

Whelan - Recalculated Emissions

Table 2. Gerald Whelan Energy Center - reported emissions

Unit	SO ₂ Emissions (tons per year)					
	2013	2014	2015	2016	2017	2018
1	1,587	1,439	2,301	1,579	1,828	1,776
2	546	692	598	440	446	1,052
Total	2,133	2,131	2,899	2,019	2,274	2,828
Average (2013-2015)	2,388					
Average (2016-2018)				2,374		

Recalculated Emissions - Method 1

This method uses average ratios of SO₂:operating time, SO₂:gross load, and SO₂:heat input from 2012-2018/2016-2018 (excluding 2018 Q4) to calculate SO₂ emissions for 2018 Q4

	Operating time (hr)	Gross Load (MW-hr)	Heat Input (mmBTU)	SO ₂ (tons)	SO ₂ tons/hr operating	SO ₂ tons/MW- hr	SO ₂ lbs/mmBtu
2018 Q4	2208	390512	3894703				
Recalculated 2018 Q4 SO₂ emissions (tons) using averages				AVG			
using 2012-2018 quarterly data*	178	180	187	182	0.080730	0.000462	0.095888
using 2016-2018 quarterly data*	169	187	192	182	0.076364	0.000478	0.098518

*2018 Q4 excluded

If we use the recalculated emissions average of 182 tons in the 2018 emission calculations

2018 Q4 reported	687
recalculated 2018 Q4	-182
Difference	505 tons

2018 Unit 2 Annual Emissions (recalculated)

1,052 - 505

547

2018	
1,776 + 547	2,323
2016-2018 average	
(2019 + 2274 + 2323)/3	2,205

Table 2. Gerald Whelan Energy Center - recalculated emissions (method 1)						
Unit	SO ₂ Emissions (tons per year)					
	2013	2014	2015	2016	2017	2018
1	1,587	1,439	2,301	1,579	1,828	1,776
2	546	692	598	440	446	547
Total	2,133	2,131	2,899	2,019	2,274	2,323
Average (2013-2015)	2,388					
Average (2016-2018)				2,205		

2018 recalculated emissions show a **2.2%** increase over 2017 emissions.

2018 recalculated emissions are **2.7%** below the 2013-2015 average modeled emissions.

Recalculated Emissions - Method 2	
This method uses SO ₂ control efficiency from 2016 through 2018 (excluding 2018 Q4) to calculate SO ₂ emissions for 2018 Q4	

WEC1 = Whelan Unit 1

WEC2 = Whelan Unit 2

*Data Analysis: 1Q2016 thru 3Q2018 using SO₂ removal efficiency

Average Efficiency Removal	87.35	%
Total WEC2 SO ₂ Emission	1,250.70	Tons
Total WEC2/WEC1 SO ₂ Processed	10,115.80	Tons

	1,279.65		
WEC2 Calc SO ₂ Emission Based upon WEC2/WEC1 Rate	tons	Positive Error of	28.95 tons
WEC2 4Q2018SO ₂ Processed	1,594.72	Tons of SO ₂	
WEC2 4Q2018 Potentially Removed	87.35	% Removal	
Estimated 4Q2018 SO ₂ Emission	201.73	Tons of SO ₂	

**The CEM DAHS estimated 4Q2018 SO₂ Emission as 687.5 tons however based upon operating conditions the WEC2 SO₂ Emissions were calculated to be 201.7 tons a reduction of 485.8 tons.*

If we use the calculated emissions average of 202 tons in the 2018 emission calculations

2018 Q4 reported	687
calculated 2018 Q4	-202
Difference	485

2018 Unit 2 Annual Emissions (recalculated)

1,052 - 485

567

2018	
1, 776 + 567	2,343
2016-2018 average	
(2019 + 2274 + 2343)/3	2,212

Table 2. Gerald Whelan Energy Center - recalculated emissions (method 2)						
Unit	SO₂ Emissions (tons per year)					
	2013	2014	2015	2016	2017	2018
1	1,587	1,439	2,301	1,579	1,828	1,776
2	546	692	598	440	446	567
Total	2,133	2,131	2,899	2,019	2,274	2,343
Average (2013-2015)	2,388					
Average (2016-2018)				2,212		

2018 recalculated emissions show a **3%** increase over 2017 emissions.

2018 recalculated emissions are **1.9%** below the 2013-2015 average modeled emissions.

Detailed data and calculations are presented on the following pages.

Method 1

2012-2018 quarterly emissions data										
Facility Name	Unit ID	Year	Quarter	Operating Time	Gross Load (MW-h)	Heat Input (mmBtu)	SO ₂ (tons)	SO ₂ tons/hr operating	SO ₂ tons/MW-h	SO ₂ lbs/mmBtu
Whelan	2	2012	1	845	146884	1403194	68	0.08	0.000463	0.0968562
Whelan	2	2012	2	1047	192165	1828522	140	0.13	0.000729	0.1532407
Whelan	2	2012	3	1812	368048	3509664	172	0.09	0.000467	0.0978777
Whelan	2	2012	4	2145	402268	3930738	166	0.08	0.000414	0.0847128
Whelan	2	2013	1	1911	373741	3640730	168	0.09	0.000449	0.0922381
Whelan	2	2013	2	2046	401571	4039282	196	0.10	0.000489	0.0972801
Whelan	2	2013	3	2136	428167	4359324	205	0.10	0.000478	0.093849
Whelan	2	2013	4	1431	279836	2624615	123	0.09	0.000440	0.0938431
Whelan	2	2014	1	2116	417305	3899976	178	0.08	0.000426	0.0911477
Whelan	2	2014	2	1707	314627	3038449	157	0.09	0.000498	0.1030552
Whelan	2	2014	3	2134	383019	3785109	166	0.08	0.000432	0.0874654
Whelan	2	2014	4	1322	237204	2188581	98	0.07	0.000411	0.0891893
Whelan	2	2015	1	1541	256844	2336254	72	0.05	0.000279	0.0613204
Whelan	2	2015	2	2184	401818	3669078	127	0.06	0.000315	0.0689885
Whelan	2	2015	3	2208	413092	3829526	157	0.07	0.000380	0.0820112
Whelan	2	2015	4	629	100126	949312	53	0.08	0.000532	0.1122076
Whelan	2	2016	1	2184	346146	3257464	142	0.07	0.000411	0.0873403
Whelan	2	2016	2	866	141628	1297049	71	0.08	0.000502	0.1097137
Whelan	2	2016	3	2205	385658	3522962	154	0.07	0.000400	0.0875922
Whelan	2	2016	4	906	140546	1372448	72	0.08	0.000512	0.1048506
Whelan	2	2017	1	2160	330986	3177950	149	0.07	0.000449	0.093527
Whelan	2	2017	2	1039	157951	1580968	88	0.08	0.000554	0.1107385
Whelan	2	2017	3	2073	354469	3448063	171	0.08	0.000482	0.0990759
Whelan	2	2017	4	460	73219	752408	39	0.09	0.000534	0.1039968
Whelan	2	2018	1	1958	315139	3089341	135	0.07	0.000427	0.0870969
Whelan	2	2018	2	1884	312854	3060402	152	0.08	0.000485	0.099068
Whelan	2	2018	3	1071	155845	1564778	79	0.07	0.000506	0.1006967
Averages								0.080730	0.000462	0.095888

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Attachment 1

	Operating time (hr)	Gross Load (MW-hr)	Heat Input (mmBTU)	SO ₂ (tons)	SO ₂ tons/hr operating	SO ₂ tons/MW- hr	SO ₂ lbs/mmBtu
2018 Q4	2208	390512	3894703				

Calculated 2018 Q4 SO ₂ emissions (tons) using averages				AVG			
178	180	187	182	0.080730	0.000462	0.095888	

2016-2018 quarterly emissions data										
Facility Name	Unit ID	Year	Quarter	Operating Time	Gross Load (MW-h)	Heat Input (mmBtu)	SO ₂ (tons)	SO ₂ tons/hr operating	SO ₂ tons/MW-h	SO ₂ lbs/mmBtu
Whelan	2	2016	1	2184	346146	3257464	142	0.07	0.000411	0.0873403
Whelan	2	2016	2	866	141628	1297049	71	0.08	0.000502	0.1097137
Whelan	2	2016	3	2205	385658	3522962	154	0.07	0.000400	0.0875922
Whelan	2	2016	4	906	140546	1372448	72	0.08	0.000512	0.1048506
Whelan	2	2017	1	2160	330986	3177950	149	0.07	0.000449	0.093527
Whelan	2	2017	2	1039	157951	1580968	88	0.08	0.000554	0.1107385
Whelan	2	2017	3	2073	354469	3448063	171	0.08	0.000482	0.0990759
Whelan	2	2017	4	460	73219	752408	39	0.09	0.000534	0.1039968
Whelan	2	2018	1	1958	315139	3089341	135	0.07	0.000427	0.0870969
Whelan	2	2018	2	1884	312854	3060402	152	0.08	0.000485	0.099068
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Averages								0.076364	0.000478	0.098518

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2018 Q4	2208	390512	3894703				

Calculated 2018 Q4 SO ₂ emissions (tons) using averages				AVG			
169	187	192	182	0.076364	0.000478	0.098518	

Method 2

								Excluding 2018 Q4		
Year	Quarter	WEC1 Emission Rate (lbs/mmBtu)	WEC2 Heat Input (mmBtu)	WEC2/WEC1 SO ₂ Processed (Tons)	WEC2 SO ₂ Emission (Tons)	Removal Efficiency	*Recalculated SO ₂ Emission During CEM Outage	Removal Efficiency	Unit 2 SO ₂ Emissions	Unit 2/ Unit1 processed
2016	1	0.651	3,257,464	1,060.15	142.3	86.58%		0.865774	142.3	1060.1525
	2	0.758	1,297,049	491.30	71.2	85.51%		0.8550789	71.2	491.30195
	3	0.722	3,522,962	1,272.01	154.3	87.87%		0.8786963	154.3	1272.0141
	4	0.694	1,372,449	476.08	72.0	84.88%		0.8487643	72	476.07791
2017	1	0.786	3,177,950	1,248.81	148.6	88.10%		0.8810067	148.6	1248.8096
	2	0.767	1,580,968	606.16	87.5	85.56%		0.8556491	87.5	606.16159
	3	0.745	3,448,063	1,284.88	170.8	86.71%		0.8670688	170.8	1284.8752
	4	0.914	752,408	344.00	39.1	88.63%		0.886338	39.1	344.00242
2018	1	0.825	3,089,341	1,274.14	134.5	89.44%		0.8944389	134.5	1274.1431
	2	0.892	3,060,402	1,364.39	151.6	88.89%		0.8888879	151.6	1364.3883
	3	0.887	1,564,778	693.87	78.8	88.64%		0.8864342	78.8	693.87116
	4	0.819	3,894,703	1,594.72	687.5	56.89%	201.78	Average	Total	Total
								0.873467	1250.7	10115.80

WEC1 = Whelan Unit 1

WEC2 = Whelan Unit 2

*Data Analysis: 1Q2016 thru 3Q2018 using SO₂ removal efficiency

Average Efficiency Removal	87.35	%
Total WEC2 SO ₂ Emission	1,250.70	Tons
Total WEC2/WEC1 SO ₂ Processed	10,115.80	Tons

WEC2 Calc SO₂ Emission Based upon WEC2/WEC1 Rate

1,279.65 Tons

Positive
Error of

28.95

WEC2 4Q2018 SO ₂ Processed	1,594.72	Tons of SO ₂
WEC2 4Q2018 Potentially Removed	87.35	% Removal
Estimated 4Q2018 SO ₂ Emission	201.73	Tons of SO ₂

*The CEM DAHS estimated 4Q2018 SO₂ Emissions as 687.5 tons however, based upon operating conditions, the WEC2 SO₂ Emission was calculated to be 201.7 tons - this equates to a reduction of 485.8 tons.

