 Fuel Oil Consumption and Storage Requirements for API 27 through API 39 Fuel Oil at 50 °F and 122 °F

FOR S15 ULSD FUEL at 50°F											
API	SG @ 50°F	Fuel Density (lbs/gal)	HHV @ 50°F(Btu/lb)	Fuel (S15) Consumption Rate (lb/bhp-hr)	Div 1 & 2 S15 Consumption at Rated bhp for 7-day Continuous (lbs)	Div 1 & 2 S15 Consumption at Rated bhp for 7-day Continuous (gals)	Div 1 & 2 S15 Consumption at Rated bhp for 50 minutes Continuous (lbs)	Div 1 & 2 S15 Consumption at Rated bhp for 50 minutes Continuous (gals)	Div 1 & 2 Unusable Volume - Day Tank Volume	Div 1 & 2 Required Volume for S15 (gals)	Div 1 & 2 Required Weight of S15 Fuel (lbs)
40	0.8284	6.907	19725								
39	0.8333	6.947	19695	0.3721	227766	32786	1130	163	1987	34773	241570
38	0.8381	6.987	19664	0.3727	228121	32647	1132	162	1987	34634	242005
37	0.8431	7.029	19632	0.3733	228489	32506	1133	161	1987	34493	242456
36	0.8481	7.071	19601	0.3739	228862	32367	1135	161	1987	34354	242911
35	0.8532	7.113	19568	0.3745	229245	32228	1137	160	1987	34215	243379
34	0.8583	7.156	19535	0.3752	229631	32090	1139	159	1987	34077	243850
33	0.8635	7.199	19501	0.3758	230028	31952	1141	158	1987	33939	244333
32	0.8687	7.243	19467	0.3765	230430	31816	1143	158	1987	33803	244820
31	0.8741	7.288	19432	0.3772	230850	31677	1145	157	1987	33664	245330
30	0.8795	7.333	19396	0.3779	231274	31541	1147	156	1987	33528	245844
29	0.8850	7.378	19360	0.3786	231707	31405	1149	156	1987	33392	246367
28	0.8904	7.423	19323	0.3793	232143	31272	1152	155	1987	33259	246894
27	0.8961	7.471	19285	0.3800	232600	31136	1154	154	1987	33123	247444
26	0.9017	7.518	19247								
FOR S15 ULSD FUEL at 122°F											
API	SG @ 122°F	Fuel Density @ 122°F (lbs/gal)	HHV @ 122°F (Btu/lb)	Fuel (S15) Consumption Rate (lb/bhp-hr)	Div 1 & 2 S15 Consumption at Rated bhp for 7-day Continuous (lbs)	Div 1 & 2 S15 Consumption at Rated bhp for 7-day Continuous (gals)	Div 1 & 2 S15 Consumption at Rated bhp for 50 minutes Continuous (lbs)	Div 1 & 2 S15 Consumption at Rated bhp for 50 minutes Continuous (gals)	Div 1 & 2 Unusable Volume - Day Tank Volume	Div 1 & 2 Required Volume for S15 (gals)	Div 1 & 2 Required Weight of S15 Fuel (lbs)
40	0.8044	6.706	19874								
39	0.8093	6.747	19844	0.3693	226054	33505	1121	166	1987	35492	239460
38	0.8141	6.787	19814	0.3699	226394	33355	1123	165	1987	35342	239881
37	0.8191	6.829	19783	0.3705	226748	33204	1125	165	1987	35191	240317
36	0.8241	6.871	19752	0.3710	227105	33054	1127	164	1987	35041	240757
35	0.8292	6.913	19720	0.3716	227472	32904	1128	163	1987	34891	241208
34	0.8343	6.956	19688	0.3722	227842	32756	1130	162	1987	34743	241663
33	0.8395	6.999	19655	0.3729	228224	32608	1132	162	1987	34595	242131
32	0.8447	7.042	19622	0.3735	228608	32461	1134	161	1987	34448	242602
31	0.8501	7.087	19588	0.3742	229011	32312	1136	160	1987	34299	243094
30	0.8555	7.132	19553	0.3748	229418	32165	1138	160	1987	34152	243591
29	0.8610	7.178	19518	0.3755	229833	32019	1140	159	1987	34006	244096
28	0.8664	7.223	19482	0.3762	230252	31876	1142	158	1987	33863	244604
27	0.8721	7.270	19445	0.3769	230690	31730	1144	157	1987	33717	245136
26	0.8777	7.318	19408								

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The bounding usable fuel mass (ULSD API Gravity 27 fuel at 50 °F) is converted to ULSD API Gravity 30 fuel at 60 °F. This is performed by dividing the mass of ULSD API Gravity 27 fuel at 50 °F by the density of ULSD API Gravity 30 fuel at 60 °F. The fuel density of ULSD API Gravity 30 fuel at 60 °F is 7.305 pounds/gallon.

The volume of API Gravity 30 fuel at 60 °F is:

Volume (Div 1 and 2 EDG ULSD API 30 @ 60 °F) = fuel mass / density

$$\begin{aligned} &= 232600 \text{ pound} / 7.305 \text{ pound/gal} \\ &= 31841.205 \text{ gallons} \end{aligned}$$

An engineering margin of 1% is added to this volume:

Volume (Div 1 and 2 EDG ULSD API 30 @ 60 °F, with 1% margin)

$$\begin{aligned} &= 31841.205 \text{ gal} * 1.01 \\ &= 32160 \text{ gallons} \end{aligned}$$

The volume of 32160 gallons is rounded up to the next 100 gallons, which results in a volume of 32200 gallons. This volume (32200 gallons) is the new Technical Specification Bases 7 day onsite usable fuel storage requirements for the Division 1 and 2 EDG.

Division 1 and 2 EDG 6 Day Onsite Usable Fuel Storage Requirement

The new Technical Specification 3.8.3 Bases 6 day onsite usable fuel storage requirements for the Division 1 and 2 EDG is calculated as follows:

The Division 1 and 2 EDG fuel bounding required pound-mass is 214216 pounds for ULSD S15 API Gravity 27 fuel at 50 °F per Table 4. This is the total mass in the combined storage tank and day tank (unusable plus usable fuel mass). Table 4 states the Division 1 and 2 EDG fuel mass required to support 6 days of continuous EDG operation at rated load or rated bhp is 199372 pounds, which is the bounding usable fuel mass.

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Table 4: Div 1 and 2 Fuel Requirements for 6 Days EDG Operation

Determining density, fuel usage and storage at different SG and temperatures:											
For API 29.3 at 0°F the sg = 0.900 and at 150°F the sg =0.850.											
API	@ 0°F	@60°F	@150°F	sg/°F	change in sg @ 50°F	change in sg @ 122°F					
29.30	0.9000	0.88	0.8500	0.0003	0.0033	-0.0207					
To determine the HHV at different temperatures:											
API	SG @ 60°F	SG @ 50°F	SG @ 122°F	HHV @ 60°F(Btu/lb)	HHV @ 50°F(Btu/lb)	HHV @ 122°F (Btu/lb)	Fuel Density @ 50°F (lbs/gal)	Fuel Density @ 122°F (lbs/gal)			
40	0.8251	0.8284	0.8044	19750	19725	19874	6.907	6.706			
39	0.8300	0.8333	0.8093	19715	19694	19844	6.947	6.747			
30	0.8762	0.8795	0.8555	19420	19396	19553	7.333	7.132			
29	0.8817	0.8850	0.8610	19385	19360	19518	7.378	7.178			
28	0.8871	0.8904	0.8664	19350	19323	19482	7.423	7.223			
27	0.8928	0.8961	0.8721	19310	19285	19445	7.471	7.270			
26	0.8984	0.9017	0.8777	19270	19247	19408	7.518	7.318			
API	SG	Fuel Density (lbs/gal)	HHV @ 50°F(Btu/lb)	Consumpt. Rate @50°F (lb/bhp-hr)	Div 1&2 Consumption @ Rated bhp @ 50°F for 6-day Continuous (lbs)	Div 1&2 Consumption @ Rated bhp @ 50°F for 6-day Continuous (gals)	Div 1&2 Consumption @ Rated bhp @ 50°F for 50 min. Continuous (lbs)	Div 1&2 Consumption @ Rated bhp @50°F 50 min.Cont. (gals)	Div 1&2 Unusable Vol. @ 50°F-Day Tank Vol.(gals)	Div 1&2 Required Vol @ 50°F (gals)	Div 1&2 Required Wt @ 50°F Fuel (lbs)
FOR S500 FUEL @ 50°F											
30	0.8795	7.333	19396	0.3741	196272	26767	1136	155	1987	28754	210842
27	0.8961	7.471	19285	0.3763	197398	26423	1142	153	1987	28410	212242
FOR S15 ULSD FUEL at 50°F											
27	0.8961	7.471	19285	0.3800	199372	26688	1154	154	1987	28675	214216
FOR S15 ULSD FUEL at 122°F											
39	0.8093	6.747	19844	0.3693	193764	28717	1121	166	1987	30704	207171

The bounding usable fuel mass (ULSD API Gravity 27 fuel at 50 °F) is converted to ULSD API Gravity 30 fuel at 60 °F. This is performed by dividing the mass of ULSD API Gravity 27 fuel at 50 °F by the density of ULSD API Gravity 30 fuel at 60 °F. The fuel density of ULSD API Gravity 30 fuel at 60 °F is 7.305 pounds/gallon.

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The volume of API Gravity 30 fuel at 60 °F is:

Volume (Div 1 and 2 EDG ULSD API 30 @ 60 °F) = fuel mass / density

= 199372 pound / 7.305 pound/gal

= 27293 gallons

An engineering margin of 1% is added to this volume:

Volume (Div 1 and 2 EDG ULSD API 30 @ 60 °F, with 1% margin) = 27293 gal * 1.01

= 27566 gallons

The volume of 27566 gallons is rounded up to the next 100 gallons, which results in a volume of 27600 gallons. This volume (27600 gallons) is the new Technical Specification Bases 6 day onsite usable fuel storage requirements for the Division 1 and 2 EDG.

Division 3 EDG 7 Day Onsite Usable Fuel Storage Requirement

The new Technical Specification 3.8.3 Bases 7 day onsite usable fuel storage requirements for the Division 3 EDG is calculated as follows:

The Division 3 fuel bounding pound-mass is 212813 pounds for ULSD S15 API Gravity 27 fuel at 50 °F per Table 5. This is the total mass in the combined storage tank and day tank (unusable plus usable required fuel mass). Table 5 states the Division 3 EDG fuel mass required to support 7 days of continuous EDG operation at maximum expected load profile is 211431 pounds, which is the bounding usable fuel mass.

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Table 5: Total Division 3 ULSD Fuel Oil Consumption and Storage Requirements for API 27 through API 39 Fuel Oil at 50 °F and 122 °F

FOR S15 ULSD FUEL at 50°F													
API	SG @ 50°F	Fuel Density (lbs/gal)	HHV @ 50°F (Btu/lb)	Fuel (S15) Consumption Rate (lb/bhp-hr)	Fuel (S15) Consumption at 100% (eff 95.7%) Rated bhp and @ 50°F for 50 min (lbs)	Fuel (S15) Consumption at 100% (eff 95.7%) Rated bhp and @ 50°F for 50 min (gals)	Div3 Fuel (S15) Consumption at 100% Rated bhp and @ 50°F for 25 hrs (gals)	Div 3 Fuel (S15) Consumption at 2322 kw for 143 hrs (7days* 24hr/day -25 hrs) at 50°F (gals)	Div 3 Grand Total Fuel (S15) Consumption @ 50°F (gals)	Div 3 Grand Total Fuel (S15) Consumption @ 50°F (lbs)	Div 3 Unusable Tank Vol + Day Tank Vol (gals)	Div 3 Required Volume for S15 @ 50°F (gals)	Div 3 Required Weight of S15 @ 50°F Fuel (lbs)
40	0.8284	6.907	19725										
39	0.8333	6.947	19695	0.3721	1130	163	4879	24923	29802	207036	185	29987	208322
38	0.8381	6.987	19664	0.3727	1132	162	4858	24818	29676	207359	185	29861	208652
37	0.8431	7.029	19632	0.3733	1133	161	4837	24710	29548	207694	185	29733	208995
36	0.8481	7.071	19601	0.3739	1135	161	4817	24605	29421	208032	185	29606	209341
35	0.8532	7.113	19568	0.3745	1137	160	4796	24499	29294	208381	185	29479	209697
34	0.8583	7.156	19535	0.3752	1139	159	4775	24394	29169	208732	185	29354	210056
33	0.8635	7.199	19501	0.3758	1141	158	4755	24289	29044	209093	185	29229	210425
32	0.8687	7.243	19467	0.3765	1143	158	4735	24186	28920	209458	185	29105	210798
31	0.8741	7.288	19432	0.3772	1145	157	4714	24080	28794	209840	185	28979	211188
30	0.8795	7.333	19396	0.3779	1147	156	4694	23977	28670	210226	185	28855	211582
29	0.8850	7.378	19360	0.3786	1149	156	4673	23873	28547	210619	185	28732	211984
28	0.8904	7.423	19323	0.3793	1152	155	4654	23772	28426	211015	185	28611	212389
27	0.8961	7.471	19285	0.3800	1154	154	4633	23669	28302	211431	185	28487	212813
26	0.9017	7.518	19247										
FOR S15 ULSD FUEL at 122°F													
API	SG @ 122°F	Fuel Density @ 122°F (lbs/gal)	HHV @ 122°F (Btu/lb)	Fuel (S15) Consumption Rate (lb/bhp-hr)	Fuel (S15) Consumption at 100% (eff 95.7%) Rated bhp and @ 122°F for 50 min (lbs)	Fuel (S15) Consumption at 100% (eff 95.7%) Rated bhp and @ 122°F for 50 min (gals)	Div3 Fuel (S15) Consumption at 100% Rated bhp and @ 122°F for 25 hrs (gals)	Div 3 Fuel (S15) Consumption at 2322 kw for 143 hrs (7days* 24hr/day -25 hrs) at 122°F (gals)	Div 3 Grand Total Fuel (S15) Consumption @ 122°F (gals)	Div 3 Grand Total Fuel (S15) Consumption @ 122°F (lbs)	Div 3 Unusable Tank Vol + Day Tank Vol (gals)	Div 3 Required Volume for S15 @ 122°F (gals)	Div 3 Required Weight of S15 @ 122°F Fuel (lbs)
40	0.8044	6.706	19874										
39	0.8093	6.747	19844	0.3693	1121	166	4986	25470	30455	205481	185	30640	206729
38	0.8141	6.787	19814	0.3699	1123	165	4964	25356	30320	205790	185	30505	207045
37	0.8191	6.829	19783	0.3705	1125	165	4941	25241	30182	206111	185	30367	207375
36	0.8241	6.871	19752	0.3710	1127	164	4919	25127	30046	206435	185	30231	207707
35	0.8292	6.913	19720	0.3716	1128	163	4896	25013	29909	206769	185	30094	208048
34	0.8343	6.956	19688	0.3722	1130	162	4874	24900	29775	207106	185	29960	208393
33	0.8395	6.999	19655	0.3729	1132	162	4852	24788	29640	207452	185	29825	208747
32	0.8447	7.042	19622	0.3735	1134	161	4831	24676	29507	207802	185	29692	209105
31	0.8501	7.087	19588	0.3742	1136	160	4808	24563	29371	208169	185	29556	209480
30	0.8555	7.132	19553	0.3748	1138	160	4786	24451	29238	208539	185	29423	209858
29	0.8610	7.178	19518	0.3755	1140	159	4765	24340	29105	208915	185	29290	210243
28	0.8664	7.223	19482	0.3762	1142	158	4743	24231	28975	209296	185	29160	210632
27	0.8721	7.270	19445	0.3769	1144	157	4722	24120	28842	209694	185	29027	211039
26	0.8777	7.318	19408										

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The bounding usable fuel mass (ULSD API Gravity 27 fuel at 50 °F) is converted to ULSD API Gravity 30 fuel at 60 °F. This is performed by dividing the mass of ULSD API Gravity 27 fuel at 50 °F by the density of ULSD API Gravity 30 fuel at 60 °F. The fuel density of ULSD API Gravity 30 fuel at 60 °F is 7.305 pounds/gallon.

The volume of API Gravity 30 fuel at 60 °F is:

Volume (Div 3 EDG ULSD API 30 @ 60 °F) = fuel mass / density

$$\begin{aligned} &= 211431 \text{ pound} / 7.305 \text{ pound/gal} \\ &= 28943 \text{ gallons} \end{aligned}$$

An engineering margin of 1000 gallons is added to this volume, which complies with UFSAR Section 9.5.4.1.1.d.3:

$$\begin{aligned} \text{Volume (Div 3 EDG ULSD API 30 @ 60 °F, with margin)} &= 28943 \text{ gal} + 1000 \text{ gal} \\ &= 29943 \text{ gallons} \end{aligned}$$

The volume of 29943 gallons is rounded up to the next 100 gallons, which results in a volume of 30000 gallons. This volume (30000 gallons) is the new Technical Specification Bases 7 day onsite usable fuel storage requirements for the Division 3 EDG.

Division 3 EDG 6 Day Onsite Usable Fuel Storage Requirement

The new Technical Specification 3.8.3 Bases 6 day onsite usable fuel storage requirements for the Division 3 EDG is calculated as follows:

The Division 3 fuel bounding required pound-mass is 183137 pounds for ULSD S15 API Gravity 27 fuel at 50 °F per Table 6. This is the total mass in the combined storage tank and day tank (unusable plus usable fuel mass). Table 6 states the Division 3 EDG fuel mass required to support 6 days of continuous EDG operation at maximum expected load profile is 181755 pounds, which is the bounding usable fuel mass.

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Table 6: Div 3 Fuel requirements for 6 days EDG operation

Determining density, fuel usage and storage at different SG and temperatures (50 and 122°F)													
For API 29.3 at 0°F the sg = 0.900 and at 150°F the sg =0.850.													
API	@ 0°F	@ 60°F	@ 150°F	sg/°F	change in sg @ 50°F	change in sg @ 122°F							
29.30	0.9000	0.88	0.8500	0.0003	0.0033	-0.0207							
To determine the HHV at different temperatures.													
API	SG @ 60°F	SG @ 50°F	SG @ 122°F	HHV @ 60°F (Btu/lb)	HHV @ 50°F (Btu/lb)	HHV @ 122°F (Btu/lb)	Fuel Density @ 50°F (lbs/gal)	Fuel Density @ 122°F (lbs/gal)					
40	0.8251	0.8284	0.8044	19750	19725	19874	6.907	6.706					
39	0.8300	0.8333	0.8093	19715	19695	19844	6.947	6.747					
30	0.8762	0.8795	0.8555	19420	19396	19553	7.333	7.132					
29	0.8817	0.8850	0.8610	19385	19360	19518	7.378	7.178					
28	0.8871	0.8904	0.8664	19350	19323	19482	7.423	7.223					
27	0.8928	0.8961	0.8721	19310	19285	19445	7.471	7.270					
26	0.8984	0.9017	0.8777	19270	19247	19408	7.518	7.318					
API	SG @ 50°F	Fuel Density (lbs/gal)	HHV @ 50°F (Btu/lb)	Fuel (S500) Consumption Rate @ 50F (lb/bhp-hr)	Div3 Fuel Cons @ 100% (eff 95.7%) Rated bhp @ 50°F for 50 min (lbs)	Div3 Fuel Cons @ 100% (eff 95.7%) Rated bhp @ 50°F for 50 min (gals)	Div 3 Fuel Cons. @ 100% Rated bhp @ 50°F for 25 hrs (gals)	Div 3 Fuel Cons @ 2322 kw for 119 hrs (6 dys* 24 hr -25 hrs) @50F (gals)	Div 3 Grand Total Fuel Consumption @ 50F (gals)	Div 3 Grand Total Fuel Consumption @ 50F (lbs)	Div3 Unusable Tk Vol - Day Tk Vol (gals)	Div 3 Required Vol @ 50°F (gals)	Div 3 Required Weight @ 50°F (lbs)
FOR S500 FUEL @ 50°F													
30	0.8795	7.333	19396	0.3741	1136	155	4647	19755	24402	178930	185	24587	180286
27	0.8961	7.471	19285	0.3763	1142	153	4587	19501	24089	179956	185	24274	181338
FOR S15 ULSD FUEL at 50°F													
27	0.8961	7.471	19285	0.3800	1154	154	4633	19696	24330	181755	185	24515	183137
FOR S15 ULSD FUEL at 122°F													
39	0.8093	6.747	19844	0.3693	1121	166	4986	21195	26181	176640	185	26366	177888

The bounding usable fuel mass (ULSD API Gravity 27 fuel at 50 °F) is converted to ULSD API Gravity 30 fuel at 60 °F. This is performed by dividing the mass of ULSD API Gravity 27 fuel at 50 °F by the density of ULSD API Gravity 30 fuel at 60 °F. The fuel density of ULSD API Gravity 30 fuel at 60 °F is 7.305 pounds/gallon.

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The volume of API Gravity 30 fuel at 60 °F is:

Volume (Div 3 EDG ULSD API 30 @ 60 °F) = fuel mass / density

= 181755 pound / 7.305 pound/gal

= 24881 gallons

An engineering margin of 1000 gallons is added to this volume, which complies with UFSAR Section 9.5.4.1.1.d.3:

Volume (Div 3 EDG ULSD API 30 @ 60 °F, with margin) = 24881 gal + 1000 gal

= 25881 gallons

The volume of 25881 gallons is rounded up to the next 100 gallons, which results in a volume of 25900 gallons. This volume (25900 gallons) is the new Technical Specification Bases 6 day onsite usable fuel storage requirements for the Division 3 EDG, and is provided in Table 7 below.

Table 7: Div 1, 2, and 3 EDG New Technical Specification 3.8.3 Bases Onsite Usable Fuel Oil Volume

EDG	Seven-day Usable Fuel Supply (New)	Six-day Usable Fuel Supply (New)
Division 1 and 2	32200 gallons	27600 gallons
Division 3	30000 gallons	25900 gallons