ATTACHMENT B

Approved Modeling Protocol and Amendments/ Correspondence

URS

Rick Graw <rgraw@fs.fed.us>

04/25/2011 11:56 AM

To Christy Schmitt <Christy_Schmitt@urscorp.com>

cc Sunghye_Chang@URSCorp.com, Clint Bowman <clint@ecy.wa.gov>, Clint at Home <clint.bowman@comcast.net>

Subject Re: PSE Fredonia and Mt Baker Wilderness

Christy,
I spoke with Clint on Friday about the terrain between Fredonia and Mt. Baker Wilderness. As Clint denotes, there is a considerable obstacle to plume transport directly from Fredonia to Mt. Baker Wilderness imposed by the Lyman Hills. Based upon our conversation, I don't believe we have adequate tools to address plume blight for this particular scenario. As such, please forego the VISCREEN/PLUVUE analysis and simply use CALPUFF to address visibility impacts for Wilderness. However, please include a receptor grid to cover the entire Wilderness area, not just the distance beyond 50 km from PSE - Fredonia.

Best regards,

Rick Graw
Air Quality Program Manager
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rgraw@fs.fed.us

Clint Bowman <clint@ecy.wa.gov>

04/22/2011 12:00 PM

To Rick Graw <rgraw@fs.fed.us>

cc Christy Schmitt <Christy_Schmitt@urscorp.com>, Clint at Home <clint.bowman@comcast.net>

Subject PSE Fredonia and Mt Baker Wilderness

Rick,

Christy just pointed out to me that I'd missed the extension of the Mt Baker Wilderness Area that includes the Twin Sisters Mountain (my 6000' rock in Wednesday's email). However the Lyman Hills top 4000' and would still be sufficient to impeach VISCREEN and PLUVUE as acceptable tools. By the time the plume navigates around the

Lyman Hills, it will have traveled more than 50 km and the circuitous route would suggest that a puff model would be more appropriate.

Do we wish to rethink our approach?

And, yes, I am waiting for the more complete puff model with radiative transfer incorporated in it. Actually, the computer graphics community had a pretty good approach about five years ago. But I haven't seen any development lately.

Clint

--

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Sunghye_Chang@URSCorp.com

11/23/2010 07:23 AM

To Rick Graw <rgraw@fs.fed.us>
cc Christy_Schmitt@URSCorp.com, Stephen_Barnard@URSCorp.com
Subject CALPUFF question (PSE-Fredonia)

Good Morning Rick,

I have several questions regarding CALPUFF modeling analysis for PSE-Fredonia project. We are going by FLAG2010 only and were told that you specifically agreed that CALPUFF version 5.8 (EPA approved version for regulatory purpose) is ok to keep using it.

1. For visibility analysis, the current EPA-approved CALPOST version 5.8 (v 5.6394) does not have option for the new FLAG 2010 (MVISBK = 8 and M8_MODE =5). However, the most updated CALPOST version 6 (which is not EPA-approved) (CALPOST v 6.221) has this option in it. Does FS allow us to use the version 6 of CALPOST while we stay to use the EPA approved version (5.8) for all the other CALMET/CALPUFF/CALPOST? Otherwise, what would be the right approach to apply the new FLAG 2010 MVISBK option?

2. For Mount Baker Wilderness Area, we will need the values correspondent to the Table 6 through Table 9 in the new FLAG 2010.
These are
- Annual average natural conditions - concentrations and Rayleigh scattering
-Monthly relative humidity adjustment factors of large ammonium sulfate and ammonium nitrate
-Monthly relative humidity adjustment factors of small ammonium sulfate and ammonium nitrate
-Monthly relative humidity adjustment factors of sea salt

3. The FLAG 2010 specifically mentioned that application requires an estimate of natural visibility conditions (See first sentence of section 3.3.5). However, the natural visibility conditions will be addressed in the CALPOST output if we use Version 6 CALPOST when the model calculates the changes in light extinction (delta B ext). Do we have to present the natural visibility condition separately in the report?

4. Just need confirmation. 98th percentile change in light extinction means the 7th largest daily light extinction that model predict. Is it correct?

Thank you and have a safe and happy Thanksgiving!

Sunghye Chang, Ph.D, P.E.
Environmental Engineer

URS Corporation
400 Northpark Town Center

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Rick Graw <rgraw@fs.fed.us>

11/23/2010 01:03 PM

To Sunghye_Chang@URSCorp.com
cc Christy_Schmitt@URSCorp.com, Stephen_Barnard@URSCorp.com
Subject Re: CALPUFF question (PSE-Fredonia)

Sunghye,
Good questions.

1. Yes, for visibility analysis, please use CALPOST Version v6.221 which incorporates the MVISBK = 8, M8_Mode = 5. CALPOST v6.221 is fully compatible with the EPA regulatory CALPUFF system (v5.8), but is not intended as an endorsement of the Version 6 of CALPUFF.
2. For Mount Baker Wilderness Area, please use the values representative of North Cascades National Park, as its the closest representative IMPROVE monitoring site.
3. In your modeling report, you may refer to the method, th FLAG2010 guidance, and specific values you selected for CALPOST input used to calculate the natural background conditions. A discussion of natural conditions beyond this is unneccesary.
4. Since the model calcualtes 365 daily visibility impacts at each receptor in the Class I area for each year (except for a leap year), the 98th percentile is the 8th highest value.

Best regards,

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Rick Graw <rgraw@fs.fed.us>

11/10/2010 08:58 AM

To Christy_Schmitt@URSCorp.com

cc

Subject Re: FLAG - Q/D for sources w/ intermittent operation

Christy,
Admittedly, this is confusing. The key point is to recognize that visibility impacts are immediate and short-term. The example in FLAG 2010 starts with a permitted annual emission rate, and then adjusts back upwards to calculate the emissions as would occur if emitted 8760 hrs/yr.

I recommend not starting with annual emissions in the Q/D calculation. Rather start with the worst-case 24-hour emissions rate of haze-causing pollutant (NOx, SO2, H2SO4, and PM10) expressed in units of lbs/hr, then multiply this by 8760 hrs/2000 lbs. to obtain the equivalent emission rate expressed in tons per year and use that value as Q in the Q/D calculation.

Hope this helps.

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Christy_Schmitt@URSCorp.com

11/09/2010 05:43 PM

To rgraw@fs.fed.us

cc

Subject FLAG - Q/D for sources w/ intermittent operation

Hi Rick - I'm back to reading the FLAG guidance with this option for looking at sources that operate less than full time. I don't know why I couldn't pick this out on the phone today???

Last paragraph of Section 3.3:

In cases where a source's operations which generate visibility-affecting emissions are limited to time periods shorter than a year, the short-term potential to impact visibility may not be adequately expressed by the Q/D concept. For example, a source that is operated either seasonally or intermittently, and has zero emissions for substantial portions of a year, would have a total annual emission rate that under-represents its potential emission strength over a shorter time frame, such as a day or week. Because visibility is an air quality related value that is sensitive to immediate and short-term conditions, in order to apply the Q/D=10 screening tool, these types of sources need to first adjust the tons-per-year emissions to reflect what the emissions would be if the source operated year-round. For instance, if operations are restricted to 3,000 hours per year, then the annual steady-state-equivalent emission rate (Q) is found by multiplying the permitted total tons per year for SO2, NOx, PM10 , and H2SO4 by the ratio of hours: 8,760 hours per year/3,000 hours operation.5 Then, using this annual equivalent Q in the Q/D test, the Agencies will consider a source locating greater than 50 km and showing that its ratio of annual equivalent Q (tons per year) divided by distance from the Class I area (km) of 10 or less, as having negligible impacts with respect to Class I visibility impacts, and would not request any further Class I visibility impact analyses from such sources.

It seems like this is starting w/ annual emissions, and does NOT run the worst-case 24 hr up to the full time annual rate. Would this be applicable to our project (run times < 3000 hrs for frame unit options, and ~ 5000 hrs for the aero-derivative turbine option)? If so, can we apply it to Mt. Baker from 50km onward? Please let me know if this interpretation is incorrect.

Thanks,

Christy

Christina C. Schmitt, P.E.

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Rick Graw <rgraw@fs.fed.us>

10/13/2010 11:01 AM

To Sunghye_Chang@URSCorp.com
cc Christy_Schmitt@URSCorp.com
Subject Re: PSE Fredonia - Revised Model Protocol (Draft Addendum to Model Protocol)

Sunghye,

I suggest you move forward with the elevations you have confidence in.

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Sunghye_Chang@URSCorp.com

10/13/2010 10:39 AM

To Rick Graw <rgraw@fs.fed.us>
cc Christy_Schmitt@URSCorp.com
Subject Re: PSE Fredonia - Revised Model Protocol (Draft Addendum to Model Protocol)

Rick,

Christy and I used the Mt. Baker receptor grid that you provided and ran AERMAP/AERMOD to assess the near-field impact on the Mt. Baker WA.
After AERMAP process, Christy figured out that the base elevation that AERMAP calculated from 7.5 min DEM files (or 1 deg DEM files) are very different from the base elevation that you provided. Max absolute difference of the elevations at the same receptor location is approximately 570 meters. I double checked our conversion from LCC to UTM coordinates just to make sure the conversion was correct (it was correct and verified with lat/long again).

Could you please verify the base elevation is correct? We would like to make a decision of whether we use your elevation for CALPUFF/AERMOD, or get new elevation from DEM files.

Thank you so much for your help!

Sunghye Chang, Ph.D, P.E.
Environmental Engineer

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Rick Graw <rgraw@fs.fed.us>

Rick Graw
<rgraw@fs.fed.us>

10/08/2010 03:57 PM

To: Sunghye_Chang@URSCorp.com

cc: Christy_Schmitt@URSCorp.com

Subject: Re: PSE Fredonia - Revised Model Protocol (Draft Addendum to Model Protocol)

Sunghye,
Here's a list of receptors for the Mt. Baker Wilderness that was used on another recent PSD permit application. It is based upon an LCC coordinate system using the same reference latitude and longitude, and false easting and northing, and matching parallels, and uses a NWS-84 datum. Of course, though the reference point (SW corner) of the grid is different, but the grid spacing is the same. You'll have to convert the coordinates to match your reference coordinate system. This grid used X = -320 km, and Y = -364 km.

Ozone file is to follow soon.

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Sunghye_Chang@URSCorp.com

10/07/2010 11:29 AM

To Rick Graw <rgraw@fs.fed.us>
cc Christy_Schmitt@URSCorp.com
Subject Re: PSE Fredonia - Revised Model Protocol (Draft Addendum to Model Protocol)

Rick,

We are using LCC coordinate in Km and Datum as NWS-84.

Please see the following coordinate for the modeling domain that we set up for CALMET.

```
Map projection for all X,Y (km)

(PMAP) Default: UTM ! PMAP = LCC !


Latitude and Longitude (decimal degrees) of projection origin

(Used only if PMAP= TTM, LCC, PS, EM, or LAZA)

(RLAT0) No Default ! RLAT0 = 49.0N !

(RLON0) No Default ! RLON0 = 121.0W !


Matching parallel(s) of latitude (decimal degrees) for projection

(Used only if PMAP= LCC or PS)

(RLAT1) No Default ! RLAT1 = 30.0N !

(RLAT2) No Default ! RLAT2 = 60.0N !


Datum-region for output coordinates

(DATUM) Default: WGS-84 ! DATUM = NWS-84 !


Reference coordinates X,Y (km) assigned to the southwest corner

of grid cell (1,1) (lower left corner of grid)

(XREFKM) No Default ! XREFKM = -350 !
```

```
(YREFKM) No Default ! YREFKM = -258 !


Cartesian grid definition

No. X grid cells (NX) No default ! NX = 117 !

No. Y grid cells (NY) No default ! NY = 85 !

Grid Spacing (km)(DGRIDKM) No default ! DGRIDKM = 4 !
```

Thank you!

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Clint Bowman <clint@ecy.wa.gov>

10/12/2010 07:38 AM

To Axel Franzmann <axel@nwcleanair.org>

cc Christy Schmitt <Christy_Schmitt@urscorp.com>, Herman Wong <wong.herman@epamail.epa.gov>

Subject Shell Meteorological Data

All,

I guess I should have more furlough days--got more done on the Shell data than have in the past several weeks. I received two phone messages yesterday, the first from Axel and then one from Christy. You two may have been recording at the same time they were that close.

Axel--thanks for the phone message about the Shell data. That's good news that it looks as if the data are PSD from sometime in the '90s. Because I expect to begin ramping up the number of required years of meteorology within a year, I'd like a decade of Q/A-Q/C but we need the years that Christy requires first.

Christy--I've forgotten which years you are planning to use. Could you "reply all" with the years so that Axel can tell his contact at Shell which years we need Q/A-Q/C first.

Herman--it looks as if we will be able to provide documentation for the Shell meteorology confirming that it is PSD quality data.

Clint

--

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Rick Graw <rgraw@fs.fed.us>

10/08/2010 02:09 PM

To Sunghye_Chang@URSCorp.com

cc Christy_Schmitt@URSCorp.com

Subject Re: PSE Fredonia - Revised Model Protocol (Draft Addendum to Model Protocol)

Sunghye,
Here's a paper explaining the rationale behind asking for the ficticious ozone site at the Alpine Lakes Wilderness.

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Rick Graw <rgraw@fs.fed.us>

10/08/2010 02:06 PM

To Sunghye_Chang@URSCorp.com

cc Christy_Schmitt@URSCorp.com

Subject Re: PSE Fredonia - Revised Model Protocol (Draft Addendum to Model Protocol)

Sunghye,
Here's the hourly ozone data file for running CALPUFF. Please add another ficticious station at the closest boundary in the Alpine Lakes Wilderness to the PSE Fredonia facility. Then copy the hourly data from Mt. Rainier National Park to this site.

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rgraw@fs.fed.us oz3state.dat

Rick Graw
<rgraw@fs.fed.us>

10/04/2010 05:03 PM

Sunghye_Chang@URSCorp.com

To

Christy_Schmitt@URSCorp.com

cc

Re: PSE Fredonia - Revised Model Protocol (Draft Addendum to Model Protocol)

Subje
ct

Sunghye,
Thank you for the summary of our conversation today. Here's the link to the PM speciation for oil-fired turbines
http://www.nature.nps.gov/air/permits/ect/ectOilFiredCT.cfm. There is no speciation that I'm aware of for Emergency Generators operating on ULSD. If all we are talking about is routine operations up to an hour in an individual day, there's no need to speciate their PM emissions.
I'm working on the O3 file and the Mt. Baker Wilderness receptors and will get those to you soon. What coordinate system and datum are you using?

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Sunghye_Chang@URSCorp.com

10/04/2010 01:05 PM

To Rick Graw <rgraw@fs.fed.us>
cc Christy_Schmitt@URSCorp.com
Subject PSE Fredonia - Revised Model Protocol (Draft Addendum to Model Protocol)

Rick,

It was good to talk with you today.
The attached is an addendum to the PSE Fredonia Modeling Protocol based upon our conversation today.
Please see if this OK to you. Once we get your OK after your review, we will send it out to everybody.

Thank you again for your help!

(See attached file: Addendum to PSE Fredonia Modeling Protocol 101004.doc)

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Rick Graw <rgraw@fs.fed.us>

Addendum to PSE Fredonia Modeling Protocol
October 4, 2010

Memo from 10/4/10 Conference Call with Rick Graw (FS) (rgraw@fs.fed.us) and Sunghye Chang (URS) and Christy Schmitt (URS).

1. The development of model inputs and options for CALMET/CALPUFF processor will be based on guidance provided in following references:
   - FLM's *Air Quality Related Values Workgroup (FLAG) Phase I Report* (December 2000);
   - *Inter-agency Working Group on Air Quality Modeling (IWAQM) Phase 2 Summary Report and Recommendations for Modeling Long Range Transport Impacts* (December 1998);
   - *Clarification on EPA-FLM Recommended Settings for CALMET* (EPA, August 31, 2009)
   - Conversation with Rick Graw on 10/4/2010.

2. Modeling domain will be specified using Lambert Conformal Conic (LCC) Projection system and include the following Class I areas and protected Class II area: North Cascade National Park, Olympic National Park, Glacier Peak Wilderness Area, Alpine Lakes Wilderness Area, and Mt. Baker Wilderness Protected Class II Area. The domain buffer will extend 50km or greater beyond the Class I and II areas being analyzed.
3. The receptors of Mt. Baker Wilderness Protected Class II area will be provided by Rick Graw for the CALPUFF modeling analysis.
4. Since Mt. Baker Wilderness Area is located both within and beyond 50 km distance from the PSE project, both VISCREEN and CALPUFF models will be utilized to analyze the Air Quality Relative Values (AQRV).
5. For CALMET, 4km resolution of MM5 will be used for the meteorological data year from 2003 to 2005.
6. CALMET options will be set up based on *Clarification on EPA-FLM Recommended Settings for CALMET* (EPA, August 31, 2009)
7. Due to the special characteristics of ozone values in high elevation sites, pseudo-ozone monitoring stations (based on Mt. Rainier data) were created and will be provided by Rick Graw. All hourly ozone monitoring data in the region will also be provided by Rick Graw.
8. Either 10 ppb or 17 ppb of monthly background ammonia concentration will be utilized in the analysis.
9. The regulatory options (MDISP = 3) and visibility calculation Method (MVISBK = 2 and RHMAX = 95%) will be used for CALPUFF analysis.
10. For the turbine options on natural gas, PM and SO2 will be speciated based on NPS Particulate Matter Speciation method for "Gas-Fired Combustion Turbines".

11. For the turbine options on ULSD, PM will be speciated based on NPS Particulate Matter Speciation method for "Oil-Fired Combustion Turbines". Rick Graw will provide instruction on speciation methodology for the emergency generator (on ULSD).
12. Two scenarios may need to be modeled (turbine options on natural gas and on backup ULSD).
13. It is not necessary to include building downwash in the AQRV analyses.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

AUG 3 1 2009

OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

MEMORANDUM

SUBJECT: Clarification on EPA-FLM Recommended Settings for CALMET

TO: Regional Modeling Contacts

FROM: Tyler J Fox, Group Leader
Air Quality Modeling Group, C439-01

The purpose of this memorandum is to update the draft recommendations for CALMET settings that were provided previously with the draft *Reassessment of the Interagency Workgroup on Air Quality Modeling (IWAQM) Phase 2 Summary Report: Revisions to Phase 2 Recommendations* (EPA, 2009).

On May 15, 2009, the EPA Model Clearinghouse issued a memorandum addressing a number of issues related to the operation of the CALMET diagnostic meteorological model in regulatory modeling applications for long-range transport (LRT). Additionally, a draft version of revisions to the existing IWAQM Phase 2 guidance was released on May 27, 2009 to provide technical context for the Clearinghouse memorandum. This draft document outlined a series of recommendations for CALMET settings that were intended to facilitate the direct "pass-through" of prognostic meteorological data to the CALPUFF modeling system using the same horizontal and vertical grid structure of the parent prognostic data set. This purpose is consistent with one of our overarching goals expressed at the 8th Conference on Air Quality Modeling promoting the use of prognostic meteorological model products in regulatory dispersion modeling applications.

Due to the time sensitive nature of the Clearinghouse memorandum, it was not possible to complete extensive testing of the recommended CALMET operational settings prior to release of the memorandum and draft IWAQM reassessment report. Subsequent testing of the CALMET model with the proposed settings against mesoscale tracer databases indicates that CALMET/CALPUFF performance using the draft recommendations deteriorates somewhat in comparison to other MM5/CALMET horizontal grid configurations that were tested. Specifically, testing against the Cross-Appalachian Tracer Experiment (CAPTEX) mesoscale tracer study dataset showed that when MM5 and CALMET were run on the same horizontal grid resolution, performance was poorer than other MM5/CALMET grid configurations tested. While the performance deterioration was not drastic, it was significant. These results have caused us to reconsider our interim guidance because it is inconsistent with our desire to promote the use of both the best meteorological products and prognostic data in general. The use of

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CALMET as a vehicle to "pass-through" MM5 or other numerical weather prediction (NWP) model data is no longer considered viable.

The EPA has dedicated considerable time and resources to the evaluation of the use of NWP data in conjunction with the CALMET/CALPUFF modeling system. As discussed in the draft IWAQM reassessment report, there are technical limitations to the applicability of diagnostic wind field models that together with advances in NWP model technology and resolution make the fuller use of NWP model data an attractive alternative. The draft IWAQM reassessment document also discusses EPA's intention to transition to the full use of NWP model data rather than continue reliance upon wind fields from DWMs for LRT applications. Therefore, rather than continue to dedicate time and resources to evaluating configurations for CALMET that would facilitate a direct "pass-through" of NWP data, EPA will focus its efforts toward expediting the testing and review of its MM5/WRF-to-CALPUFF software prototype discussed at the 9th Conference on Air Quality Modeling in anticipation of an early 2010 release.

In the interim, a revised series of recommendations for CALMET settings were agreed upon during a recent meeting with modelers from EPA and the Federal Land Manager (FLM) community. Therefore, as discussed during the EPA modelers' conference call on August 19th, the EPA Model Clearinghouse is providing all of the Regional Modeling Contacts with the attached revised list of recommended switch settings for CALMET. These recommendations are based in large part upon the understanding we have developed from the numerous tracer evaluations we have conducted in addition to the collective experience of the National Park Service, Forest Service, and US Fish and Wildlife from the BART process. In general the recommendations are based upon values from the VISTAS BART modeling protocol with limited modifications based on our internal testing.

As attached, these updated recommendations supersede the recommendations from the draft IWAQM reassessment report. While the draft IWAQM recommendations intended to configure CALMET to facilitate a direct "pass-through" of MM5 data are no longer considered viable, our position regarding grid resolution presented in the May 15, 2009, Model Clearinghouse memorandum have not changed. In particular, we wish to call to your attention that in most circumstances it is considered inappropriate to consider CALMET horizontal grid resolutions of less than four (4) kilometers, consistent with our discussion in the May 15, 2009 Model Clearinghouse memorandum. It is anticipated that the FLMs will likewise require adherence to these recommendations for modeling conducted pursuant to the Class I AQRV requirements of the PSD program. In those cases, it is important to remember that the FLMs have the affirmative responsibility for AQRV related studies, and usually take the lead in negotiating the protocol for model settings (per Section 6.2.3 of the *Guideline on Air Quality Models*, Appendix W to 40 CFR Part 51).

REFERENCES

USEPA, 2009: Reassessment of the Interagency Workgroup on Air Quality Modeling (IWAQM) Phase 2 Summary Report: Revisions to Phase 2 Recommendations (Draft). EPA- EPA-454/B-09-XXX, Research Triangle Park, NC, 56 pp.

cc: Richard Wayland
Bill Harnett
Raj Rao
Dan Deroeck
Roger Brode
Bret Anderson
John Vimont
Tim Allen
John Notar
Rick Graw

EPA-FLM Recommended CALMET Input File Values

August 28, 2009

Input Group	Subgroup	Variable	Description	Default	EPA-FLM
0 - Input and output file names	a	GEODAT	Input filename of geophysical data	GEO.DAT	User defined
		SRFDAT	Input filename of hourly meteorological data	SURF.DAT	User defined
		CLDDAT	Input filename of gridded cloud data	CLOUD.DAT	
		PRCDAT	Input filename of hourly precipitation data	PRECIP.DAT	User defined
		WTDAT	Input filename of gridded fields of terrain weighting factors	WT.DAT	
		METLST	Output filename of list file	CALMET.LST	User defined
		METDAT	Output filename of generated gridded met fields	CALMET.DAT	User defined
		PACDAT	Output filename of generated gridded met files (MESEOPUFF II)	PACOUT.DAT	
		LCFILES	Convert names to upper or lower case	User defined	T
		NUSTA	Number of upper air stations	User defined	User defined (>0)
		NOWSTA	Number of over water met stations	User defined	User defined
		NM3D	Number of MM4/MM5/3D.DAT files	User defined	User defined (>0)
		NIGF	Number of coarse grid CALMET fields as initial guess fields	User defined	0
	b	UPDAT	Input filenames of upper air data	UPn.DAT (n=1,2,3...)	User defined
	c	SEADAT	Input filename of over water stations	SEAn.DAT (n=1,2,3;..)	User defined
	d	M3DDAT	Input filename of MM4/MM5/3D.DAT	MM50n.DAT	User defined
	e	IGFDAT	Input filename of IGF-CALMET files	IGFn.DAT (n=1,2,3...)	
	f	DIADAT	Input filename of preprocessed sfc/UA data	DIAG.DAT	
		PRGDAT	Input filename of prognostic gridded wind fields	PROG.DAT	
		TSTPRT	Output filename of intermediate winds, and misc...etc	TEST.PRT	

Input Group	Subgroup	Variable	Description	Default	EPA-FLM
		TSTOUT	Output filename of final wind fields	TEST.OUT	
		TSTKIN	Output filename of wind fields after kinematic winds	TEST.KIN	
		TSTFRD	Output filename of winds after Froude Number effects	TEST.FRD	
		TSTSLP	Output filename winds after slope effects	TEST.SLP	
		DCSTGD	Output filename of distance land internal variables	DCST.GRD	
1 - General run and control parameters		IBYR	Beginning year	User defined	User defined
		IBMO	Beginning month	User defined	User defined
		IBDY	Beginning day	User defined	User defined
		IBHR	Beginning hour	User defined	User defined
		IBTZ	Base time zone	User defined	User defined
		IRLG	Length of run (hours)	User defined	User defined
		IRTYPE	Output type to create	1	1
		LCALGRD	Require fields for CALGRID	T	T
		ITEST	Flag to stop run after setup phase	2	2
		MREG	Conformity to regulatory values	User defined	1
2 - Map projection and grid control parameters		PMAP	Map projection	UTM	LCC
		FEAST	False Easting at projection origin (km)	0.0	0.0
		FNORTH	False northing at projection origin (km)	0.0	0.0
		IUTMZN	UTM zone	User defined	-999
		UTMHEM	Hemisphere of UTM projection	N	N
		RLAT0	Latitude of projection origin (decimal degrees - N)	User defined	User defined
		RLON0	Longitude of projection origin (decimal degrees - W)	User defined	User defined
		XLAT1	Matching latitude for projection (decimal degrees - N)	User defined	User defined

Input Group	Subgroup	Variable	Description	Default	EPA-FLM
		XLAT2	Matching latitude of projection (decimal degrees - N)	User defined	User defined
		Datum	Datum-region of output coordinates	WGS-84	User defined
		NX	Number of east to west or X grid cells	User defined	User defined
		NY	Number of north to south or Y grid cells	User defined	User defined
		DGRIDKM	Grid spacing in kilometers (km)	User defined	User defined (≥4km)
		XORIGKM	Southwest corner of grid cell (1,1), X-coordinate (km)	User defined	User defined
		YORIGKM	Southwest corner of grid cell (1,1), Y-coordinate (km)	User defined	User defined
		NZ	Number of vertical layers	User defined	10
		ZFACE	Cell face heights in arbitrary vertical grid (ZFACE (NZ+1)) (m)	User defined	0,20,40,80,160,320, 640,1200,2000,3000, 4000
3 - Output options		LSAVE	Save met fields in unformatted file	T	T
		IFORMO	Type of unformatted output file	1	1
		LPRINT	Print met fields	F	F
		IPRINF	Print interval in hours	1	1
		IUVOUT	Layers of U, V wind components to print (IUVOUT (NZ))	NZ*0	10*0
		IWOUT	Levels of W wind component to print (IWOUT (NZ))	NZ*0	10*0
		ITOUT	Levels of 3-D temps to print (ITOUT (NZ))	NZ*0	10*0
		STABILITY	Print PGT Stability	0	0
		USTAR	Print friction velocity	0	0
		MONIN	Print Monin-Obukhov	0	0
		MIXHT	Print mixing height	0	0
		WSTAR	Print convective velocity scale	0	0
		PRECIP	Print precipitation rate	0	0

Input Group	Subgroup	Variable	Description	Default	EPA-FLM
		SENSHEAT	Print sensible heat flux	0	0
		CONVZI	Print convective mixing height (Zic)	0	0
		LDB	Print met data and internal variables)	F	F
		NN1	Test and debug print options: first time step	1	1
		NN2	Test and debug print options: last time step	1	1
		LDBCST	Test and debug print options: distance to land internal variables	F	F
		IOUTD	Test and debug print options: control variables for writing winds	0	0
		NZPRN2	Test and debug print options: number of levels starting at sfc	1	0
		IPR0	Test and debug print options: interpolated winds	0	0
		IPR1	Test and debug print options: terrain adjusted surface wind	0	0
		IPR2	Test and debug print options: smoothed wind and diverge fields	0	0
		IPR3	Test and debug print options: final wind speed and direction	0	0
		IPR4	Test and debug print options: final divergence	0	0
		IPR5	Test and debug print options: winds after Kinematic effects	0	0
		IPR6	Test and debug print options: winds after Froude No. adjustment	0	0
		IPR7	Test and debug print options: winds after slope flow	0	0
		IPR8	Test and debug print options: final winds	0	0
4 - Meteorological data options		NOOBS	No observation mode	0	0
		NSSTA	Number of surface stations	User defined	User defined (>0)
		NPSTA	Number of precipitation stations	User defined	User defined (>0)
		ICLOUD	Gridded cloud fields	0	0
		IFORMS	Surface met data file format	2	2
		IFORMP	Precipitation data file format	2	2

Input Group	Subgroup	Variable	Description	Default	EPA-FLM
		IFORMC	Cloud data format	2	2
5 - Wind field options and parameters		IWFCOD	Wind model options	1	1
		IFRADJ	Compute Froude number adjustment effects	1	1
		IKINE	Compute Kinematic effects	0	0
		IOBR	Use O'Brien procedures for adjust vertical velocity	0	0
		ISLOPE	Compute slope effects	1	1
		IEXTRP	Extrapolate sfc wind obs to upper levels	-4	-4
		ICALM	Extrapolate sfc winds even if calm	0	0
		BIAS	Surface/upper weighting factors (BIAS (NZ))	NZ*0	10*0
		RMIN2	Minimum distance for extrapolation of winds	4	-1
		IPROG	Use prognostic model winds as input to diagnostic wind model	0	14
		ISTEPPG	Timestep (hours) of prognostic model data	1	1
		IGFMET	Use coarse CALMET fields as initial guess	0	0
		LVARY	Use varying radius of influence	F	F
		RMAX1	Maximum radius of influence in surface layer (km)	User defined	100
		RAMX2	Maximum radius of influence over land aloft (km)	User defined	200
		RMAX3	Maximum radius of influence over water (km)	User defined	200
		RMIN	Minimum radius of influence in wind field interpolation (km)	0.1	0.1
		TERRAD	Radius of influence of terrain features (km)	User defined	15
		R1	Relative weight at surface of 1st guess fields and obs (km)	User defined	50
		R2	Relative weight aloft of 1st guess fields and obs (km)	User defined	100
		RPROG	Weighting factors of prognostic wind field data (km)	User defined	0
		DIVLIM	Maximum acceptable divergence	5.0E-06	5.0E-06

Input Group	Subgroup	Variable	Description	Default	EPA-FLM
		NITER	Maximum number of iterations in divergence minimum	50	50
		NSMTH	Number of passes in smoothing (NSMITH (NZ))	2, (nxnz-1)*4	2, 9*4
		NINTR2	Maximum number of stations for interpolation (NINTR2(NZ))	99	10*99
		CRITFN	Critical Froude Number	1	1
		ALPHA	Empirical factor controlling influence of kinematic effects	0.1	0.1
		FEXTR2	Multiplicative scaling factor for extrap of sfc obs to upper layers (FEXTRS(NX))	NZ*0.0	10*0
		NBAR	Number of barriers to interpolation of wind fields	0	0
		KBAR	Level (1 to NZ) up to which barriers apply	NZ	10
		XBBAR (NBAR>0)	X coordinate of beginning of each barrier (km)	User defined	0
		YBBAR (NBAR>0)	Y coordinate of beginning of each barrier (km)	User defined	0
		XEBAR (NBAR>0)	X coordinate of ending of each barrier (km)	User defined	0
		YEBAR (NBAR>0)	Y coordinate of ending of each barrier (km)	User defined	0
		IDIOPT1	Compute surface temperature	0	0
		ISURFT [b]	Sfc met station to use for sfc temp	User defined	User defined
		IDIOPT2	Domain-averaged temp lapse rate	0	0
		IUPT (IDIOPT2=0) [b]	UA station to use for the domain-scale lapse rate	User defined	User defined
		ZUPT (IDIOPT2=0)	Depth through which domain-scale lapse rate is computed (m)	200	200
		IDIOPT3	Domain-averaged wind component	0	0
		IUPWIND (IDIOPT3=0)	UA station to use for domain-scale winds	-1	-1
		ZUPWIND (IDIOPT3=0)	Bottom and top of layer thru which domain winds computed (m)	1., 1000	1., 1000
		IDIOPT4	Read observed surface wind components	0	0
		IDIOPT5	Read observed upper wind components	0	0

Input Group	Subgroup	Variable	Description	Default	EPA-FLM
		LLBREZE	Use lake breeze module	F	F
		NBOX	Number of lake breeze regions	User defined	0
		XG1	X grid line 1 defining the region of interest	User defined	0
		XG2	X grid line 2 defining the region of interest	User defined	0
		YG1	Y grid line 1 defining the region of interest	User defined	0
		YG2	Y grid line 2 defining the region of interest	User defined	0
		XBCST	X point defining the coastline (km)	User defined	0
		YBCST	Y point defining the coastline (km)	User defined	0
		XECST	X point defining the coastline (km)	User defined	0
		YECST	Y point defining the coastline (km)	User defined	0
		NLB	Number of stations in the region (sfc + upper air)	User defined	0
		METBXID	Station ID's in the region (METBXID (NLB))	User defined	0
6 - Mixing height, temperature and precipitation parameters		CONSTB	Mix ht constant: neutral, mechanical equation	1.41	1.41
		CONSTE	Mix ht constant: convective equation	0.15	0.15
		CONSTN	Mix ht constant: stable equation	2400	2400
		CONSTW	Mix ht equation: over water	0.16	0.16
		FCORIOL	Absolute value of Coriolis parameter	1.0E-04	1.0E-04
		IAVEZI	Spatial averaging of Mix ht: conduct spatial averaging	1	1
		MNMDAV	Spatial averaging of Mix ht: Max search radius (# of grid cells)	1	1
		HAFANG	Spatial avg'n of Mix ht: 0.5-angle of upwind cone for avg (deg)	30	30
		ILEVZI	Spatial averaging of Mix ht: Layer of winds used in upwind	1	1
		IMIXH	Zic Mix Ht Options: Method to compute Mix ht	1	-1

Input Group	Subgroup	Variable	Description	Default	EPA-FLM
		THRESHL	Zic Mix Ht Options: Threshold buoyancy flux reqrd to sustain over land (W/m3)	0.05	0.0
		THRESHW	Zic Mix Ht Options: Threshold buoyancy flux reqrd sustain over water (W/m3)	0.05	0.05
		ITWPROG	Zic Mix Ht Options: Overwater lapse rates used in Zic growth	0	0
		ILUOC3D	Zic Mix Ht Options: Land use category in 3D.DAT	16	16
		DPTMIN	Min potential Temp lapse rate in stable layer above Zic (deg-K/m)	0.001	0.001
		DZZI	Depth of computing capping lapse rate (m)	200	200
		ZIMIN	Minimum over land mixing height (m)	50	50
		ZIMAX	Maximum over land mixing height (m)	3000	3000
		ZIMINW	Minimum over water mixing height (m)	50	50
		ZIMAXW	Maximum over water mixing height (m)	3000	3000
		ICOARE	Over water surface fluxes methods and parameters	10	0
		DSELF	Coastal/shallow water length scale (km)	0	0
		IWARM	COARE warm layer computation	0	0
		ICOOL	COARE cool skin layer computation	0	0
		ITPROG	3D temp from obs or from prognostic data	0	0
		IRAD	Temp interpolation type	1	1
		TRADKM	Radius of influence of temp interpolation (km)	500	500
		NUMTS	Max number of stations to include in interpolation	5	5
		IAVET	Conduct spatial averaging of temp	1	1
		TGDEFB	Default temp gradient below mix ht over water (deg-K/m)	-0.0098	-0.0098
		TGDEFA	Default temp gradient above mix ht over water (deg-K/m)	-0.0045	-0.0045

Input Group	Subgroup	Variable	Description	Default	EPA-FLM
		JWAT1	Beginning land use categories for temp interpolation over water	User defined - 999	55
		JWAT2	Ending land use categories for temp interpolation over water	User defined - 999	55
		NFLAGP	Method of precipitation interpolation	2	2
		SIGMAP	Radius of influence for precipitation (km)	100	100
		CUTP	Minimum precipitation rate cutoff (mm/hr)	0.01	.01
7 -Surface meteorolo-gical station parameters		CSNAM	Station name	User defined	User defined
		IDSSTA	Station identification number	User defined	User defined
		XSSTA	X-coordinate (km)	User defined	User defined
		YSSTA	Y-coordinate (km)	User defined	User defined
		XSTZ	Time zone	User defined	User defined
		ZANEM	Anemometer height (m)	User defined	User defined
8- Upper air meteorolo-gcal station parameters		CUNAM	Station name	User defined	
		IDUSTA	Station identification number	User defined	
		XUSTA	X-coordinate (km)	User defined	
		YUSTA	Y-coordinate (km)	User defined	
		UUTZ	Time zone	User defined	
9 - Precipitation station parameters		CPNAM	Station name	User defined	User defined
		IDPSTA	Station identification number	User defined	User defined
		XPSTA	X-coordinate (km)	User defined	User defined
		YPSTA	Y-coordinate (km)	User defined	User defined

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Sunghye Chang/Atlanta/URSCorp

11/24/2010 11:56 AM

To Rick Graw <rgraw@fs.fed.us>
cc Christy_Schmitt@URSCorp.com, Stephen_Barnard@URSCorp.com
Subject Re: CALPUFF question (PSE-Fredonia) Link

Rick,

I have one more question.

In the CALPOST visibility input file, what values should I used for RHFAC for each month? I do not see that the RHFAC is specifically listed in the FLAG2010. Is it the max of RHFSML, RHFLRG, and RHFSEA?

Thank you for your help,

Sunghye Chang, Ph.D, P.E.
Environmental Engineer

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sunghye_chang@urscorp.com

Rick Graw <rgraw@fs.fed.us>

11/24/2010 10:46 AM

To Sunghye_Chang@URSCorp.com

cc Christy_Schmitt@URSCorp.com, Stephen_Barnard@URSCorp.com

Subject Re: CALPUFF question (PSE-Fredonia)

Yes, you can leave RHFAC blank.

Rick Graw
Air Resource Management Specialist
USDA Forest Service
Pacific Northwest Region
Natural Resources
P.O. Box 3623
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Tel: (503) 808-2918
rgraw@fs.fed.us

Sunghye_Chang@URSCorp.com

11/24/2010 10:27 AM

To Rick Graw <rgraw@fs.fed.us>

cc Christy_Schmitt@URSCorp.com, Stephen_Barnard@URSCorp.com

Subject Re: CALPUFF question (PSE-Fredonia)

Rick,

I think M8_MODE= 5 setting does not require the input for "RHFAC" because the option 5 just uses "RHFSML", "RHFLRG'", and "RHFSEA".
Please confirm whether I can just leave "RHFAC" as blank.

Have a happy thanksgiving!

Sunghye Chang, Ph.D, P.E.
Environmental Engineer

URS Corporation
400 Northpark Town Center

Clint Bowman <clint@ecy.wa.gov>

10/04/2010 04:33 PM

To "Ogulei, David (ECY)" <dogu461@ecy.wa.gov>

cc Rick Graw <rgraw@fs.fed.us>, "Newman, Alan (ECY)" <anew461@ecy.wa.gov>, Dee Morse <Dee_Morse@nps.gov>, Holtrop.Bryan@epamail.epa.gov, "Henderson, Joey" <Joey.Henderson@pse.com>, "Boyle, Lea M" <lea.boyle@pse.com>, Lyn Tober <ltober@nwcleanair.org>, "Adams, Nathan" <nathan.adams@pse.com>, "Chen, Qing (ECY)" <qche461@ecy.wa.gov>, Stephen_Barnard@URSCorp.com, Sunghye_Chang@URSCorp.com, William_Steiner@URSCorp.com, wong.herman@epa.gov, Christy Schmitt <Christy_Schmitt@URSCorp.com>

Subject RE: PSE Fredonia - Revised Model Protocol

Rick has done an excellent job describing the USDA Forest Service concerns and I will offer a few editorial, one policy, and a couple of technical comments.

First, on Thu, 30 Sep 2010 the EPA Administrator sign the PM2.5 Increment, SIL and SMC rule and it should appear in the Federal register by mid-month. The air quality analysis must be prepared to address them.

A couple of editorial comments:

p5-1, Section 5.1, 3rd sentence: photochemical modeling may be triggered by either VOC or NOx emissions.

p5-8, Section 5.5, second sentence: replace "it's" (it is) with "its" (possessive form).

And then a couple of technical comments:

p5-1, Section 5.1, 3rd sentence: photochemical modeling may be triggered by either VOC or NOx emissions.

p5-9, Section 5.5.1: Reference to 12 km mesoscale horizontal grid spacing is inconsistent with the proposed 4 km mesh spacing receptor grid. Because the output grid spacing of CALMET must agree with the input grid spacing of the mesoscale model, you want to begin with the 4 km mesoscale model output.

Do be sure that the analysis accompanying the application carefully spells out the startup conditions that were used. Also be specific in the description of those items that will affect the air quality analysis that are undefined at this time.

Unless David has additional comments regarding the emissions calculations, Ecology accepts the protocol.

Clint

--

Clint Bowman INTERNET:
clint@ecy.wa.gov
Air Quality Modeler INTERNET:
clint@math.utah.edu
Department of Ecology VOICE: (360)
407-6815
PO Box 47600 FAX: (360)
407-7534
Olympia, WA 98504-7600

On Mon, 4 Oct 2010, Ogulei, David (ECY) wrote:

> Rick:
>
> Thank you for the comments. Based on PSE's prompt response, I conclude
> that they are on top of it, and will work directly with you (and looping
> Ecology) to provide details of the Class I AQRV analyses.
>
> Thanks,
>
> David
>
>
> From: Christy_Schmitt@URSCorp.com [mailto:Christy_Schmitt@URSCorp.com]
> Sent: Monday, October 04, 2010 10:15 AM
> To: Rick Graw
> Cc: Newman, Alan (ECY); Bowman, Clint (ECY); Dee_Morse@nps.gov; Ogulei,
> David (ECY); Holtrop.Bryan@epamail.epa.gov; Henderson, Joey; Boyle, Lea
> M; Lyn Tober; Adams, Nathan; Chen, Qing (ECY);
> Stephen_Barnard@URSCorp.com; Sunghye_Chang@URSCorp.com;
> William_Steiner@URSCorp.com; wong.herman@epa.gov
> Subject: RE: PSE Fredonia - Revised Model Protocol
>
>
> Rick - our CALPUFF modeler (Sunghye Chang) will be contacting you in
> regards to the 'details'. We expected to be working with you on this to
> make sure it meets your needs. The revised Protocol did state that we
> would be following the old FLAG guidance, as you requested. We had been
> waiting for final project info to get started on the CALPUFF analysis,
> so we could not provide you detailed input files before. As this part of
> the analysis gets going (this week), we will provide the details in the
> modeling protocol as an addendum.
>
> Thanks,
> Christy
> _____
> Christina C. Schmitt, P.E.
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> (503) 222-4292 - fax
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>
> Rick Graw <rgraw@fs.fed.us>
>
> 10/04/2010 09:53 AM
>
> To
> "Ogulei, David (ECY)" <dogu461@ECY.WA.GOV>
>
> cc
> "Newman, Alan (ECY)" <anew461@ECY.WA.GOV>, "Bowman, Clint (ECY)"

> <cbow461@ECY.WA.GOV>, Christy_Schmitt@URSCorp.com, Dee_Morse@nps.gov,
> Holtrop.Bryan@epamail.epa.gov, "Henderson, Joey"
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> "Chen, Qing (ECY)" <qche461@ECY.WA.GOV>, Stephen_Barnard@URSCorp.com,
> Sunghye_Chang@URSCorp.com, William_Steiner@URSCorp.com,
> wong.herman@epa.gov
>
> Subject
>
> RE: PSE Fredonia - Revised Model Protocol
>
> David,
>
> The revised modeling protocol for Puget Sound Energy Fredonia is missing
> the details of the Class I area AQRV analyses. The applicant refers to
> screening threshold from the draft 2008 FLAG document. Until the new
> version of FLAG is publically released, we won't know what changes will
> occur between the draft and the final, as such, we're still following
> the 2000 guidance. Please have the applicant include a detailed protocol
> for the AQRV impact analyses for Class I areas managed by the US Forest
> Service following the FLAG 2000 guidance.
>
> Thanks.
>
> Rick Graw
> Air Resource Management Specialist
> USDA Forest Service
> Pacific Northwest Region
> Natural Resources
> P.O. Box 3623
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> Tel: (503) 808-2918
> rgraw@fs.fed.us
>
> "Ogulei, David (ECY)" <dogu461@ECY.WA.GOV>
>
> 09/28/2010 11:48 AM
>
> To
> <Christy_Schmitt@URSCorp.com>
>
> cc
> "Bowman, Clint (ECY)" <cbow461@ECY.WA.GOV>, "Newman, Alan (ECY)"
> <anew461@ECY.WA.GOV>, "Chen, Qing (ECY)" <qche461@ECY.WA.GOV>,
> <Dee_Morse@nps.gov>, <Holtrop.Bryan@epamail.epa.gov>, "Henderson, Joey"
> <Joey.Henderson@pse.com>, "Boyle, Lea M" <lea.boyle@pse.com>, "Lyn
> Tober" <ltober@nwcleanair.org>, "Adams, Nathan" <nathan.adams@pse.com>,
> "Rick Graw" <rgraw@fs.fed.us>, <William_Steiner@URSCorp.com>,
> <wong.herman@epa.gov>, <Stephen_Barnard@URSCorp.com>,
> <Sunghye_Chang@URSCorp.com>
>
> Subject
>
> RE: PSE Fredonia - Revised Model Protocol
>
> Christy,
>
> We are reviewing the revised protocol and will get back to you as soon
> as possible with our comments.
>
> Thanks,
>
> David

>
> From: Christy_Schmitt@URSCorp.com [mailto:Christy_Schmitt@URSCorp.com]
> Sent: Friday, September 24, 2010 2:44 PM
> To: Ogulei, David (ECY)
> Cc: Newman, Alan (ECY); Bowman, Clint (ECY); Dee_Morse@nps.gov;
> Holtrop.Bryan@epamail.epa.gov; Henderson, Joey; Boyle, Lea M; Blain,
> Lindsay (ECY); Lyn Tober; Adams, Nathan; Rick Graw;
> William_Steiner@URSCorp.com; wong.herman@epa.gov;
> Stephen_Barnard@URSCorp.com; Sunghye_Chang@URSCorp.com
> Subject: PSE Fredonia - Revised Model Protocol
>
> Hi David et. al. - attached Modeling Protocol for PSE's Fredonia
> project. The revisions incorporate changes/comments as requested by the
> EPA and USFS regarding the draft version, along with updated equipment
> and operating information. The Protocol also includes Attachment A
> (attached in a separate email), which has detailed emission and modeling
> information, as requested by EPA (referenced and summarized in the
> text). Also attached is a Response to EPA Comments document, which shows
> the individual responses to each of EPA's comments on the draft, as
> provided in an email dated 6/21/10 (Herman Wong to Bryan Holtrop). There
> is not a huge amount of detail included on the CALPUFF inputs (as
> requested by Rick Graw (USFS), who wanted to see example input files)
> because we have not begun this portion of the modeling. We are still in
> the process of collecting data for this, but will keep working with
> Ecology (Bowman) and USFS (Graw) as we proceed.
>
> I think I have included everybody in this email, but feel free to
> forward as necessary if I missed someone. Hopefully we can get this
> approved, and get the application in shortly thereafter. Please
> call/email w/ comments/questions. I appreciate the reviews and your
> time. Also, I am not sending Attachment A to everybody on this list
> because it might bog down your system (>7MB). If you do not receive it
> (email to follow) and want it, please let me know.
>
> Thanks,
> Christy
>
> (See attached file: Response to EPA Comments 100924.pdf)(See attached
> file: PSE-Fredonia Model Protocol 100924.pdf)
> _____
> Christina C. Schmitt, P.E.
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>
>

Christy_Schmitt@URSCorp.com

10/04/2010 11:29 AM

To "Rick Graw" <rgraw@fs.fed.us>
cc Sunghye_Chang@URSCorp.com
Subject Fw: PSE Fredonia - Revised Model Protocol

Hi Rick - email below and attachments are the REVISED Protocol.

Thanks again for giving us the time and info today. We look forward to working with you and getting this finalized.

Christy

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----- Forwarded by Christy Schmitt/Portland/URSCorp on 10/04/2010 11:23 AM -----

Clint Bowman <clint@ecy.wa.gov>

09/29/2010 01:00 PM

To Christy_Schmitt@urscorp.com

cc William_Steiner@urscorp.com

Subject Re: Fw: URS' responses to my PSE Fredonia Generating Station Modeling Protocol Comments

Christy,

I've let loose the dogs to search for the information. I can find at least four projects that have used the data but don't find the appendix (or appendix-like) write-up that Herman is looking for--it would contain an analysis of the Q/A logs and the Q/C reports. I think I recall seeing it in an application but haven't found that application yet.

I'll keep you informed as information comes in.

Clint

--

Clint Bowman INTERNET:
clint@ecy.wa.gov
Air Quality Modeler INTERNET:
clint@math.utah.edu
Department of Ecology VOICE: (360)
407-6815
PO Box 47600 FAX: (360)
407-7534
Olympia, WA 98504-7600

On Wed, 29 Sep 2010, Christy_Schmitt@urscorp.com wrote:

>
> Hi Clint - see Herman's comment below regarding met data. I know we've been
> through this before, and I have in my notes that you were going to look for
> the original audit reports for the met data, but I'm not sure whether you
> found anything or not (I never heard back, so I assumed you didn't find
> anything). Can you help a little more now??? Is there someone there that
> can track down that info? Would it be easier to go back to originator of
> data (Environ?)? Let me know if you have any good ideas on this one. It is
> a big holdup for us.
>
> Thanks,
> Christy
> _____
> Christina C. Schmitt, P.E.
> URS Corporation
> Portland, OR
>
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>
> ----- Forwarded by Christy Schmitt/Portland/URSCorp on 09/29/2010 10:09 AM
> -----
>
> "Ogulei, David (ECY)"
> <dogu461@ECY.WA.GOV>
> To
> 09/29/2010 10:05 AM <Christy_Schmitt@URSCorp.com>
> cc
> <William_Steiner@URSCorp.com>
> , <wong.herman@epa.gov>,
> "Bowman, Clint (ECY)"
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> Qing (ECY)"
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> Tober"
> <ltober@nwcleanair.org>,
> <Holtrop.Bryan@epamail.epa.go
> v>, "Rick Graw"
> <rgraw@fs.fed.us>,
> <Dee_Morse@nps.gov>
> Subject
> FW: URS' responses to my PSE
> Fredonia Generating Station
> Modeling Protocol Comments
>
>
>
>
> Christy:
>
> Below are comments from EPA Region 10.
>
> Thanks,
>
> David
>
> From: Holtrop.Bryan@epamail.epa.gov [mailto:Holtrop.Bryan@epamail.epa.gov]
> Sent: Wednesday, September 29, 2010 9:26 AM
> To: Ogulei, David (ECY)
> Cc: Wong.Herman@epamail.epa.gov
> Subject: Fw: URS' responses to my PSE Fredonia Generating Station Modeling
> Protocol Comments
>
> Hi David - See Herman Wong's comments below concerning the modeling
> protocol. Thanks, Bryan.
>
> Bryan Holtrop
> EPA Region 10
> Office of Air, Waste and Toxic
> 1200 Sixth Avenue
> Suite 900, MS AWT-107
> Seattle, WA 98101
> Tel: 206.553.4473
> Fax: 206.553.0110
>
> ----- Forwarded by Bryan Holtrop/R10/USEPA/US on 09/29/2010 09:24 AM -----

>
>
>
> From: Herman Wong/R10/USEPA/US
>
> To: Bryan Holtrop/R10/USEPA/US@EPA
>
> Date: 09/29/2010 08:39 AM
>
> Subjec URS' responses to my PSE Fredonia Generating Station Modeling
> t: Protocol Comments
>
>
>
> Bryan:
>
> 1. URS has concluded based on their preliminary analysis that
> project impacts will be below the SILs. Consequently, background air
> quality measurements, and allowable and actual emission inventories are not
> needed. This will be confirmed when an application is submitted to R10 for
> review.
>
> 2. The hourly meteorological data used in a SILs and/or refined
> modeling analysis as part of an air permit application should meet the PSD
> regulation and guidance. The conclusion by URS that the data has been
> used in a previous application and accepted by Ecology is inadequate from
> an EPA perspective. URS should justify the use of the data collected at
> the Shell refinery, Whidbey Island, Arlington Municipal Airport and
> Burlington-Skagit Regional Airport. The justification must include data
> representativeness, equipment siting and location, and data quality such
> independent audits and frequency, recovery rates, and instrument
> characteristics. They should also explain in detail why so many station
> data were necessary.
>
> An acceptable response to #2 is absolutely necessary before Item #1 can be
> found adequate.
>
> Herman

MODELING PROTOCOL FOR PUGET SOUND ENERGY FREDONIA GENERATING STATION
PROPOSED DEVELOPMENT PROJECT

MOUNT VERNON, WASHINGTON

Prepared for:

Puget Sound Energy
10885 NE 4th Street
Bellevue, Washington 98009-9734

Submitted to:

Washington State Department of Ecology
P.O. Box 47600
Olympia, Washington 98504-7600

September, 2010

URS

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(503) 222-7200 ♦ Fax (503) 222-4292
Project No. 33762289

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ATTACHMENTS

Attachment A Equipment Emission Rates and Stack Parameters

1.1 BACKGROUND

Puget Sound Energy (PSE) owns and operates the Fredonia Generating Station (FGS) at 13085 Ball Road, in Mount Vernon, Washington. The current site is approximately 43 acres and is located approximately five miles northwest of the town of Mount Vernon, south of Skagit Regional Airport. The existing FGS facility consists of two Westinghouse W501D simple cycle combustion generators, and two Pratt & Whitney Model FT-8 Twin Pac simple cycle turbines. All four turbines can be fired on either natural gas or distillate fuel. The Westinghouse turbines (Units 1 and 2) have a base load rating of 104 megawatts (MW) each, and the Pratt & Whitney turbines (Units 3 and 4) have a base load rating of 54 MW each.

The proposed Fredonia Development Project (Project) is a simple cycle electric generating unit addition to the existing FGS. The Project will consist of one or more additional gas combustion turbines totaling approximately 181-207 MW. The Project base design will consist of one of the following simple cycle turbine options:

- One GE 7FA.05 frame turbine, approximately 207 MW;
- One GE 7FA.04 frame turbine, approximately 181 MW;
- One Siemens SGT6-5000F frame turbine, approximately 197 MW; or
- Two 100 MW GE LMS100 high-efficiency aeroderivative turbines, totaling approximately 200 MW.

The purpose of the new generating unit(s) will be to serve future peak load and to potentially support the integration of wind on PSE's system. Turbine selection will be made on the basis of a commercial and technical evaluation by PSE after further engineering and procurement efforts, possibly after air permits are issued. The selected equipment's thermodynamic and environmental performance will meet or exceed the performance of the turbines analyzed for the permit application. The plant's primary fuel will be natural gas delivered to the site by the adjacent transmission pipeline owned by Cascade Natural Gas. Ultra-low sulfur (0.0015% sulfur) No. 2 distillate (ULSD) is planned as backup fuel, stored onsite in an existing 100,000 barrel tank. Back-up fuel oil will be needed/used when natural gas supply is not reasonably available. PSE anticipates that operation of the new unit(s) on ULSD will occur no more than 336 hours per year. PSE proposes to interconnect the new unit(s) to the adjacent FGS substation, which is the nearest connection point to PSE's electrical grid.

The existing facility is a major Prevention of Significant Deterioration (PSD) stationary source per 40 CFR 52.21(b)(1)(i), and operates under PSD Permit PSD-01-04, issued on July 29th, 2003, and Northwest Clean Air Agency (NWCAA) Air Operating Permit (AOP) 003-R1, issued March 7, 2005. The proposed Project is expected to be a major modification under PSD (per 40 CFR 52.21(b)(40)). Washington State Department of Ecology (Ecology) is the permitting lead for PSD, with concurrence from the regional agency, NWCAA. Separately, NWCAA will conduct a Notice of Construction (NOC) review and issue an Order of Approval for the proposed Project. At present, the project region is attainment for all criteria air pollutants. It is anticipated that this Project will be permitted prior to adoption of the Environmental Protection Agency's (EPA) proposed revised 1-hour ozone standard.

1.2 PURPOSE

This document presents a summary of the procedures to be used for the air quality dispersion modeling for Project permitting. Modeling of operating impacts will be performed per EPA and Ecology guidance. This protocol is submitted to Ecology for review and approval. Because the facility is within 100 kilometers of PSD Class I areas, Federal Land Managers (FLM's) will be included in the PSD review process for the Project. The proposed model selection and modeling approach has been based on applicable regulations and agency communications.

1.3 ORGANIZATION

The balance of this protocol is organized into the following sections: **2.0** - Project Description; **3.0** - Regulatory Setting; **4.0** - Model Selection; **5.0** - Modeling Approach; and **6.0** - Presentation of Results.

2.1 PROJECT LOCATION

The PSE facility is located at 13085 Ball Road in Mount Vernon, Skagit County, Washington (see Figure 1). The site is on south side of Ovenell Road, south of the west end of the Skagit Regional Bayview Airport, approximately 2.5 miles inland of Padilla Bay. The terrain surrounding the facility is essentially flat. The elevation of the facility is approximately 50 feet above mean sea level (MSL). There are no known sensitive receptors nearby to the facility.

2.1.1 Land Use

The region surrounding the PSE site is primarily agricultural and forest, with a few municipal and industrial facilities in the immediate vicinity, including the Skagit Regional Bayview Airport and the Paccar Technical Center, both north of the PSE facility.

2.2 DESCRIPTION OF THE PROPOSED SOURCE

As described above, the proposed Project involves the addition of a simple cycle electric generating unit(s) to the existing FGS. The Project base design will consist of one of the following simple cycle turbine options:

- One GE 7FA.05 frame turbine, approximately 207 MW;
- One GE 7FA.04 frame turbine, approximately 181 MW;
- One Siemens SGT6-5000F frame turbine, approximately 197 MW; or
- Two 100 MW GE LMS100 high-efficiency aeroderivative turbines, totaling approximately 200 MW.

The permit application, including modeling analysis, is being prepared to address each of these options. Final turbine selection will be made on the basis of a commercial and technical evaluation by PSE after further engineering and procurement efforts, possibly after air permits are issued. The selected equipment's thermodynamic and environmental performance will meet or exceed the performance of the turbines analyzed for the permit application.

The plant's primary fuel will be natural gas. Back-up fuel oil (ULSD) will be needed/used when natural gas availability at the site is low. In addition to the turbine(s), the Project may include one nominal 600 kW diesel emergency generator to supply critical electrical loads in the event power could not be back fed from either the site's 230 kV or 115 kV transmission systems. The turbine(s) would be supplied with a 125 VDC battery bank to supply a critical 120 VAC Essential Power Bus through an inverter or directly from a 125 VDC Essential Power Bus. Examples of devices needing Essential Power from one or both of these sources would be the facility's Distributed Control System (DCS), protective relays and a DC driven emergency lube oil pump. In the event of a transmission system failure and blackout of the facility, the 125 VDC and 120 VAC Essential Power Buses could be kept energized for a period of time from the 125 VDC battery bank. The frame turbine units (GE 7FA.05, GE 7FA.04, and Siemens SGT6-5000F options) would expend the battery's power quickly since they have larger, heavier components such as rotor bearings that need larger electrically driven lubricating pumps. To prevent damage to these components during a transmission system failure, an emergency generator is needed to provide power to backup the batteries. The aeroderivative units (LMS100's) have smaller, lighter

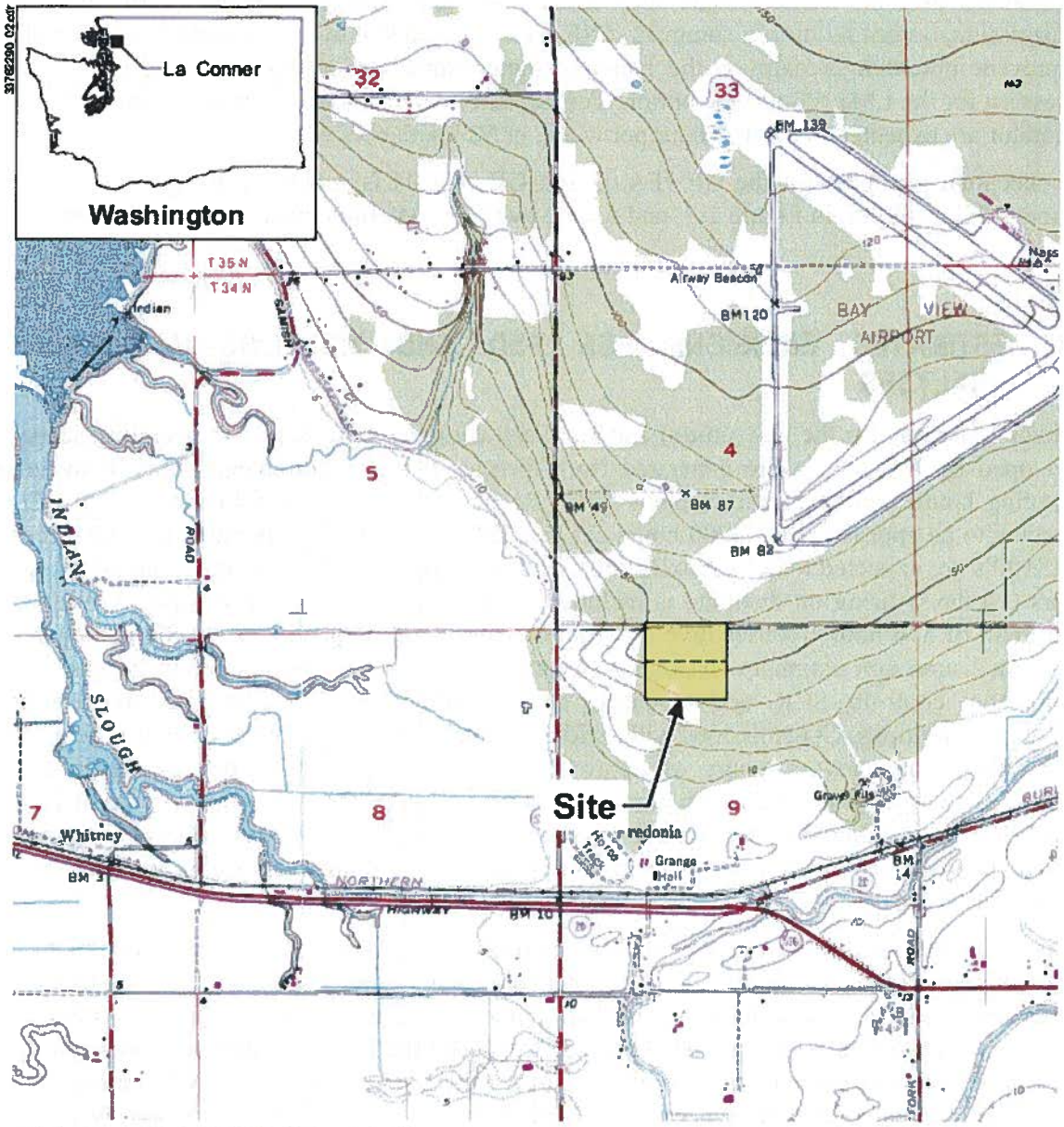
components than the frame turbine units and require less emergency power in the event of a transmission system failure. In summary, PSE feels it is prudent to have an emergency generator to prevent potential damage to the heavier single frame turbine unit options, but it is not necessary for the LMS100 turbine option. Testing and maintenance operations for the emergency generator are expected to occur 1 hour per week, or 52 hours per year.

A conceptual plot plan for the GE 7FA.05 and GE 7FA.04 is presented in Figure 2-2; for the Siemens SGT6-5000F in Figure 2-3; and for the two GE LMS100 turbine option in Figure 2-4.

2.3 ESTIMATED EMISSIONS FOR PSD AND MODELING APPLICABILITY ANALYSES

Annual emissions for the new unit(s) and auxiliary equipment are based on operating scenarios developed by PSE, and were generated from forecast power requirements. Maximum annual operating hours for the Frame turbines (GE 7FA.05, GE 7FA.04, and Siemens 5000 F4) are expected to be approximately 2700 hours per year. Maximum annual operating hours for the GE LMS100's are expected to be approximately 5500 hours per year (each unit). A maximum of 336 hours (14 days) firing on distillate is included in the annual emission estimates. A worst-case maximum of 336 hours (consecutive or nonconsecutive) firing on backup ULSD is included in the annual emission estimates. NO_x and CO emissions assume a combination of gas turbine combustion controls, SCR, and oxidation catalyst to achieve 2.5 ppm NO_x under normal operating conditions. CO emissions with oxidation catalyst controls vary for the turbine options; preliminary data show a range of approximately 2-13 ppm CO under normal operating conditions. A worst-case maximum number of start-ups and shutdowns on both natural gas and ULSD are also included in the annual estimates. Table 2-1 summarizes preliminary potential annual emission estimates for the three turbine options. Detailed emission spreadsheets are included as Attachment A.

Emissions are expected to exceed the PSD Significant Emission Rates (SER) for all project development options for particulate matter (Total Suspended Particulate (TSP), particulate matter less than 10 microns in diameter (PM_{10}), and particulate matter less than 2.5 microns in diameter ($PM_{2.5}$)). Emissions are also expected to exceed the SER for nitrogen oxides (NO_x) for the LMS100 option, and carbon monoxide (CO) for the Siemens SGT6 option. The project will require air quality evaluations in accordance with Washington Administrative Code (WAC) rules for pollutants that exceed the SER. Applicable regulations and guidelines require that the project use dispersion modeling to demonstrate compliance with applicable ambient air quality standards and PSD increments. The ambient air quality impact and increment analyses will be performed for the worst-case turbine scenarios, which will be determined for each turbine option, and for each pollutant and averaging period. The project's potential annual emissions for volatile organic compounds (VOC) and sulfur dioxide (SO_2) are not expected to exceed the SER for any turbine option.



Job No. 33762290

Figure 1
USGS Quadrangle Map

URS

Fredonia Development Project

Figure 2-1 – General Location Map

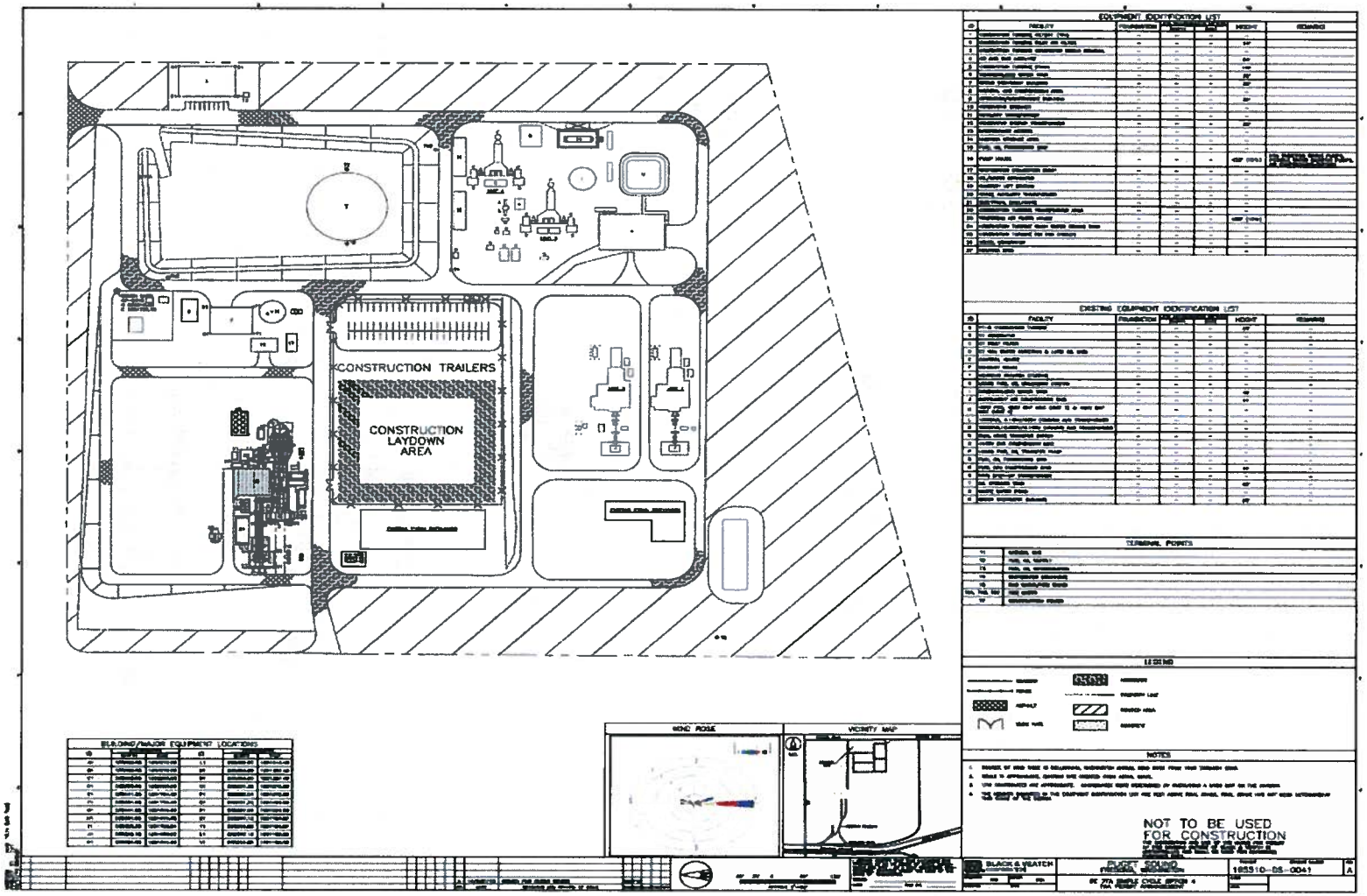


Figure 2-2 – Conceptual Turbine Site Layout for the GE 7FA.05 and GE 7FA.04

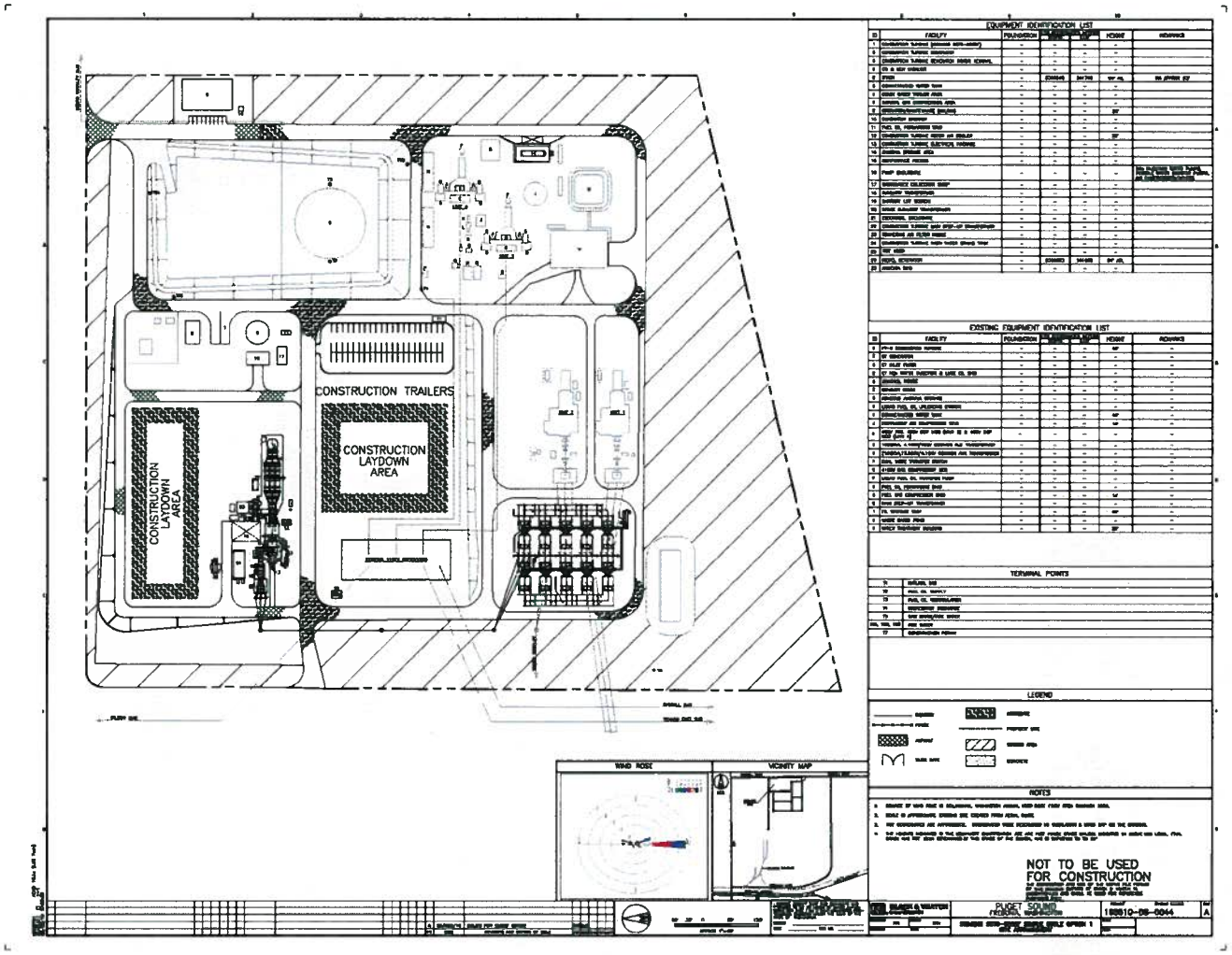


Figure 2-3 – Conceptual Turbine Site Layout for the Siemens SGT6-5000F4

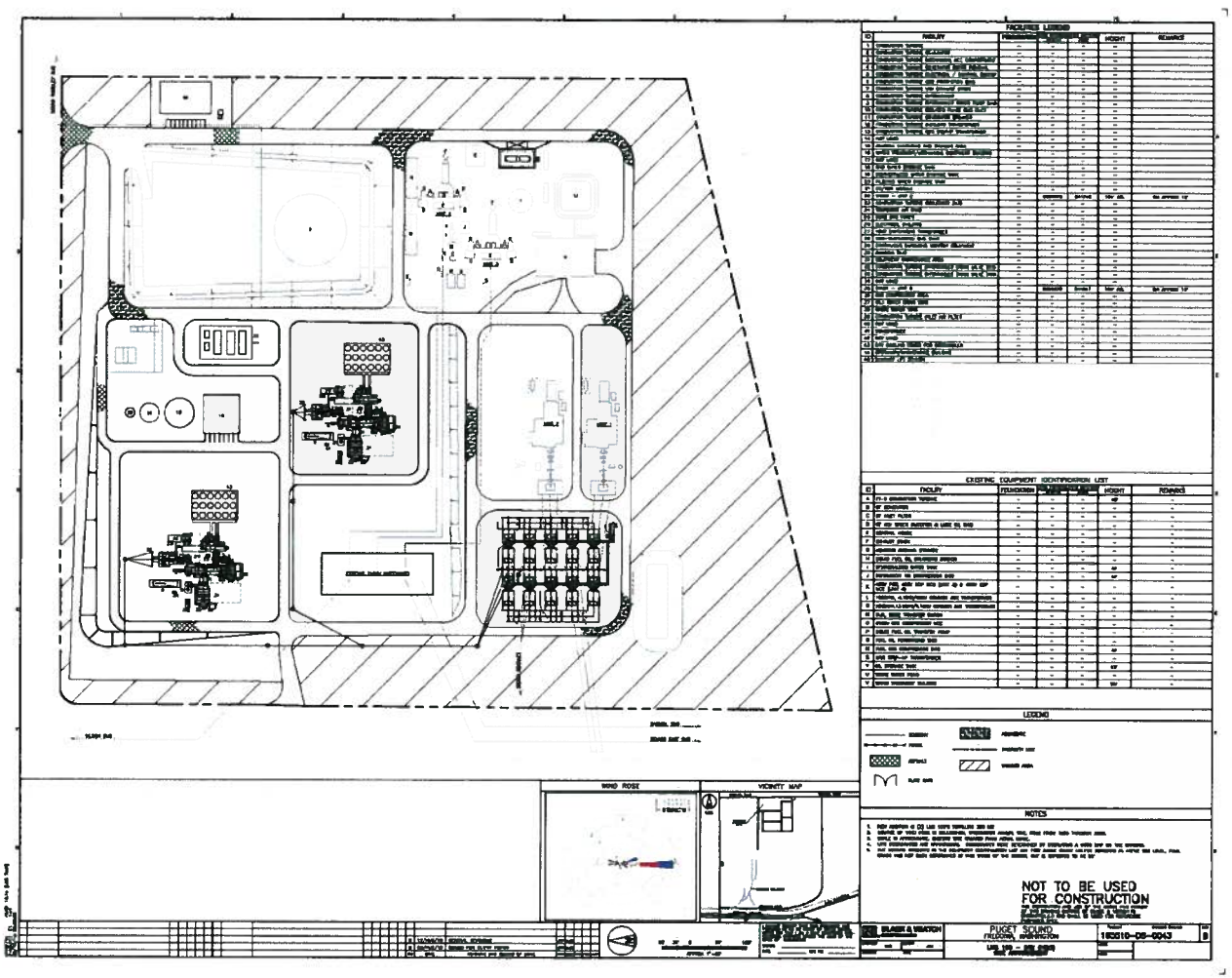


Figure 2-4 – Conceptual Turbine Site Layout for the GE LMS100

Table 2-1
Estimated Annual Emissions for the Potential Turbine Options

Pollutant	Expected Increased Emissions (tpy)				Significant Emission Rate (tpy)
	GE 7FA.05	GE 7FA.04	Siemens SGT6-5000F4	GE LMS100 (2 Units)	
NO_x	30	27	32	*48*	40
CO	43	39	*149*	54	100
SO_2	6	5	5	11	40
TSP	*41*	*42*	*31*	*74*	25
PM_{10}	*41*	*42*	*31*	*74*	15
$PM_{2.5}$	*41*	*42*	*31*	*74*	10
VOC	7	6	19	13	40
H_2SO_4	*12*	*11*	*13*	*26*	7
Pb	0.0084	.0079	0.0079	0.0045	0.6

Notes:
Emissions estimates are based on equipment vendor data (as provided by Black & Veatch) and operating scenarios provided by PSE.
Emissions estimates are inclusive of turbine and one emergency generator (frame turbine options only).
SO_2 and particulate emissions are based on historic annual average sulfur content in natural gas of 2.24 gr/100 dscf reported at the Willliams Northwest Pipeline Sumas compressor station.
Significant Emission Rate (SER) per 40 CFR 52.21(b)(23)(i) and WAC 173-400-030.
Values shown in *italic* indicate exceedance of the SER.

The proposed Project also has the potential to emit non-criteria air pollutants, known as hazardous and/or toxic air pollutants. These will also be addressed for the Project. Emissions will be compared to Washington State's Small Quantity Emission Rates (SQERs) and Acceptable Source Impact Levels (ASILs), as necessary. Non-criteria pollutant emission rates are provided in Attachment A.

3.1 REGULATORY APPLICABILITY REVIEW

As described above, Ecology is the state-level governing body for air quality in Washington. In addition, the state is divided into multiple air pollution control agencies. The Mount Vernon site is located within the NWCAA. The air pollution control agencies defer to Ecology for major source attainment permitting issues, such as PSD.

The existing facility is a PSD major source. The New Source Review (NSR) process is triggered for sources that emit emissions in excess of those listed in WAC 173-400-030 (27 – Emission Threshold), and 40 CFR 52.21(b)(23)(i). As shown above in Table 2-1, these SERs are expected to be exceeded for the facility, depending on the pollutant and option. As a result, the Project will have to go through the PSD NSR process.

Requirements for ambient air quality impact modeling to demonstrate compliance with ambient air quality standards and PSD increments include the following:

- Description of the project, including emissions, fuel type(s), control technologies, and stack characteristics;
- The basis for all emission estimates and/or calculations;
- Existing baseline data for all regulated pollutants;
- A description of the meteorological data; and
- A worst-case air quality impact assessment, including an assessment of cumulative impacts if necessary.

3.2 AMBIENT AIR QUALITY STANDARDS (AAQS)

The Clean Air Act of 1970 mandated that the EPA establish ambient ceilings for certain pollutants based upon the identifiable effects that pollutants might have on the public health and welfare. Subsequently, EPA promulgated regulations which set National Ambient Air Quality Standards (NAAQS) for SO_2, TSP, NO_2, CO, non-methane hydrocarbons (NMHC), photochemical oxidants as ozone (O_3), and lead (Pb). The standard for NMHC was eventually changed to a guideline and the ozone standard was revised. After further review, the NAAQS for NMHC was revoked in 1983. A new ambient standard to control ambient concentrations of PM_{10} was promulgated by EPA on July 1, 1987 to replace ambient standards for TSP. In 1997, EPA added standards for $PM_{2.5}$. Pollutants having NAAQS are collectively referred to as criteria pollutants.

Pursuant to the Clean Air Act and its amendments, Washington has adopted the Federal standards for some criteria pollutants, promulgated more stringent standards for others, and promulgated standards for additional pollutants. Ecology has retained the TSP air quality standard. The Federal and Washington Ambient Air Quality Standards are shown in Table 3-1.

Section 107 of the 1977 Clean Air Act Amendments required both the EPA and individual states to evaluate the attainment of the NAAQS. Areas not meeting the NAAQS are designated as non-attainment areas. For these non-attainment areas, states are required to revise their State Implementation Plan (SIP) to provide for attainment of the NAAQS as expeditiously as practical, within certain time limits. Areas lacking in sufficient data for determination of attainment or non-

Table 3-1
Federal and State Ambient Air Quality Standards

Pollutant	Averaging Period	National Standards		Washington State Standards	Details
		Primary	Secondary		
Ozone (O_3)	8-hour	0.075 ppm	0.075 ppm		The 3-year average of the 4th highest daily 8-hour maximum is not to be above this level.
	1-hour (Daily Maximum)			0.12 ppm (235 μg/m^3)	Not to be above this level on more than 1 day in a calendar year.
Particulate Matter less than 2.5 microns in diameter ($PM_{2.5}$)	Annual (Arithmetic Mean)	15.0 μg/m^3	15.0 μg/m^3		The 3-year average from a community-oriented monitor is not to be above this level.
	24-hour	35 μg/m^3	35 μg/m^3		The 3-year average of the annual 98th percentile for each population-oriented monitor within an area is not to be above this level.
Particulate Matter less than 10 microns in diameter (PM_{10})	Annual (Arithmetic Mean)			50 μg/m^3	The 3-year average of annual arithmetic mean concentrations at each monitor within an area is not to be above this level.
	24-hour	150 μg/m^3	150 μg/m^3	150 μg/m^3	Not to be above this level on more than three days over 3 years with daily sampling.
Carbon Monoxide (CO)	8-hour	9 ppm (10 mg/m^3)		9 ppm (10 mg/m^3)	Not to be above this level more than once in a calendar year.
	1-hour	35 ppm (40 mg/m^3)		35 ppm (40 mg/m^3)	Not to be above this level more than once in a calendar year.
Nitrogen Dioxide (NO_2)	Annual (Arithmetic Mean)	0.053 ppm (100 μg/m^3)	0.053 ppm (100 μg/m^3)	0.05 ppm (100 μg/m^3)	Not to be above this level in a calendar year.
	1-hour	0.100 ppm			The 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor is not to be above this level.
Sulfur Dioxide (SO_2)	Annual (Arithmetic Mean)	0.03 ppm		0.02 ppm	Not to be above this level in a calendar year.
	24-hour	0.14 ppm		0.10 ppm	Not to be above this level more than once in a calendar year.
	3-hour		0.5 ppm (1300 μg/m^3)		Not to be above this level more than once in a calendar year.
	1-hour	0.075 ppm		0.40 / 0.25 ppm	State Standards: Not to be above this level more than once in a calendar year / Not to be above this level more than twice in a consecutive 7-day period. Federal Standard: The 3-year average of the 99th percentile of the daily maximum 1-hour average at each monitor is not to be above this level.
	5-minute			0.80 ppm	This is the Northwest Clean Air Agency's standard, which applies in Island, Skagit, and Whatcom counties.
Lead (Pb)	Rolling 3-Month Average	0.15 μg/m^3	0.15 μg/m^3		Not to be above this level.
	Quarterly Average	1.5 μg/m^3	1.5 μg/m^3		
Total Suspended Particulate (TSP)	Annual (Geometric Mean)			60 μg/m^3	Not to be above this level.
	24-hour			150 μg/m^3	Not to be above this level more than once in a calendar year.

Source: EPA 40 CFR Patr 50 (http://www.epa.gov/air/criteria.html) and WAC Chapters 173-470 through 173-475 (http://www.ecy.wa.gov/laws-rules/ecywac.html#air)

attainment status are designated as unclassifiable, but are treated as being attainment areas until designated otherwise. The classification of an area is made on a pollutant specific basis. The PSE facility is located in Skagit County. Air quality throughout Skagit County is currently designated as unclassifiable or in attainment of each State and/or Federal AAQS.

3.3 AMBIENT AIR QUALITY ANALYSES

As part of the PSD permitting process, continued compliance with the State and Federal air quality standards must be demonstrated through the use of dispersion models. The modeling simulation predicts the impact of the proposed facility and, where applicable, existing background sources. To account for regional background levels and unmodeled sources of the relevant pollutants, a measured background concentration is added to the predicted concentration. This total concentration is then compared to the ambient air quality standards to assess compliance.

EPA has defined a set of impact levels that are used to determine whether a multi-source air quality impact analysis needs to be performed to assess compliance with the NAAQS. These significant impact levels (SILs), which have been adopted by Washington, are shown in Table 3-2. The SILs are generally 1 to 5 percent of the NAAQS (typically 4 percent), and are thus well below any levels which could lead to adverse health or welfare impacts. Impacts below these SILs are presumed to be insignificant. The SILs for the recently revised 24-hour $PM_{2.5}$, 1-hour NO_2, and 1-hour SO_2 standards have not yet been finalized. The values shown in Table 3-2 are conservative estimates based on current available information from EPA and recent communication with Ecology staff.

The primary purpose of comparing a proposed source's modeled concentrations with the SILs is to establish the source's significant impact area (SIA) for each pollutant and averaging period. The SIA is defined as all locations at which predicted impacts from the Project are above the SILs for the pollutant being considered. EPA and Ecology typically require an applicant to evaluate cumulative impacts of all sources at locations where predicted concentrations attributable to the proposed facility are above the SILs. If the source does not exceed the SILs, evaluation of cumulative impacts is not required. Major background sources located within 50 km of the proposed source's pollutant-specific SIA are generally modeled as part of the multi-source air quality impact analysis. Also, major sources located beyond the SIA, but which themselves have significant impacts within the SIA of the proposed source, are also included in the multi-source impact analysis. Therefore, the SILs are a regulatory tool that define procedures and are not of themselves measures of adverse health impacts. Ecology is expected to provide all applicable source information for the analysis, if required.

In addition to the SILs described above, EPA has proposed SILs for Class I areas, as shown below in Table 3-3. The FLM-recommended SILs are also shown in this table. As with the Class II areas (all areas that are *not* designated as Class I), if the source does not exceed the SILs, evaluation of cumulative impacts is not required.

For the proposed project, the impact assessment will be performed using dispersion models. The modeling approaches used for both Class I (all greater than 50 km from the source) and Class II areas are discussed in more detail in Section 5 of this protocol.

Table 3-2
Significant Impact Levels[1]
(micrograms per cubic meter (μg/m³))

Pollutant	Annual	24-Hour	8-Hour	3-Hour	1-Hour
CO	- -	- -	500	- -	2,000
$PM_{2.5}$	0.3 (est.)[2]	1.2 (est.)[2]	- -	- -	- -
PM_{10}	1.0	5.0	- -	- -	- -
SO_2	1.0	5.0	- -	25.0	30.0[3] / 7.8[4]
NO_2	1.0	- -	- -	- -	7.6 [4]

[1] WAC 173-400-720, unless otherwise noted.

[2] Proposed $PM_{2.5}$ SILs were published in the Federal Register on September 27, 2007 (72 FR 54112) under *Prevention of Significant Deterioration (PSD) for Particulate Matter Less Than 2.5 Micrometers (PM2.5)—Increments, Significant Impact Levels (SILs) and Significant Monitoring Concentration (SMC)*, EPA-HQ-OAR-2006-0605. The three options proposed for Class II areas range between 0.3 and 1.0 μg/m³ for the annual average, and 1.2 and 5.0 μg/m³ for the 24-hour average. The estimated values shown in Table 3-2 are from EPA's most stringent option, or Option 3.

[3] The SIL of 30 μg/m³ is for the Washington State 1-hr SO_2 limit (WAC 173-400-720).

[4] EPA recently provided guidance for conducting impact analyses for compliance demonstration of the new 1-hour SO_2 standard (EPA, *General Guidance for Implementing the 1-hour SO_2 National Ambient Air Quality Standard in Prevention of Significant Deterioration Permits, Including an Interim 1-hour SO_2 Significant Impact Level*, Memorandum from Anna Marie Wood (Office of Air Quality Planning and Standards) to Regional Air Division Directors, August 23, 2010). This guidance suggests a SIL of 3 ppb (the equivalent of 7.8 μg/m³), to be compared to 1) "the highest of the 5-year averages of the maximum modeled 1-hour SO_2 concentrations predicted each year at each receptor, based on 5 years of National Weather Service data"; or 2) "the highest modeled 1-hour SO_2 concentration predicted across all receptors based on 1 year of site-specific meteorological data, or the highest of the mulit-year averages of the maximum modeled 1-hour SO_2 concentrations predicted each year at each receptor, based on 2 or more, up to 5 complete years of available site-specific meteorological data.

[5] EPA recently provided guidance for conducting impact analyses for compliance demonstration of the new 1-hour NO_2 standard (EPA, *General Guidance for Implementing the 1-hour NO_2 National Ambient Air Quality Standard in Prevention of Significant Deterioration Permits, Including an Interim 1-hour NO_2 Significant Impact Level*, Memorandum from Anna Marie Wood (Office of Air Quality Planning and Standards) to Regional Air Division Directors, June 28, 2010). This guidance suggests a SIL of 4 ppb (the equivalent of 7.6 μg/m³), to be compared to 1) "the highest of the 5-year averages of the maximum modeled 1-hour NO_2 concentrations predicted each year at each receptor, based on 5 years of National Weather Service data"; or 2) "the highest modeled 1-hour NO_2 concentration predicted across all receptors based on 1 year of site-specific meteorological data, or the highest of the mulit-year averages of the maximum modeled 1-hour NO_2 concentrations predicted each year at each receptor, based on 2 or more, up to 5 complete years of available site-specific meteorological data.

3.4 AIR QUALITY RELATED VALUES (AQRV) AND VISIBILITY

Because the Project is subject to PSD, an analysis of Air Quality Related Values (AQRV) at Class I areas within 100 km of the facility may also be required for this facility. WAC 173-400-030-16 lists the Class I areas in Washington. North Cascades National Park (NCNP), Olympic National Park (ONP), and Glacier Peak Wilderness (GPW) are the only Class I areas within this range. AQRVs include: regional visibility or haze; the effects of primary and secondary pollutants on sensitive plants; the effects of pollutant deposition on soils and receiving bodies of water; and other effects associated with secondary aerosol formation. A modeling approach for addressing impacts of the proposed project on AQRVs in the Class I area is described in Section 5.4.

Table 3-3

Significant Impact Levels at Class I Areas[1]
(micrograms per cubic meter (μg/m³))

Pollutant	Averaging Period	EPA SIL	FLM SIL
PM_{10}	Annual	0.2	0.08
	24-hour	0.3	0.27
$PM_{2.5}$	Annual	0.04[2]	- -
	24-hour	0.07[2]	- -
SO_2	Annual	0.1	0.03
	24-hour	0.2	0.07
	3-hour	1.0	0.48
NO_2	Annual	0.1	0.03

[1] EPA proposed and FLM recommended SILs (61 FR 142, July 23, 1996), unless otherwise noted. These have not been finalized to date.

[2] Proposed $PM_{2.5}$ SILs were published in the Federal Register on September 27, 2007 (72 FR 54112) under *Prevention of Significant Deterioration (PSD) for Particulate Matter Less Than 2.5 Micrometers (PM2.5)—Increments, Significant Impact Levels (SILs) and Significant Monitoring Concentration (SMC)*, EPA-HQ-OAR-2006-0605. The three options proposed for Class I areas range between 0.04 and 0.16 μg/m³ for the annual average, and 0.07 and 0.24 μg/m³ for the 24-hour average. The estimated values shown in Table 3-3 are from EPA's most stringent options (Option 1 for the annual average and Option 3 for the 24-hour average).

Visual impacts to Class I areas must also be considered for project permitting. Visibility impairment is defined in WAC 173-400-030-91 as "any humanly perceptible change in visibility (light extinction, visual range, contrast, or coloration) from that which would have existed under natural conditions". In addition, a cumulative impact study that assesses the impacts from multiple sites in the area may be required. Currently, if the visibility impact of the proposed source is less than a 5 percent change in extinction, a cumulative impact analysis would not be required.

In addition to these Class I analyses, per direction of the U.S. Forest Service (USFS) (USFS, 2010, *email from Rick Graw (USFS) to Christy Schmitt (URS)*, June 11), analyses for visibility, growth impacts, and impacts to soils and vegetation at the Alpine Lakes Wilderness (a Class I area located just over 100 km from the Project site) and Mt. Baker Wilderness (a Class II protected area located approximately 42 km from the Project site) will also be conducted. The applicable modeling approaches outlined in Section 5 for addressing impacts of the proposed project on ambient air quality and AQRVs as described above will be used for these areas as well.

3.5 TOXICS

The proposed Project also has the potential to emit toxic/hazardous non-criteria air pollutants. These are regulated by EPA as hazardous air pollutants (HAPs) under Clean Air Act (CAA) Section 112, and by Ecology as toxic air pollutants (TAPs) under WAC 173-460. Ecology also

has a NSR requirement for TAP sources (WAC 173-460-040); an analysis must indicate that the proposed project is in compliance with ASILs.

4.1 METEOROLOGICAL DATA

Representative hourly meteorological data for 1995-1999 were obtained from Shell's March Point Refinery, located approximately 5 miles west northwest of the FGS site. The data are in the standard AERMET meteorological input file format. Upper air data was from the NWS site at Quillayute, WA. This data was recently used for the permitting at Sierra Pacific Industries (SPI) in Mount Vernon, Washington (located adjacent to the FGS site). The processed data was approved for use by Ecology (Phone conversation between Christy Schmitt (URS) and Clint Bowman (Ecology), January 28, 2010). An excerpt from the SPI Notice of Construction and PSD Permit APplication regarding collection and processing details of the meteorological data follows (Geomatrix, June, 2008):

> "A representative data set was prepared [by Geomatrix] using a combination of surface data from a meteorological station located at the nearby Puget Sound Refinery owned and operated by Shell Oil Company, supplemented by National Weather Service (NWS) observations from nearby airports including Whidbey Island Naval Air Station (located approximately 12 miles to the southwest of the site), Arlington Municipal Airport (approximately 23 miles southeast of the site), and Burlington-Skagit Regional Airport (approximately 2 miles north-northeast of the site), and NWS upper air data from Quillayute, Washington. Missing data were treated according to EPA guidance (Atkinson, D. and R. F. Lee. *Procedures for Substituting Values for Missing NWS Meteorological Data for Use in Regulatory Air Quality Models*. U.S. EPA, Office of Air Quality Planning and Standards, July 7, 1992).
>
> "According to the *Guidelines* [EPA's *Guideline on Air Quality Models*], five years of representative meteorological data are considered adequate for dispersion modeling applications. Hourly wind speed and wind direction data from January 1995 through December 1999 were obtained from the Shell meteorological station. The station is located approximately 5 miles west of SPI's Burlington facility. A wind rose describing the wind speed and wind direction data recorded at the Shell meteorological monitoring station over the entire five-year dataset is shown in Figure 4-3 [of the SPI Application]. The wind rose shows that the winds are generally bimodal, with winds from the south and southeast following the broad Skagit River Valley, and the winds from the northwest coming from Padilla Bay. Twice-daily mixing height data for the same period were obtained for the monitoring station at Quillayute, Washington, approximately 104 miles west-southwest of the facility.
>
> "Additional meteorological variables and geophysical parameters are required for use in the AERMOD dispersion modeling analysis to estimate the surface energy fluxes and construct boundary layer profiles. Surface characteristics including albedo, Bowen ratio, and surface roughness length were determined for the area surrounding the Shell meteorological station using the AERMET surface characteristic preprocessor, AERSURFACE (version 08009), and the USGS 1992 National Land Cover (NLCD92) land use data set. (The USGS NLCD92 data set is described and can be accessed at http://landcover.usgs.gov/natlandcover.php.) The NLCD92 data set used in the analysis has a 30 m mesh size and 21 land use categories. Seasonal surface parameters were

determined using AERSURFACE according to the EPA's guidance [The AERMET Implementation Guide (EPA, 2008) and AERSURFACE User's Guide (EPA-454/B-08-001, January 2008)].

"Seasonal albedo and Bowen ratio values were based on averaging over a 10-km by 10-km region centered on the Boise [sic] Airport meteorological site [note: per discussion with Clint Bowman at Ecology, this was a typo in the original report; it should refer to the Burlington-Skagit Regional Airport]. An unweighted arithmetic average was used for calculating seasonal albedo; and an unweighted geometric average was used for calculating seasonal Bowen ratio. Seasonal surface roughness values were calculated for 12 30-degree sectors within one kilometer of the Shell meteorological station. An inverse-distance weighted geometric average was used to calculate seasonal surface roughness length values for each of the 12 sectors.

"The AERSURFACE input file requires the user to provide additional location and climatological information regarding the primary meteorological site (Shell). The following information was used to process seasonal surface parameters for the meteorological station:

- The site was assumed to not have continuous snow cover most of the winter. There is typically little or no snowfall at March Point, where the meteorological station is located, and the annual average total snowfall for Anacortes, Washington is zero inches. (Western U.S. Climate Historical Summaries can be accessed at http://www.wrcc.dri.edu/Climsum.html.)
- The site is not located at an airport.
- The site was assumed to not be located in an arid region.
- The surface moisture condition at the site was assumed to be average.

"The EPA meteorological program AERMET (version 06341) was used to combine the Shell meteorological station surface meteorological observations with twice-daily upper air soundings from Quillayute, and to derive the necessary meteorological variables and profiles for AERMOD."

4.2 BACKGROUND AIR QUALITY DATA

Preliminary analyses show that the modeled impacts will be below SILs, therefore, cumulative analyses will not be required, and source emission inventories will not be necessary. If cumulative analyses are required, all increment-consuming sources will be included in the modeling emissions inventory. Source data will be obtained from Ecology, or through other methods approved by Ecology. Ecology and NWCAA currently have an inventory for actual emissions; URS will work with these agencies to prepare a protocol for developing an allowable inventory if required. Background concentrations used to demonstrate compliance with ambient air quality standards will also be obtained from Ecology, or through sources approved by Ecology.

5.1 INTRODUCTION

Modeling for a PSD analysis must adequately simulate the concentration increases of emitted pollutants, which are used to demonstrate compliance with ambient air quality standards. The facility emissions include criteria pollutants that will be assumed to be inert for the purpose of NAAQS analyses. In keeping with EPA and Ecology policy, no photochemical modeling for ozone will be conducted since VOC emissions do not exceed the SER.

EPA's *Guideline on Air Quality Models* (Appendix W to 40 CFR 51) recommends the use of the AERMOD dispersion model for PSD analyses of criteria pollutants for distances out to 50 km. AERMOD is the preferred dispersion model for sources located in all types of terrain (simple and/or complex), and for sources subject to aerodynamic building downwash. The modeling analysis will be done using the current version of the AERMOD model (Version 09292). The modeling will provide an indication of the project impact area, and will dictate the extent (if any) of cumulative analyses. The AERMOD analysis methodology is discussed further in Section 5.2, below.

For impacts beyond 50 km, the *Guideline* recommends the use of the CALPUFF model. CALPUFF is a transport and dispersion model that simulates the advection and dispersal of "puffs" of material emitted from modeled sources. CALPUFF will also be used for the AQRV and visibility analyses at the Class I areas (and Class II Wilderness areas) beyond 50 km. The current version of the CALPUFF model (Version 5.8, level 070623) will be used. The CALPUFF analysis methodology is discussed further in Section 5.5, below.

For the Class II Wilderness areas within 50 km from the source (Mt. Baker Wilderness), the VISCREEN model will be used for the visibility analysis. The VISCREEN model is a screening tool for assessing potential visibility impairment from a project. The analysis methodology will follow the *Workbook for Plume Visual Impact Screening* (EPA-450/4-88-015), using model version 88341 (December 6, 1988). Because there are no Class II guidelines for visibility assessment, the modeling results will be presented for informational purposes only. A more refined visibility analysis is not expected for the Mt. Baker area.

5.2 AERMOD MODEL INPUT

5.2.1 Emissions

PSE is currently considering four gas turbine options for the proposed FGS Development Project. The individual turbine options will be modeled for the increases in emissions of criteria pollutants that meet applicability levels (exceed SER), as shown above in Table 2-1. These are summarized below, by turbine option:

- GE 7FA.05 – TSP/PM_{10}/$PM_{2.5}$ [note: particulate emissions are assumed to all be fine particulate for each of the turbine options, so modeled emissions are for the grouping];
- GE 7FA.04 – TSP/PM_{10}/$PM_{2.5}$;
- Siemens SGT6-5000F - CO, and TSP/PM_{10}/$PM_{2.5}$.; and
- GE LMS100 (2 units) – NO_x, and TSP/PM_{10}/$PM_{2.5}$.

Each of these pollutants for analysis has different averaging periods for comparison to NAAQS (and SILs). Therefore, emission rates will be developed for each averaging period.

Annual average impacts, for NO_x and $TSP/PM_{10}/PM_{2.5}$, will be modeled using the annual average emission rates, as shown in Table 2-1.

Short-term emission rates will be developed using worst-case operating scenarios for the specific pollutant over the time period. These worst-case scenarios are dependent upon both the emission rate *and* the stack parameters under each scenario. For example, operation at higher loads may have increased emissions, but a lower load with lower emissions may have stack exhaust features (such as lower flow rate and temperature) that produce higher impacts. A preliminary load-check analysis will be conducted to determine worst-case scenarios. This analysis will include modeling for 1-hour impacts at each load basis (100%, 75%, and 50%), each ambient temperature (7F, 51F, and 88F), and each fuel type (natural gas and ULSD) to determine worst-case load scenarios. The worst-case averaging period scenario for full modeling will then be developed using a combination of worst-case load (that is operationally feasible for the time duration) and start ups and shutdowns when they are operationally feasible for the time duration *and* have the potential to cause higher impacts due to increased emissions (such as in the case of NO_2, but unlikely in the case of particulate emissions which are more dependent on fuel usage than combustion properties). Preliminary results of the worst-case scenario analysis have been completed for the three turbine options. Table 5-1 shows the expected worst-case turbine parameters and emissions that will be included in the refined modeling analyses, along with the corresponding operating conditions which dictate these stack parameters and emissions. Please note that this Modeling Protocol presents preliminary results only; additional operation and emission data are pending for the turbine options. Final worst-case scenario results and full modeling set-ups will be presented in the modeling section of the air permit application.

The emergency generator (for the frame turbine options only) will also be included in the refined modeling analyses. Emissions from the emergency generator will include 24 hours of engine testing/maintenance emissions and/or emergency use emissions for modeled averaging periods up to 24-hours, and 52 hours of testing/maintenance emissions plus 200 hours of emergency use emissions for annual average modeling. Table 5-2 shows the stack parameters and emissions for the emergency generator.

Emissions of TAPs will be developed for each pollutant by specific averaging period (1-hr, 24-hr, or annual, depending on pollutant ASIL period). HAP and TAP emissions from the turbine options and auxiliary equipment will be determined using vendor data, where available, or AP-42 factors. TAPs that have emissions exceeding SQERs will be modeled using the same methodology as the criteria pollutant analyses, and resultant impacts will be compared to ASILs.

Equipment data, including emissions and stack parameters (similar to Attachment A of this Model Protocol), will be included in an appendix in the final modeling report.

5.2.2 Building Downwash

For each turbine option, the facility layout, including structure elevations, will be used to enter building locations and dimensions into the Building Profile Input Program for the PRIME algorithm (BPIP-PRIME). The BPIP-PRIME program produces a file of wind-direction specific

Table 5-1
Turbine Modeling Parameters and Emission Rates for Criteria Pollutant Analyses

Pollutant	Averaging Period	Stack Temp. (F)	Stack Exit Velocity (fps)	Emission Rate (lb/hr)	Operating Scenario
GE 7FA.05 (Stack Height = 125 ft, Stack Diameter = 23 ft)					
NO_2	Annual	--	--	--	No further analysis; expected below SER.
	1-hour	--	--	--	No further analysis; expected below SER.
CO	1-hour	--	--	--	No further analysis; expected below SER.
	8-hour	--	--	--	No further analysis; expected below SER.
PM	Annual	800	104	9.45	Natural gas @ average sulfur content (2.24 gr/100dscf) and maximum ULSD use (annual load mix); average ambient temperature (51F); plus maximum start-up and shutdown events.
	24-hour	799	87	36.80	ULSD; 50% load; minimum ambient temperature (7F); no start-ups or shutdowns.
SO_2	Annual	--	--	--	No further analysis; expected below SER.
	1-hour	--	--	--	No further analysis; expected below SER.
	3-hour	--	--	--	No further analysis; expected below SER.
	24-hour	--	--	--	No further analysis; expected below SER.
GE 7FA.04 (Stack Height = 125 ft, Stack Diameter = 21 ft)					
NO_2	Annual	--	--	--	No further analysis; expected below SER.
	1-hour	--	--	--	No further analysis; expected below SER.
CO	1-hour	--	--	--	No further analysis; expected below SER.
	8-hour	--	--	--	No further analysis; expected below SER.
PM	Annual	800	111	9.63	Natural gas @ average sulfur content (2.24 gr/100dscf) and maximum ULSD use (annual load mix); average ambient temperature (51F); plus maximum start-up and shutdown events.
	24-hour	799	102	37.60	Natural gas @ maximum sulfur content (3.48 gr/100dscf); 50% load; minimum ambient temperature (7F); no start-ups or shutdowns.
SO_2	Annual	--	--	--	No further analysis; expected below SER.
	1-hour	--	--	--	No further analysis; expected below SER.
	3-hour	--	--	--	No further analysis; expected below SER.
	24-hour	--	--	--	No further analysis; expected below SER.

Table 5-1 (continued)
Turbine Modeling Parameters and Emission Rates for Criteria Pollutant Analyses

Pollutant	Averaging Period	Stack Temp. (F)	Stack Exit Velocity (fps)	Emission Rate (lb/hr)	Operating Scenario
Siemens SGT6-5000F4 (Stack Height = 125 ft, Stack Diameter = 23 ft)					
NO_2	Annual	--	--	--	No further analysis; expected below SER.
	1-hour	--	--	--	No further analysis; expected below SER.
CO	1-hour	799	103	2067	ULSD; 1 start-up on natural gas and 1 shutdown (ULSD); remainder of hour at 75% load; minimum ambient temperature (7F).
	8-hour	799	103	2067	ULSD; 1 start-up on natural gas and 1 shutdown (ULSD); remainder of period at 50% load; minimum ambient temperature (7F).
PM	Annual	800	101	7.02	Natural gas @ average sulfur content (2.24 gr/100dscf) and maximum ULSD use (annual load mix); average ambient temperature (51F); plus maximum start-up and shutdown events.
	24-hour	799	95	32.80	ULSD; 50% load; maximum ambient temperature (88F); no start-ups or shutdowns.
SO_2	Annual	--	--	--	No further analysis; expected below SER.
	1-hour	--	--	--	No further analysis; expected below SER.
	3-hour	--	--	--	No further analysis; expected below SER.
	24-hour	--	--	--	No further analysis; expected below SER.
GE LMS100 (each unit) (Stack Height = 125 ft, Stack Diameter = 12 ft)					
NO_2	Annual	771	114	5.49	Natural gas, with 336 hrs ULSD; annual load mix; average ambient temperature (51F); maximum start-up and shutdowns.
	1-hour	784	136	27.23	ULSD; 1 shutdown on natural gas; remainder of hour at 100% load; average ambient temperature (51F).
CO	1-hour	--	--	--	No further analysis; expected below SER.
	8-hour	--	--	--	No further analysis; expected below SER.
PM	Annual	771	114	8.44	Natural gas @ average sulfur content (2.24 gr/100dscf) and maximum ULSD use (annual load mix); average ambient temperature (51F); plus maximum start-up and shutdown events.
	24-hour	800	128	22.18	ULSD; 75% use factor combined for 2 units (over 24 hour period); 100% load 90% of time, down to 75% load for 10% of time; maximum ambient temperature (88F); no start-ups or shutdowns.
SO_2	Annual	--	--	--	No further analysis; expected below SER.
	1-hour	--	--	--	No further analysis; expected below SER.
	3-hour	--	--	--	No further analysis; expected below SER.
	24-hour	--	--	--	No further analysis; expected below SER.

Table 5-2

Emergency Generator Modeling Parameters and Emission Rates for Criteria Pollutant Analyses

Stack Height (ft)	35
Stack Diameter (inches)	10
Exit Temperature (F)	534
Exit Velocity (fps)	146
CO Emission Rate (lb/hr) [1-hr and 8-hr]	0.248
TSP/PM_{10}/$PM_{2.5}$ Emission Rate (lb/hr) [Annual]	0.00015
TSP/PM_{10}/$PM_{2.5}$ Emission Rate (lb/hr) [24-hour]	0.0248

Notes:
Annual emissions estimate (used in annual analysis for particulates) includes 52 hours of testing/maintenance and 200 hours of emergency use.

downwash characteristics for input to AERMOD. The facility layout diagrams are provided in Figures 2 and 3 for the three turbine options. Structures exceeding 20 feet in height will be included in the model setup.

5.2.3 Elevation Data and Receptor Grid

Terrain elevations and hill height scale values for the sources, buildings, and receptors will be calculated using the AERMAP preprocessor with USGS 7.5-minute digital elevation model (DEM) data. The DEM data for the nearfield area surrounding the Fredonia site includes the Mt. Vernon and La Conner quadrangles. Beyond approximately 5 km, the following quadrangles may also be included: Alger, Anacortes North, Anacortes South, Bow, Conway, Crescent Harbor, and Utsalady.

Receptors will be located on a Cartesian grid system as follows: 25-meter grid from fenceline out to a distance 100m; 50-meter grid out to 250m; 100-meter grid out to 500m; 250-meter grid out to 1000m, and; 500-meter grid out to 2000m. (Additional receptors will be added further out than 2 km at a 500 meter spacing, if needed to show impacts beyond the normal grid to show impacts above the SIL's.) Nested 25-meter resolution grids will be placed around the initial maximum receptor location (found using the above grid) for each pollutant and averaging period in order to better resolve the maximum impact magnitude and location. Receptor elevations will be based on USGS 7.5-minute DEM data, as described above.

5.2.4 Meteorological Data

The meteorological data set from Shell's March Point Refinery will be input to AERMOD. This meteorological data set is described above in Section 4.1.

5.3 CUMULATIVE AND INCREMENT MODELING

If the project is found to have potentially significant impacts (i.e., greater than applicable SILs), a cumulative modeling analysis will be performed which considers the proposed project's emissions (entire facility) combined with other permitted stationary sources within a 50-kilometer radius of the project's SIA. If needed, the emission inventories will be obtained from Ecology and NWCAA (as described in Section 4.2). If an inventory is prepared, URS will also work with the agencies to include applicable modeling inputs for these sources.

Should the project show impacts of PSD pollutants greater than SILs identified in Table 3-2, increment modeling will be performed. This analysis will include increment-consuming sources within the area of significant impact plus 50 km, as defined by the project impact analysis. PSE will work with Ecology to construct the appropriate increment inventory (as described above and in Section 4.2) for this analysis, if required.

In addition, an evaluation of PM_{10} and $PM_{2.5}$ incremental impacts at the nearby Class I Areas will also be conducted if impacts at these locations exceed the Class I SILs (as shown in Table 3-3). CALPUFF will be used in the analysis to show the comparison of impacts to theNO_x, PM_{10}, and $PM_{2.5}$ SILs. The CALPUFF methodology is described below in Section 5.5. If the SILs are exceeded, a complete increment analysis will be performed using the appropriate emission inventory.

5.4 AQRV AND VISIBILITY MODELING

As discussed in Section 3.4, AQRV analyses will be performed at Class I areas (and some Class II Wilderness areas) to determine potential impacts on sensitive plants, soils, and receiving bodies of water, and whether regional haze (visibility) would be degraded significantly as a result of emissions from the proposed Project. The FLM's Air Quality Related Values Workgroup (FLAG) guidance will be used for these analyses. Based on input from Ecology and the USFS, analyses will be performed using both the old FLAG guidance ("FLAG 2000", Phase I Report, December 2000) and the draft FLAG guidance ("FLAG 2010", Phase I Report, Revised 6/27/08; note the "2010" date is now commonly referred to in the literature, based on the expected promulgation year, although it has not yet been finalized by EPA). Both of these guidance methodologies are described below.

5.4.1 FLAG 2000

FLAG is responsible for providing policies and procedures for identifying and evaluating AQRV's, primarily in federal Class I areas. FLAG 2000 encompasses the guidance given in the *Interagency Workgroup on Air Quality Modeling (IWAQM) Phase 2 Summary Report and Recommendations for Modeling Long Range Transport Impacts* (EPA-454/R-98-019, EPA, 1998). The IWAQM report recommends CALPUFF for use in long-range transportation (LRT) and dispersion analyses involving one or more emission sources. Further details on CALPUFF modeling are provided in Section 5.5, below. During the setup of CALPUFF modeling, URS will work with Ecology and the FLM's to ensure that the FLAG 2000 methodologies are being followed.

5.4.2 FLAG 2010

The revised FLAG guidance basically follows the same methodology as the original FLAG 2000 guidance (with some improvements, as noted below) but also includes a threshold ratio of emissions to distance, below which AQRV review is not required. The criteria threshold was adopted from a similar screening method from EPA's 2005 Best Available Retrofit Technology (BART) guidelines for the Regional Haze Rule, which is used to screen out of AQRV review those sources with relatively small emissions located far from a Class I area. Specifically, this FLAG 2010 "10D" Rule is:

If Q (tpy)/d (km) is less than 10, no AQRV analysis is required, where:

- Q is the emissions increase of sulfur dioxide (SO2), oxides of nitrogen (NOx), particulate matter less than 10 microns (PM10), and sulfuric acid mist (H2SO4), combined in tons per year (tpy)
- d is the nearest distance to a Class I Area in kilometers (km)

If Q/d is less than 10 for a Class I Area, then presumptively, there is no adverse impact and a project "screens out" of a Class I AQRV analysis. If Q/d results in a value above 10, a Class I analysis is required.

Based on FLAG 2010, estimates are made for the Project's maximum 24-hour emission rates, and then prorated to an annual emission rate assuming full-time (8760 hours) operation. These estimates are made for each turbine option. Table 5-3 provides preliminary estimates of both the specific pollutant emission rates, and the total, Q, for each turbine technology option. These values are then divided by the distance to the nearest Class I area (NCNP at 66 kilometers from the Project site). Using these conservative estimates for emissions, none of the Project options are expected to require a Class I analysis based on the new FLAG 2010 guidance. [Note: The preliminary emissions estimates are based on current data for the four tubine options, using worst-case operations profiles, by pollutant, for a 24-hour period. This may include startups and shutdowns, and either natural gas or distillate fuel, depending on the pollutant (see operation scenarios in Table 5-1 above). It also includes 24 hours of emergency engine use for the frame turbine options. This screening will be refined as more information on Project emissions is obtained during permit application preparation.]

If refined emission data shows that full AQRV modeling analyses are required (ie, Q/d greater than or equal to 10), analyses will be conducted using CALPUFF, following the updated draft guidance for FLAG 2010 (*FLAG Phase I Report-Revised* (Draft, June 2008)). Besides the adoption of the Q/d screening method, the most significant changes in the new FLAG 2010, as compared to the original FLAG 2000, are: the inclusion of updated EPA estimates for determining visibility conditions (including a new EPA-approved visibility algorithm); the adoption of additional BART criteria (from the 2005 BART guidelines) for relative humidity effects on visibility, and statistical interpretation of anomalous weather events; the inclusion of analysis thresholds for nitrogen and sulfur deposition impacts on vegetation, soil, and water, and; it provides more explicit impact determination process to consider regulatory and other factors (for more transparent and consistent analyses to remove subjectivity).

Table 5-3

Preliminary Project AQRV Screening for Potential Turbine Options

	Turbine Option			
	GE 7FA.05	GE 7FA.04	Siemens SGT6- 5000F4	GE LMS100 (2 Units)
Maximum Emissions (lb/hr) on a 24-hour Basis:				
NO_x (lb/hr)	47	42	47	27
SO_2 (lb/hr)	48	46	40	45
PM_{10} (lb/hr)	8	7	7	7
H_2SO_4 (lb/hr)	22	19	23	17
Sum of Emissions Prorated to Full-Time Annual Basis (tpy):				
Q (tpy)	549	502	516	415
AQRV Screening:				
Q/d	**8.31**	**7.61**	**7.82**	**6.29**

Notes:
Annual emissions (Q) assume 8760 hrs at maximum 24-hour emission rate (lb/hr).
Distance to nearest Class I Area is 66 km (NCNP).
Emission rates include emergency generator operation for the frame turbine options.

[Note: if Q/d is below 10, no further analyses will be conducted using the revised guidance, and only the FLAG 2000 analyses (described above in Section 5.4.1) will be provided (as long as this is still the currently accepted guidance at the time of application submittal).]

5.5 CALPUFF MODELING

CALPUFF is a transport and dispersion model that simulates the advection and dispersal of "puffs" of material emitted from modeled sources. As mentioned above, it is the EPA-preferred model for use in LRT and AQRV analyses because of it's ability to consider complex 3-dimensional wind regimes, secondary aerosol formation, gaseous and particulate deposition, and wet and dry deposition processes. These aspects of the model are established through the CALMET meteorological pre-processor, and the CALPOST post-processor. Inputs to the CALPUFF modeling (meteorology, emissions speciation, background concentrations/extinction values, receptor grids, etc...) and output evaluations will be developed following the analysis guidance documents listed above (IWAQM and FLAG) as well as through more detailed discussions with the FLMs and pertinent agencies, based on specific Class I area requirements.

5.5.1 CALPUFF Input Parameters

Emission rate data and stack parameters for the turbine options and emergency generator (where applicable) are provided in Attachment A. Specific emission rates for input to the CALPUFF

analyses will be prepared following the FLAG guidance, along with EPA-recommended particulate speciation, with approval from the FLM.

The modeling domain will be processed with CALPUFF using land use and terrain data surrounding the source and the Class I areas (extended 50 km beyond boundaries). Class I boundaries and discrete receptors will be obtained from the National Park Service (NPS) databases (http://www.nature.nps.gov/air/maps/Receptors/index.cfm). In addition to these discrete receptors, a 4 km mesh spacing receptor grid will be prepared throughout the modeling domain. URS will obtain the MM5 meteorological dataset through Ecology; the dataset will be coordinated with the accepted modeling domain to incorporate each of the Class I areas required for analysis. Three years of the 12 km horizontal mesh size data will be used for the CALPUFF modeling. CALMET will be used to process this data for use in CALPUFF. User-selected (non-default) parameters used in CALMET will follow FLM guidance, based on the specific relationship between the proposed source and the Class I areas being analyzed.

Other input data required for the AQRV analyses, such as background ammonia and ozone concentrations and background visibility, will be obtained from Ecology, the FLM, and/or various other sources, such as Western Regional Air Partnership (WRAP), with approval for use by the FLM.

5.5.2 CALPUFF Postprocessing

The CALPUFF model will be used to predict several air quality parameters, including criteria pollutant concentrations for comparison to the Class I SILs, speciated particulate concentrations for assessment of regional haze, and nitrogen and sulfur deposition fluxes for comparison to Deposition Analysis Thresholds (DATs) established by the FLM. The postprocessing procedures in CALPOST will be used to manipulate the large CALPUFF output files to determine the relevant analysis results following FLAG guidance, and to present the final results for comparison to the regulated and/or guideline values.

The modeling results will be presented as a stand-alone report in support of the PSD Application. This report will describe the models used, modeling options and the derivation of all model inputs, such as emission estimates. Model results will be presented in tabular and graphical form, and will be compared to relevant standards or threshold criteria where applicable. Maximum impacts will be summarized to show controlling meteorological conditions as well as maximum impact locations and elevations. Model input and output files will be provided in electronic format as appendices to the report.

Total Emissions from Turbines: Operations (standard load breakdown), Starts/Shutdowns (maximized), dual fuel (maximized), all units

TURBINE OPTIONS

		GE 7FA.05	GE 7FA.04	Siemens SGT6	GE LMS100
# of Units		1	1	1	2
Operating time	hrs/yr/unit	2244	2244	2244	4980
NOX	ppmvd	2.5	2.5	2.5	2.5
CO	ppmvd	4.0	3.8	1.6	5.0
NOX	tpy	28.97	26.01	30.43	48.05
CO	tpy	42.78	39.16	148.81	53.60
VOC	tpy	6.94	5.94	18.90	12.72
PM (Front & Back Half)	tpy	41.39	42.18	30.73	73.96
CO2	tpy	285078	250855	269947	526071
SO2	tpy	5.79	5.15	5.21	10.59
H2SO4	tpy	12.20	10.70	12.60	25.68
Pb	tpy	0.0053	0.0047	0.0045	0.0041

Notes:
Control ppmvd is shown for natural gas, full load (100%) operation. Assumed no control during startup/shutdown.
Lead (Pb) emissions estimated using heat rate and AP-42 emission factor (Table 3.1-2a)

FREDONIA DEVELOPMENT PROJECT
EMISSIONS INCREASES DUE TO MODIFICATION

TOTAL EMISSIONS (including emergency engine - 52 hrs/yr test/maint plus 200 hrs emergency use for the Frame turbines only)

		Turbine Option				
		GE 7FA.05	GE 7FA.04	Siemens SGT6	GE LMS100	SER
NOX	tpy	30	27	32	**48**	40
CO	tpy	43	39	**149**	54	100
VOC	tpy	7	6	19	13	40
PM (TSP, PM10, PM2.5)	tpy	**41**	**42**	**31**	**74**	25, 15, 10
CO2	tpy	285,196	250,973	270,065	526,071	-
SO2	tpy	6	5	5	11	40
H2SO4	tpy	**12**	**11**	**13**	**26**	7
Pb	tpy	0.0084	0.0079	0.0079	0.0045	0.6
HAPs	tpy	1.91	1.65	1.87	3.09	-

Notes:
Values shown in bold indicate exceedance of Significant Emission Rate (SER).
H2SO4 for emergency generator assumed equal to SO2 emissions.
Pb for emergency generator assumed equal to PM emissions.

GREENHOUSE GAS INFO

		Turbine Option			
		GE 7FA.05	GE 7FA.04	Siemens SGT6	GE LMS100
	lb CO2/MWh	1,324	1,330	1,281	1,079

Total Emissions from Turbines: Operations (standard load breakdown), Starts/Shutdowns (maximized), dual fuel (maximized), all units
95th Percentile, Worst Case Scenario

Average Monthly Worst-Case Profiles

Operation Characteristic	Units	7FA.05	%	7FA.04	%	SGT6-5000F4	%	LMS-100	%
Full Load	hrs/mo	109	15%	109	15%	109	15%	340	47%
Medium Load	hrs/mo	75	10%	75	10%	75	10%	75	10%
Min Load	hrs/mo	3	0%	3	0%	3	0%	-	0%
Duct Firing	hrs/mo							n/a	
Starts	starts/mo	12		12		12		20	
Total Operating Hours		187	26%	187	26%	187	26%	415	57%
Total Idle Hours	hrs/mo	543	74%	543	74%	543	74%	315	43%

Other Assumptions

Average Hours / Month	730

Short-Term Peaker Worst-Case Profiles (used in modeling)

1-Hour	Units / Plant	Starts / Unit	Total Unit Starts
7FA.05	1	1	1
7FA.04	1	1	1
SGT6-5000F4	1	1	1
LMS-100	2	1	2

3-Hour	Units per Plant	Starts per Uni	Total Unit Starts
7FA.05	1	3	3
7FA.04	1	3	3
SGT6-5000F4	1	3	3
LMS-100	2	3	6

8-Hour	Units / Plant	Starts / Unit	Total Unit Starts
7FA.05	1	8	8
7FA.04	1	8	8
SGT6-5000F4	1	8	8
LMS-100	2	8	16

24-Hour	Units / Plant	Starts / Unit	Total Unit Starts
7FA.05	1	8	8
7FA.04	1	8	8
SGT6-5000F4	1	8	8
LMS-100	2	8	16

ULSD Operation

Please assume up to 14 days/year of baseload operation on ULSD for peakers. It would be unlikely to have more than 1 start/day when operating on ULSD. CCCT will not have oil backup.

OTHER PROPOSED OPERATIONAL LIMITATIONS:

7FA.05	None
7FA.04	None
SGT6-5000F4	None
LMS100's	Startups and Shutdowns on natural gas only.
	Distillate use limited to: 75% use factor over a 24-hour period for both units (total 36 hours), and up to 10% of total time (3.6 hrs) at loads below 100%.
	No distillate use at loads below 75%.
	No emergency generator.

Total Emissions from Turbines: Operations (standard load breakdown), Starts/Shutdowns (maximized), dual fuel (maximized), all units
(Data from Black & Veatch, 7/10)

Equipment	Units	7FA.05	7FA.05	7FA.05	7FA.05	7FA.05	7FA.05	7FA.05	7FA.05	7FA.05
Op Conditions										
NG Sulfur Content		2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25
Ambient Temperature (°F)		7	7	7	51	51	51	88	88	88
Relative Humidity		40	40	40	75	75	75	30	30	30
Unit Load (%)		100	75	50	100	75	50	100	75	50
Fuel		NG	NG	NG	NG	NG	NG	NG	NG	NG
Units		1	1	1	1	1	1	1	1	1
Operation per unit:										
hrs/mo		109	75	3	109	75	3	109	75	3
hrs/yr		1112	785	31	1112	785	31	1112	785	31
Starts (and assume shutdowns) per unit:										
per hour		1			1			1		
per month		12			12			12		
per year		144			144			144		
Op Emissions - Control (SCR/CO Cat; no SO2 scrub)										
NOX	ppmvd @ 15% O2	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
NOX as NO2	lb/h per stack	20.70	16.30	12.70	19.40	15.60	12.30	17.00	14.60	11.90
CO	ppmvd @ 15% O2	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
CO	lb/h per stack	19.8	15.8	12.4	18.6	15.0	12.0	17.2	14.2	11.8
VOC	ppmvd @ 15% O2	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
VOC as CH4	lb/h per stack	4.00	3.20	2.50	3.70	3.00	2.40	3.60	2.80	2.30
PM10 (Front & Back Half)	lb/h per stack	37.20	33.30	30.00	36.00	32.60	29.60	34.70	31.70	29.20
CO2	lb/h per stack	262,587	200,060	163,894	246,140	199,087	158,372	228,243	187,610	153,694
SOx as SO2	lb/h per stack	6.32	4.24	3.32	4.99	4.04	3.21	4.62	3.80	3.11
NH3 slip	ppmvd @ 15% O2	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
NH3 slip	lb/h per stack	15.1	12	9.4	14.1	11.4	9.1	13.1	10.8	8.8
Total Op Emissions (all units)										
NOX	lb/yr	23,019	12,475	389	21,573	11,863	377	19,905	11,174	384
CO	lb/yr	22,018	12,093	380	20,684	11,480	367	19,127	10,668	355
VOC	lb/yr	4,448	2,445	77	4,114	2,298	73	3,892	2,143	70
PM10 (Front & Back Half)	lb/yr	41,367	23,407	918	40,033	24,874	906	38,587	24,262	894
CO2	lb/yr	291,979,859	160,014,294	5,017,541	273,712,027	152,774,712	4,848,513	253,811,197	143,590,258	4,705,258
SO2	lb/yr	5,818	3,245	102	5,549	3,092	98	5,138	2,906	95
Stack Info										
Volume Flow (per Unit)	acfm	3,281,876	2,673,032	2,321,205	3,260,948	2,723,743	2,381,190	3,221,544	2,754,468	2,454,315
Exhaust Temperature	F	800	800	800	800	800	799	800	799	800
Stack Diameter	ft	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0
Stack Velocity	fps	132.00	107.00	93.00	131.00	109.00	96.00	129.00	110.00	98.00
Stack Height	ft	125	125	125	125	125	125	125	125	125

Equipment	Units	7FA.05	7FA.05	7FA.05	7FA.05	7FA.05	7FA.05	7FA.05	7FA.05	7FA.05
Op Conditions										
NG Sulfur Content		3.48	3.48	3.48	3.48	3.48	3.48	3.48	3.48	3.48
Ambient Temperature (°F)		7	7	7	51	51	51	88	88	88
Relative Humidity		40	40	40	75	75	75	30	30	30
Unit Load (%)		100	75	50	100	75	50	100	75	50
Fuel		NG	NG	NG	NG	NG	NG	NG	NG	NG
Units		1	1	1	1	1	1	1	1	1
Operation per unit:										
hrs/mo		109	75	3	109	75	3	109	75	3
hrs/yr		1112	785	31	1112	785	31	1112	785	31
Starts (and assume shutdowns) per unit:										
per hour		1			1			1		
per month		12			12			12		
per year		144			144			144		
Op Emissions - Control (SCR/CO Cat; no SO2 scrub)										
NOX	ppmvd @ 15% O2	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
NOX as NO2	lb/h per stack	20.70	16.30	12.70	18.40	15.50	12.30	17.90	14.00	11.90
CO	ppmvd @ 15% O2	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
CO	lb/h per stack	19.8	15.8	12.4	18.6	15.0	12.0	17.2	14.2	11.5
VOC	ppmvd @ 15% O2	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
VOC as CH4	lb/h per stack	4.00	3.20	2.50	3.70	3.00	2.40	3.50	2.80	2.30
PM10 (Front & Back Half)	lb/h per stack	47.70	41.60	38.50	45.80	40.60	35.90	43.80	39.20	35.40
CO2	lb/h per stack	262,555	209,060	163,914	246,158	199,079	158,365	228,233	187,802	153,888
SOx as SO2	lb/h per stack	8.22	6.56	5.13	7.72	6.24	4.97	7.14	5.88	4.81
NH3 slip	ppmvd @ 15% O2	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
NH3 slip	lb/h per stack	16.1	12	9.4	14.1	11.4	9.1	13.1	10.8	8.5
Total Op Emissions (all units)										
NOX	lb/yr	23,019	12,475	389	21,573	11,863	377	19,905	11,174	304
CO	lb/yr	22,018	12,033	380	20,684	11,480	367	19,127	10,868	355
VOC	lb/yr	4,448	2,449	77	4,114	2,298	73	3,892	2,143	70
PM10 (Front & Back Half)	lb/yr	53,043	31,839	1,117	50,931	30,897	1,009	48,706	30,002	1,084
CO2	lb/yr	291,966,828	160,007,231	5,018,163	273,730,241	152,368,015	4,848,300	253,800,042	143,543,956	4,705,001
SO2	lb/yr	9,141	5,013	157	8,585	4,776	152	7,940	4,500	147
Stack Info										
Volume Flow (per Unit)	acfm	3,281,876	2,673,032	2,321,205	3,260,948	2,723,743	2,381,190	3,221,544	2,754,468	2,454,315
Exhaust Temperature	F	800	800	800	800	800	799	800	799	800
Stack Diameter	ft	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0
Stack Velocity	fps	132.00	107.00	93.00	131.00	105.00	96.00	129.00	110.00	98.00
Stack Height	ft	125	125	125	125	125	125	125	125	125

Equipment	Units	7FA.05	7FA.05	7FA.05	7FA.05	7FA.05	7FA.05	7FA.05	7FA.05	7FA.05
Op Conditions										
NG Sulfur Content		-	-	-	-	-	-	-	-	-
Ambient Temperature (°F)		7	7	7	51	51	51	88	88	88
Relative Humidity		40	40	40	75	75	75	30	30	30
Unit Load (%)		100	75	50	100	75	50	100	75	50
Fuel		Dist	Dist	Dist.	Dist	Dist.	Dist.	Dist	Dist.	Dist.
Units		1	1	1	1	1	1	1	1	1
Operation per unit:										
hrs/mo										
hrs/yr		196	135	5	196	135	5	196	136	6
Starts (and assume shutdowns) per unit:										
per hour		1			1			1		
per month										
per year		14			14			14		
Op Emissions - Control (SCR/CO Cat; no SO2 scrub)										
NOX	ppmvd @ 15% O2	5	5	0	6	6	5	8	5	5
NOX as NO2	lb/h per stack	44.10	35.20	26.70	44.10	35.00	28.90	42.40	33.80	26.00
CO	ppmvd @ 15% O2	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
CO	lb/h per stack	42.3	34.2	27.2	42.3	34.0	26.3	40.7	32.8	25.6
VOC	ppmvd @ 15% O2	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
VOC as CH4	lb/h per stack	9.30	7.50	5.90	9.30	7.50	5.80	9.00	7.20	5.80
PM10 (Front & Back Half)	lb/h per stack	38.50	37.70	36.80	38.50	37.70	36.80	38.40	37.50	36.70
CO2	lb/h per stack	367,828	298,820	227,193	367,880	295,087	228,535	353,423	285,453	221,348
SOx as SO2	lb/h per stack	1.26	1.00	0.79	1.26	0.99	0.79	1.21	0.98	0.77
NH3 slip	ppmvd @ 15% O2	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
NH3 slip	lb/h per stack	16.0	12.9	9.9	16.0	12.8	9.9	15.4	12.4	9.8
Total Op Emissions (all units)										
NOX	lb/yr	8,643	4,739	144	8,643	4,712	145	8,310	4,564	140
CO	lb/yr	8,290	4,604	146	8,280	4,578	147	7,976	4,429	137
VOC	lb/yr	1,823	1,010	32	1,823	1,010	31	1,764	959	30
PM10 (Front & Back Half)	lb/yr	7,545	5,076	198	7,546	5,076	198	7,528	5,049	198
CO2	lb/yr	72,087,500	39,975,591	1,221,531	72,093,290	39,729,173	1,230,746	49,263,893	38,431,793	1,182,043
SO2	lb/yr	247	135	4	247	133	4	237	129	4
Stack Info										
Volume Flow (per Unit)	acfm	3,103,100	2,018,102	2,169,251	3,258,794	2,730,809	2,295,330	3,302,220	2,794,818	2,349,912
Exhaust Temperature	F	800	800	793	800	800	799	800	800	799
Stack Diameter	ft	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0
Stack Velocity	fps	124.00	105.00	87.00	131.00	110.00	92.00	132.00	112.00	94.00
Stack Height	ft	125	125	125	125	125	125	125	125	125

Start/shutdown and annual totals (NG 2.25, 7 °F and 51 °F columns; Dist 7 °F and 51 °F columns):

	Units	NG 7°F	FOR MODELING INFO lb/hr equiv.	NG 51°F Max w/ S/S	Max w/o	FOR SER Max Ann.	Dist 7°F	[lb/hr equiv.]	Dist 51°F Max w/ S/S	Max w/o
Start Emissions										
NOX	lb	30	42.07	52.79	44.10		84	173.79	108.79	44.10
CO	lb	122	252.41	[illegible]	42.30		318	387.82	[illegible]	42.30
VOC	lb	17					9			
PM10 (Front & Back Half)	lb	5	12.41	30.65	[illegible]		11.33	23.46	35.88	[illegible]
CO2	lb	32554					45668			
SO2	lb	3.89	8.05	6.14	5.22		0.45	0.93	4.68	[illegible]
Time per start	hrs	0.483					0.483			
Shutdown Emissions										
NOX	lb	25	[illegible]	[illegible]	44.10		79	[illegible]	[illegible]	44.10
CO	lb	106	334.74	134.91	42.30		186	663.33	226.01	42.30
VOC	lb	13					6			
PM10 (Front & Back Half)	lb	5.7	18.00	38.30	[illegible]		10.2	34.00	43.59	[illegible]
CO2	lb	31512					42990			
SO2	lb	3.77	[illegible]	[illegible]	8.22		0.41	1.37	6.17	[illegible]
Time per shutdown	hrs	0.317					0.300			
Annual Total Start/Shutdown Emissions (all units)					Equiv. ops.					Equiv. ops.
NOX	lb/yr			8,352	1786				2,282	384
CO	lb/yr			32,832	1728				7,198	373
VOC	lb/yr			4,320	348				210	82
PM10 (Front & Back Half)	lb/yr			1,685	3744				301	413
CO2	lb/yr			9,226,499	[illegible]				1,255,161	[illegible]
SO2	lb/yr			1,103	[illegible]				12	11
Total	hrs/yr			115					11	
ANNUAL TOTAL EMISSIONS (Op+Start/Shut - All units)					lb/hr basis					[lb/hr basis]
NOX	tpy			21.06	22.10	[illegible]			7.89	46.97
CO	tpy			32.88	34.26	42.78			10.10	60.13
VOC	tpy			6.40	5.68	6.84			1.54	6.15
PM10 (Front & Back Half)	tpy			34.78	36.46	41.38			8.62	39.38
CO2	tpy			220935	237677	[illegible]			58143	346090
SO2	tpy			4.92	6.18	5.78			0.20	1.16
Total	hrs/yr/unit			1906					330	
H2SO4 (no SU/SD emis)	tpy			11.68					0.62	

Total Emissions from Turbines: Operations (standard load breakdown), Starts/Shutdowns (maximized), dual fuel (maximized), all units
(Data from Black & Veatch, 7/10)

Equipment		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Op Conditions										
NG Sulfur Content		2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25
Ambient Temperature (°F)		7	7	7	51	51	51	88	88	88
Relative Humidity		40	40	40	75	75	75	30	30	30
Unit Load (%)		100	75	50	100	75	50	100	75	50
Fuel		NG	NG	NG	NG	NG	NG	NG	NG	NG
Units		1	1	1	1	1	1	1	1	1
Operation per unit										
hrs/mo		109	75	3	109	75	3	109	75	3
hrs/yr		1112	765	31	1112	765	31	1112	765	31
Starts (and assume shutdowns) per unit										
per hour		1			1			1		
per month		12			12			12		
per year		144			144			144		
Op Emissions - Control (SCR/CO Cat; no SO2 scrub)										
NOX	ppmvd @ 15% O2	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
NOX as NO2	lb/h per stack	17.40	14.20	11.90	16.80	13.60	11.30	15.10	12.40	11.00
CO	ppmvd @ 15% O2	3.8	3.8	3.9	3.9	3.9	3.9	3.9	3.9	4.0
CO	lb/h per stack	16.2	13.2	11.4	15.6	12.7	10.8	14.3	11.6	10.7
VOC	ppmvd @ 15% O2	1.2	1.2	1.2	1.2	1.2	1.2	1.3	1.2	1.3
VOC as CH4	lb/h per stack	2.80	2.40	2.10	2.90	2.30	7.00	2.80	7.20	1.90
PM10 (Front & Back Half)	lb/h per stack	37.50	33.90	31.50	38.80	33.30	30.70	35.00	32.00	30.30
CO2	lb/h per stack	223,638	182,497	154,021	215,297	174,854	145,399	193,890	160,494	141,292
SOx as SO2	lb/h per stack	4.53	3.71	3.12	4.37	3.54	2.95	3.92	3.25	2.86
NH3 slip	ppmvd @ 15% O2	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
NH3 slip	lb/h per stack	12.8	10.5	8.8	12.4	10	8.3	11.1	9.2	8.1
Total Op Emissions (all units)										
NOX	lb/yr	19,349	10,868	364	18,682	10,409	348	18,791	9,491	337
CO	lb/yr	18,015	10,103	349	17,348	9,720	331	15,902	9,031	328
VOC	lb/yr	3,225	1,837	64	3,226	1,760	61	2,891	1,684	58
PM10 (Front & Back Half)	lb/yr	41,701	25,948	964	40,922	25,497	940	38,921	24,492	928
CO2	lb/yr	248,576,912	139,678,818	4,715,290	239,414,852	133,827,462	4,451,340	215,617,491	122,836,499	4,325,510
SO2	lb/yr	5,037	2,840	96	4,860	2,709	90	4,358	2,487	88
			FOR MODELING INFO							
Start Emissions			lb/hr equiv.		Max w/ S/S	Max w/o				
NOX	lb	30	62.07		60.25	39.20				
CO	lb	122	[illegible]		[illegible]	35.20				
VOC	lb	17								
PM10 (Front & Back Half)	lb	6	12.41		20.97	[illegible]				
CO2	lb	32564								
SO2	lb	3.89	8.05		7.51	7.01				
Time per start	hrs	0.483								
Shutdown Emissions										
NOX	lb	29	[illegible]		[illegible]	39.20				
CO	lb	106	334.74		130.08	35.20				
VOC	lb	13								
PM10 (Front & Back Half)	lb	5.2	16.00		37.41	[illegible]				
CO2	lb	31512								
SO2	lb	3.77	[illegible]		[illegible]	7.01				
Time per shutdown	hrs	0.317								
Annual Total Start/Shutdown Emissions (all units)						Equiv. ops				
NOX	lb/yr				8,352	1567				
CO	lb/yr				32,832	1483				
VOC	lb/yr				4,320	295				
PM10 (Front & Back Half)	lb/yr				1,686	3826				
CO2	lb/yr				9,225,498	20143212				
SO2	lb/yr				1,103	408				
Total	hrs/yr				118					
							FOR SER			
ANNUAL TOTAL EMISSIONS (Op+Start/Shut - All units)						lb/hr basis	Max Ann.			
NOX	tpy				18.69	19.81	26.01			
CO	tpy				30.12	31.87	38.78			
VOC	tpy				4.68	4.91	5.94			
PM10 (Front & Back Half)	tpy				35.69	37.31	42.18			
CO2	tpy				198916	208510	250856			
SO2	tpy				4.38	4.69	5.18			
Total	hrs/yr/unit				1908					
H2SO4 (no SU/SD ems)	tpy				10.23					
Stack Info										
Volume Flow (per Unit)	acfm	2,795,240	2,368,040	2,129,021	2,884,876	2,405,641	2,146,260	2,758,547	2,380,588	2,191,245
Exhaust Temperature	F	800	799	799	800	800	799	800	799	800
Stack Diameter	ft	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0
Stack Velocity	fps	135.00	114.00	102.00	138.00	116.00	103.00	133.00	115.00	105.00
Stack Height	ft	125	125	125	125	125	125	125	125	125

Equipment		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Op Conditions										
NG Sulfur Content		3.48	3.48	3.48	3.48	3.48	3.48	3.48	3.48	3.48
Ambient Temperature (°F)		7	7	7	51	51	51	88	88	88
Relative Humidity		40	40	40	75	75	75	30	30	30
Unit Load (%)		100	75	50	100	75	50	100	75	50
Fuel		NG	NG	NG	NG	NG	NG	NG	NG	NG
Units		1	1	1	1	1	1	1	1	1
Operation per unit										
hrs/mo		109	75	3	109	75	3	109	75	3
hrs/yr		1112	765	31	1112	765	31	1112	765	31
Starts (and assume shutdowns) per unit										
per hour		1			1			1		
per month		12			12			12		
per year		144			144			144		
Op Emissions - Control (SCR/CO Cat; no SO2 scrub)										
NOX	ppmvd @ 15% O2	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
NOX as NO2	lb/h per stack	17.40	14.10	11.90	16.80	13.60	11.30	15.10	12.40	11.00
CO	ppmvd @ 15% O2	3.8	3.8	3.9	3.8	3.9	3.9	3.9	3.0	4.0
CO	lb/h per stack	16.2	13.2	11.4	15.6	12.2	10.8	14.3	11.8	10.7
VOC	ppmvd @ 15% O2	1.2	1.2	1.2	1.2	1.2	1.2	1.3	1.2	1.3
VOC as CH4	lb/h per stack	2.80	2.40	2.10	2.90	2.30	2.00	2.60	2.20	1.00
PM10 (Front & Back Half)	lb/h per stack	48.40	41.20	37.80	45.40	40.20	36.50	42.70	38.40	36.00
CO2	lb/h per stack	223,626	187,489	154,014	215,289	174,847	145,393	193,911	160,487	141,313
SOx as SO2	lb/h per stack	7.01	5.73	4.82	6.75	5.47	4.56	6.07	5.02	4.42
NH3 slip	ppmvd @ 15% O2	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
NH3 slip	lb/h per stack	12.8	10.5	8.8	12.4	10	8.3	11.1	9.2	8.1
Total Op Emissions (all units)										
NOX	lb/yr	19,349	10,792	364	18,682	10,409	348	18,791	9,491	337
CO	lb/yr	18,015	10,103	349	17,348	9,720	331	15,902	9,031	328
VOC	lb/yr	3,225	1,837	64	3,225	1,760	61	2,891	1,684	58
PM10 (Front & Back Half)	lb/yr	51,698	31,533	1,151	50,480	30,768	1,117	47,483	29,390	1,102
CO2	lb/yr	248,561,987	139,670,891	4,715,082	239,404,330	133,821,581	4,451,144	215,633,258	122,831,101	4,326,262
SO2	lb/yr	7,795	4,388	148	7,506	4,187	140	6,750	3,842	135
Stack Info										
Volume Flow (per Unit)	acfm	2,795,240	2,368,040	2,129,021	2,884,876	2,405,641	2,148,260	2,758,547	2,380,588	2,191,245
Exhaust Temperature	F	800	799	799	800	800	799	800	799	800
Stack Diameter	ft	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0
Stack Velocity	fps	135.00	114.00	102.00	138.00	116.00	103.00	133.00	115.00	105.00
Stack Height	ft	125	125	125	125	125	125	125	125	125

Equipment		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Op Conditions										
NG Sulfur Content		-	-	-	-	-	-	-	-	-
Ambient Temperature (°F)		7	7	7	51	51	51	88	88	88
Relative Humidity		40	40	40	75	75	75	30	30	30
Unit Load (%)		100	75	50	100	75	50	100	75	50
Fuel		Dist.	Dist.	Dist.	Dist.	Dist.	Dist.	Dist.	Dist.	Dist.
Units		1	1	1	1	1	1	1	1	1
Operation per unit										
hrs/mo										
hrs/yr		196	135	5	196	135	5	196	135	5
Starts (and assume shutdowns) per unit										
per hour		1			1			1		
per month										
per year		14			14			14		
Op Emissions - Control (SCR/CO Cat; no SO2 scrub)										
NOX	ppmvd @ 15% O2	5	5	5	5	5	5	5	5	5
NOX as NO2	lb/h per stack	39.20	31.40	26.40	39.00	30.90	25.50	36.20	29.00	25.40
CO	ppmvd @ 15% O2	2.4	2.5	7.2	2.5	7.8	7.7	7.4	7.8	7.2
CO	lb/h per stack	34.8	28.8	24.7	35.2	28.7	23.8	32.2	26.2	23.7
VOC	ppmvd @ 15% O2	2.7	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
VOC as CH4	lb/h per stack	7.30	6.00	5.10	7.50	6.00	5.00	6.90	5.70	5.00
PM10 (Front & Back Half)	lb/h per stack	38.40	37.80	36.90	38.40	37.50	36.80	38.10	37.20	36.80
CO2	lb/h per stack	330,042	267,343	224,479	328,869	262,999	216,841	304,837	246,390	215,856
SOx as SO2	lb/h per stack	1.12	0.90	0.78	1.12	0.88	0.76	1.03	0.86	0.74
NH3 slip	ppmvd @ 15% O2	5.0	5.0	5.0	5.0	5.0	5.0	5.0	3.0	5.0
NH3 slip	lb/h per stack	14.5	11.6	9.5	14.3	11.4	9.4	13.3	10.2	9.4
Total Op Emissions (all units)										
NOX	lb/yr	7,682	4,226	142	7,643	4,160	137	7,094	3,904	137
CO	lb/yr	6,820	3,877	133	6,899	3,884	128	6,311	3,595	128
VOC	lb/yr	1,431	808	27	1,470	808	27	1,362	767	27
PM10 (Front & Back Half)	lb/yr	7,520	5,082	199	7,526	8,049	189	7,467	8,008	198
CO2	lb/yr	64,681,777	35,993,518	1,209,900	64,412,603	35,408,872	1,188,306	59,751,625	33,172,416	1,182,457
SO2	lb/yr	219	121	4	219	116	4	202	118	4
Start Emissions			lb/hr equiv.		Max w/ S/S	Max w/o				
NOX	lb	84	173.79		104.25	39.20				
CO	lb	318	[illegible]		[illegible]	35.20				
VOC	lb	9								
PM10 (Front & Back Half)	lb	11.33	23.45		35.31	[illegible]				
CO2	lb	46566								
SO2	lb	0.45	0.90		4.07	[illegible]				
Time per start	hrs	0.483								
Shutdown Emissions										
NOX	lb	79	[illegible]		[illegible]	39.20				
CO	lb	196	653.33		220.64	36.20				
VOC	lb	6								
PM10 (Front & Back Half)	lb	10.2	34.00		42.68	[illegible]				
CO2	lb	42990								
SO2	lb	0.41	1.37		6.32	[illegible]				
Time per shutdown	hrs	0.300								
Annual Total Start/Shutdown Emissions (all units)						Equiv. ops				
NOX	lb/yr				2,282	339				
CO	lb/yr				7,196	315				
VOC	lb/yr				210	68				
PM10 (Front & Back Half)	lb/yr				301	411				
CO2	lb/yr				1,255,181	2884221				
SO2	lb/yr				12	10				
Total	hrs/yr				11					
ANNUAL TOTAL EMISSIONS (Op+Start/Shut - All units)						[lb/hr basis]				
NOX	tpy				2.11	42.33				
CO	tpy				8.04	53.83				
VOC	tpy				1.28	7.48				
PM10 (Front & Back Half)	tpy				8.59	30.24				
CO2	tpy				51937	308148				
SO2	tpy				0.18	1.05				
Total	hrs/yr/unit				336					
H2SO4 (no SU/SD ems)	tpy				0.45					
Stack Info										
Volume Flow (per Unit)	acfm	2,809,584	2,372,670	2,128,090	2,826,748	2,435,732	2,182,632	2,873,020	2,428,380	2,240,680
Exhaust Temperature	F	800	799	799	800	799	799	800	799	798
Stack Diameter	ft	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0
Stack Velocity	fps	135.00	114.00	102.00	141.00	117.00	104.00	138.00	117.00	108.00
Stack Height	ft	125	125	125	125	125	125	125	125	125

Total Emissions from Turbines: Operations (standard load breakdown), Starts/Shutdowns (maximized), dual fuel (maximized), all units
(Data from Black & Veatch, 7/10)

Equipment		SGT6	SGT6	SGT6	SGT6	SGT6	SGT6	SGT6	SGT6	SGT6
Op Conditions										
NG Sulfur Content		2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25
Ambient Temperature (°F)		7	7	7	51	51	51	88	88	88
Relative Humidity		40	40	40	75	75	75	30	30	30
Unit Load (%)		100	75	50	100	75	50	100	75	50
Fuel		NG	NG	NG	NG	NG	NG	NG	NG	NG
Units		1	1	1	1	1	1	1	1	1
Operation per unit										
hrs/mo		109	75	3	109	75	3	109	75	3
hrs/yr		1112	765	31	1112	765	31	1112	765	31
Starts (and assume shutdowns) per unit										
per hour		1			1			1		
per month		12			12			12		
per year		144			144			144		
Op Emissions - Control (SCR/CO Cat; no SO2 scrub)										
NOX	ppmvd @ 15% O2	2.5	2.5	2.5	2.5	2.5	2.5	2.5	7.5	2.5
NOX as NO2	lb/h per stack	21.10	17.10	14.60	19.70	15.70	13.40	17.70	14.30	12.20
CO	ppmvd @ 15% O2	1.8	1.8	4.0	1.8	1.8	4.0	1.8	1.8	4.0
CO	lb/h per stack	8.4	6.8	14.4	7.6	6.0	13.2	8.8	6.6	12.0
VOC	ppmvd @ 15% O2	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
VOC as CH4	lb/h per stack	2.00	2.40	2.00	2.70	2.20	1.50	2.50	2.00	1.70
PM10 (Front & Back Half)	lb/h per stack	29.00	24.30	21.50	28.70	23.00	20.80	24.90	21.60	18.70
CO2	lb/h per stack	260,228	212,142	180,620	243,583	194,246	165,797	219,078	176,704	161,383
SOx as SO2	lb/h per stack	4.78	3.90	3.32	4.47	3.57	3.04	4.02	3.24	2.76
NH3 slip	ppmvd @ 15% O2	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
NH3 slip	lb/h per stack	14.9	12.2	10.4	14	11.2	9.5	12.6	10.1	8.7
Total Op Emissions (all units)										
NOX	lb/yr	23,464	13,088	447	21,907	12,018	410	19,683	10,945	373
CO	lb/yr	9,341	5,204	441	8,451	4,592	404	7,582	4,286	367
VOC	lb/yr	3,225	1,837	61	3,002	1,684	58	2,780	1,531	52
PM10 (Front & Back Half)	lb/yr	32,249	18,596	670	29,691	17,603	637	27,689	16,532	603
CO2	lb/yr	289,378,839	162,368,497	5,579,620	270,867,057	148,689,425	5,075,826	243,618,827	135,242,965	4,634,521
SO2	lb/yr	5,315	2,985	102	4,971	2,732	93	4,470	2,480	85
Start Emissions			FOR MODELING INFO lb/hr equiv.		Max w/ S/S	Max w/o				
NOX	lb	68.00	146.09		[redacted]	43.10				
CO	lb	1343.00	2503.48		[redacted]	49.60				
VOC	lb	154.00								
PM10 (Front & Back Half)	lb	3.77	8.53		27.94	[redacted]				
CO2	lb	38547								
SO2	lb	5.00	[illegible]		[redacted]	7.39				
Time per start	hrs	0.383								
Shutdown Emissions										
NOX	lb	25.00	159.57		81.35	43.10				
CO	lb	321.00	2048.94		362.83	49.60				
VOC	lb	38.20								
PM10 (Front & Back Half)	lb	1.60	9.57		35.23	[redacted]				
CO2	lb	18400								
SO2	lb	2.38	15.19		8.61	7.39				
Time per shutdown	hrs	0.157								
Annual Total Start/Shutdown Emissions (all units)						Equiv ops				
NOX	lb/yr				11,684	1221				
CO	lb/yr				230,616	467				
VOC	lb/yr				27,360	171				
PM10 (Front & Back Half)	lb/yr				087	1788				
CO2	lb/yr				8,200,308	18104589				
SO2	lb/yr				1,063	278				
Total	hrs/yr				78					
ANNUAL TOTAL EMISSIONS (Op+Start/Shut - All units)						tpy basis	FOR SER Max Ann.			
NOX	tpy				23.00	24.11	30.43			
CO	tpy				126.53	132.63	148.81			
VOC	tpy				18.07	18.84	18.00			
PM10 (Front & Back Half)	tpy				24.86	26.06	30.73			
CO2	tpy				219859	230481	288947			
SO2	tpy				4.43	4.64	6.21			
Total	hrs/yr/unit				1908					
H2SO4 (no SU/SD ems)	tpy				12.13					
Stack Info										
Volume Flow (per Unit)	acfm	3,232,007	2,704,417	2,388,735	3,220,186	2,654,253	2,350,261	3,088,647	2,586,912	2,298,013
Exhaust Temperature	F	800	798	800	800	800	795	800	793	793
Stack Diameter	ft	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0
Stack Velocity	fps	130.00	108.00	96.00	129.00	106.00	94.00	124.00	104.00	92.00
Stack Height	ft	125	125	125	125	125	125	125	125	125

Equipment		SGT6	SGT6	SGT6	SGT6	SGT6	SGT6	SGT6	SGT6	SGT6
Op Conditions										
NG Sulfur Content		3.48	3.48	3.48	3.48	3.48	3.48	3.48	3.48	3.48
Ambient Temperature (°F)		7	7	7	51	51	51	88	88	88
Relative Humidity		40	40	40	75	75	75	30	30	30
Unit Load (%)		100	75	50	100	75	50	100	75	50
Fuel		NG	NG	NG	NG	NG	NG	NG	NG	NG
Units		1	1	1	1	1	1	1	1	1
Operation per unit										
hrs/mo		109	75	3	109	75	3	109	75	3
hrs/yr		1112	765	31	1112	765	31	1112	765	31
Starts (and assume shutdowns) per unit										
per hour		1			1			1		
per month		12			12			12		
per year		144			144			144		
Op Emissions - Control (SCR/CO Cat; no SO2 scrub)										
NOX	ppmvd @ 15% O2	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
NOX as NO2	lb/h per stack	21.10	17.10	14.60	19.70	15.70	13.40	17.70	14.30	12.20
CO	ppmvd @ 15% O2	1.8	1.8	4.0	1.8	1.8	4.0	1.8	1.8	4.0
CO	lb/h per stack	8.4	6.8	14.4	7.6	6.0	13.2	8.8	5.6	12.0
VOC	ppmvd @ 15% O2	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
VOC as CH4	lb/h per stack	2.90	2.40	2.00	2.70	2.20	1.80	2.50	2.00	1.70
PM10 (Front & Back Half)	lb/h per stack	40.00	33.20	29.50	37.00	31.10	27.70	34.10	29.00	26.00
CO2	lb/h per stack	260,217	212,133	180,639	243,598	194,238	165,790	218,068	176,723	161,403
SOx as SO2	lb/h per stack	7.39	6.02	5.13	6.91	5.51	4.71	6.22	5.02	4.30
NH3 slip	ppmvd @ 15% O2	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
NH3 slip	lb/h per stack	14.9	12.2	10.4	14	11.2	9.5	12.6	10.1	8.7
Total Op Emissions (all units)										
NOX	lb/yr	23,464	13,088	447	21,907	12,018	410	19,683	10,945	373
CO	lb/yr	9,341	5,204	441	8,451	4,592	404	7,502	4,286	357
VOC	lb/yr	3,225	1,837	61	3,002	1,684	58	2,780	1,531	52
PM10 (Front & Back Half)	lb/yr	44,481	25,410	903	41,146	23,803	848	37,920	22,196	796
CO2	lb/yr	289,395,820	147,339,360	5,539,710	270,881,290	148,662,891	5,075,603	243,608,120	135,257,036	4,635,152
SO2	lb/yr	8,218	4,608	157	7,684	4,217	144	6,917	3,842	132
Stack Info										
Volume Flow (per Unit)	acfm	3,232,007	2,704,417	2,388,735	3,220,186	2,654,253	2,350,261	3,088,647	2,585,912	2,298,013
Exhaust Temperature	F	800	799	800	800	800	795	800	799	799
Stack Diameter	ft	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0
Stack Velocity	fps	130.00	108.00	96.00	129.00	106.00	94.00	124.00	104.00	92.00
Stack Height	ft	125	125	125	125	125	125	125	125	125

Equipment		SGT6	SGT6	SGT6	SGT6	SGT6	SGT6	SGT6	SGT6	SGT6
Op Conditions										
NG Sulfur Content		-	-	-	-	-	-	-	-	-
Ambient Temperature (°F)		7	7	7	51	51	51	88	88	88
Relative Humidity		40	40	40	75	75	75	30	30	30
Unit Load (%)		100	75	50	100	75	50	100	75	50
Fuel		Dist.	Dist.	Dist.	Dist.	Dist.	Dist.	Dist.	Dist.	Dist.
Units		1	1	1	1	1	1	1	1	1
Operation per unit										
hrs/mo										
hrs/yr		196	135	5	106	135	6	196	135	5
Starts (and assume shutdowns) per unit										
per hour		1			1			1		
per month										
per year		14			14			14		
Op Emissions - Control (SCR/CO Cat; no SO2 scrub)										
NOX	ppmvd @ 15% O2	5	5	5	5	5	5	5	5	5
NOX as NO2	lb/h per stack	43.10	33.80	32.10	38.80	31.00	29.40	34.80	28.10	26.70
CO	ppmvd @ 15% O2	4.0	12.0	12.0	4.0	12.0	12.0	4.0	12.0	12.0
CO	lb/h per stack	20.8	49.6	46.6	18.8	45.2	42.8	16.8	41.2	38.6
VOC	ppmvd @ 15% O2	1.0	3.0	3.0	1.0	3.0	3.0	1.0	3.0	3.0
VOC as CH4	lb/h per stack	3.00	7.10	6.70	2.70	6.50	6.15	2.40	5.90	5.60
PM10 (Front & Back Half)	lb/h per stack	34.60	33.80	33.40	34.10	33.30	33.10	33.70	33.00	32.80
CO2	lb/h per stack	350,804	275,679	261,753	315,797	252,075	239,427	283,569	228,896	217,484
SOx as SO2	lb/h per stack	1.09	0.85	0.81	0.98	0.78	0.74	0.88	0.71	0.67
NH3 slip	ppmvd @ 15% O2	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
NH3 slip	lb/h per stack	15.3	12.0	11.4	13.7	11.0	10.4	12.3	10.0	9.5
Total Op Emissions (all units)										
NOX	lb/yr	8,447	4,551	173	7,604	4,174	158	6,820	3,783	144
CO	lb/yr	4,078	6,678	252	3,684	6,085	230	3,292	5,547	209
VOC	lb/yr	588	956	38	529	875	33	470	794	30
PM10 (Front & Back Half)	lb/yr	6,781	4,524	180	6,683	4,483	178	6,605	4,443	177
CO2	lb/yr	68,760,605	37,116,591	1,409,638	61,889,933	33,937,869	1,289,402	55,613,867	30,815,061	1,171,230
SO2	lb/yr	214	114	4	192	105	4	172	98	4
Start Emissions			lb/hr equiv.		Max w/ S/S	Max w/o				
NOX	lb	118.00	216.36		[redacted]	43.10				
CO	lb	1458.00	2856.91		[redacted]	46.60				
VOC	lb	162.00								
PM10 (Front & Back Half)	lb	13.00	23.84		31.00	[redacted]				
CO2	lb	41848								
SO2	lb	0.70	1.27		4.03	[redacted]				
Time per start	hrs	0.550								
Shutdown Emissions										
NOX	lb	90.00	284.21		119.45	43.10				
CO	lb	703.00	2238.05		742.89	46.00				
VOC	lb	79.00								
PM10 (Front & Back Half)	lb	10.00	31.58		37.33	[redacted]				
CO2	lb	40040								
SO2	lb	0.60	1.89		5.65	[redacted]				
Time per shutdown	hrs	0.317								
Annual Total Start/Shutdown Emissions (all units)						Equiv ops				
NOX	lb/yr				2,826	378				
CO	lb/yr				30,338	548				
VOC	lb/yr				3,332	79				
PM10 (Front & Back Half)	lb/yr				322	404				
CO2	lb/yr				1,154,835	3038512				
SO2	lb/yr				16	9				
Total	hrs/yr				12					
ANNUAL TOTAL EMISSIONS (Op+Start/Shut - All units)						tpy basis				
NOX	tpy				7.43	44.23				
CO	tpy				20.17	120.05				
VOC	tpy				2.38	14.19				
PM10 (Front & Back Half)	tpy				6.87	34.97				
CO2	tpy				50068	298142				
SO2	tpy				0.16	0.95				
Total	hrs/yr/unit				336					
H2SO4 (no SU/SD ems)	tpy				0.47					
Stack Info										
Volume Flow (per Unit)	acfm	3,153,454	2,565,136	2,470,797	3,023,128	2,615,394	2,422,389	2,902,243	2,449,930	2,359,651
Exhaust Temperature	F	800	799	799	800	800	800	800	799	799
Stack Diameter	ft	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0
Stack Velocity	fps	120.00	103.00	99.00	121.00	101.00	97.00	116.00	98.00	95.00
Stack Height	ft	125	125	125	125	125	125	125	125	125

Total Emissions from Turbines: Operations (standard load breakdown), Starts/Shutdowns (maximized), dual fuel (maximized), all units
(Data from Black & Veatch, 7/10)

Equipment		LMS100	LMS100	LMS100	LMS100	LMS100	LMS100	LMS100	LMS100	LMS100
Op Conditions										
NG Sulfur Content		2.25	2.25	2.25	2.25	2.25	2.25	7.25	2.25	2.25
Ambient Temperature (°F)		7	7	7	51	51	51	88	88	88
Relative Humidity		40	40	40	75	75	75	30	30	30
Unit Load (%)		100	75	50	100	75	50	100	75	50
Fuel		NG	NG	NG	NG	NG	NG	NG	NG	NG
Units		2	2	2	2	2	2	2	2	2
Operation per unit										
hrs/mo		340	75	0	340	75	0	340	75	0
hrs/yr		3805	839	0	3805	839	0	3805	839	0
Starts (and assume shutdowns) per unit										
per hour		1			1			1		
per month		20			20			20		
per year		240			240			240		
Op Emissions - Control (SCR/CO Cat; no SO2 scrub)										
NOX	ppmvd @ 15% O2	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
NOX as NO2	lb/h per stack	7.90	6.40	4.90	8.10	6.50	5.00	7.90	6.30	4.80
CO	ppmvd @ 15% O2	5.6	5.6	5.6	6.0	6.0	6.0	3.5	3.5	3.5
CO	lb/h per stack	10.6	8.7	6.6	10.0	8.0	6.1	6.7	5.4	4.1
VOC	ppmvd @ 15% O2	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
VOC as CH4	lb/h per stack	2.20	1.80	1.40	2.30	1.80	1.40	2.20	1.80	1.30
PM10 (Front & Back Half)	lb/h per stack	13.40	12.00	10.60	13.60	12.10	10.00	13.40	11.30	10.50
CO2	lb/h per stack	101,556	81,847	62,364	104,113	83,033	63,398	101,146	81,078	61,578
SOx as SO2	lb/h per stack	2.06	1.66	1.26	2.11	1.70	1.29	2.05	1.64	1.25
NH3 slip	ppmvd @ 15% O2	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
NH3 slip	lb/h per stack	5.6	4.7	3.5	6	4.8	3.6	5.5	4.7	3.5
Total Op Emissions (all units)										
NOX	lb/yr	60,115	10,743	0	61,636	10,911	0	60,115	10,576	0
CO	lb/yr	82,182	14,603	0	76,094	13,428	0	50,983	9,064	0
VOC	lb/yr	16,741	3,021	0	17,502	3,021	0	16,741	3,021	0
PM10 (Front & Back Half)	lb/yr	101,967	20,143	0	103,488	20,311	0	101,967	19,975	0
CO2	lb/yr	772,767,486	137,552,260	0	792,241,897	140,382,742	0	769,683,080	136,091,367	0
SO2	lb/yr	15,875	2,788	0	18,056	2,854	0	15,588	2,753	0
Start Emissions			FOR MODELING INFO lb/hr equiv.		Max w/ S/S	Max w/o				
NOX	lb	12.22	[illegible]		26.02	16.90				
CO	lb	11.81	[illegible]		[redacted]	10.80				
VOC	lb	0.04								
PM10 (Front & Back Half)	lb	0.80	4.36		25.06	[redacted]				
CO2	lb	9118								
SO2	lb	0.91	4.98		3.58	3.26				
Time per start	hrs	0.183								
Shutdown Emissions										
NOX	lb	12.59	[illegible]		[redacted]	16.90				
CO	lb	9.84	74.57		19.30	10.80				
VOC	lb	0.03								
PM10 (Front & Back Half)	lb	0.80	6.00		26.54	[redacted]				
CO2	lb	7635								
SO2	lb	0.85	[illegible]		[redacted]	3.26				
Time per shutdown	hrs	0.131								
Annual Total Start/Shutdown Emissions (all units)						Equiv. ops.				
NOX	lb/yr				11,904	1976				
CO	lb/yr				10,443	2432				
VOC	lb/yr				35	647				
PM10 (Front & Back Half)	lb/yr				768	3676				
CO2	lb/yr				8,040,293	23424448				
SO2	lb/yr				848	517				
Total	hrs/yr				152					
ANNUAL TOTAL EMISSIONS (Op+Start/Shut - All units)						[lb/hr basis	FOR SER Max Ann.			
NOX	tpy				42.23	18.18	48.05			
CO	tpy				49.86	21.53	63.80			
VOC	tpy				10.54	4.54	12.72			
PM10 (Front & Back Half)	tpy				83.74	27.45	73.86			
CO2	tpy				479024	206288	528071			
SO2	tpy				9.88	4.25	10.58			
Total	hrs/yr/unit				4644					
H2SO4 (no SU/SO emis)	tpy				25.26					
Stack Info										
Volume Flow (per Unit)	acfm	910,685	782,226	654,011	922,629	790,848	665,979	899,948	776,166	659,309
Exhaust Temperature	F	736	765	800	768	787	800	796	799	800
Stack Diameter	ft	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
Stack Velocity	fps	134.00	115.00	96.00	136.00	117.00	98.00	133.00	114.00	97.00
Stack Height	ft	125	125	125	125	125	125	125	125	125

Equipment		LMS100	LMS100	LMS100	LMS100	LMS100	LMS100	LMS100	LMS100	LMS100
Op Conditions										
NG Sulfur Content		3.48	3.48	3.48	3.48	3.48	3.48	3.48	3.48	3.48
Ambient Temperature (°F)		7	7	7	51	51	51	88	89	88
Relative Humidity		40	40	40	75	75	75	30	30	30
Unit Load (%)		100	75	50	100	75	50	100	75	50
Fuel		NG	NG	NG	NG	NG	NG	NG	NG	NG
Units		2	2	2	2	2	2	2	2	2
Operation per unit										
hrs/mo		340	75	0	340	75	0	340	75	0
hrs/yr		3805	839	0	3805	839	0	3805	839	0
Starts (and assume shutdowns) per unit										
per hour		1			1			1		
per month		20			20			20		
per year		240			240			240		
Op Emissions - Control (SCR/CO Cat; no SO2 scrub)										
NOX	ppmvd @ 15% O2	2.5	2.5	2.5	2.5	7.5	2.5	2.0	2.5	2.5
NOX as NO2	lb/h per stack	7.90	6.40	4.90	8.10	6.50	5.00	7.90	6.30	4.80
CO	ppmvd @ 15% O2	5.6	5.6	5.6	6.0	6.0	5.0	3.5	3.5	3.5
CO	lb/h per stack	10.6	8.7	6.6	10.0	8.0	6.1	6.7	5.4	4.1
VOC	ppmvd @ 15% O2	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
VOC as CH4	lb/h per stack	2.20	1.80	1.30	2.30	1.80	1.40	2.20	1.80	1.30
PM10 (Front & Back Half)	lb/h per stack	17.50	15.30	13.00	17.80	15.40	13.20	17.40	15.20	13.00
CO2	lb/h per stack	101,552	81,843	62,389	104,108	83,829	63,395	101,144	81,073	61,573
SOx as SO2	lb/h per stack	3.18	2.57	1.95	3.26	2.62	1.99	3.17	7.54	1.93
NH3 slip	ppmvd @ 15% O2	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
NH3 slip	lb/h per stack	5.8	4.7	3.6	6	4.5	3.5	5.8	4.7	3.5
Total Op Emissions (all units)										
NOX	lb/yr	60,115	10,743	0	61,636	10,911	0	60,115	10,575	0
CO	lb/yr	82,182	14,603	0	76,094	13,428	0	50,983	9,064	0
VOC	lb/yr	16,741	3,021	0	17,502	3,021	0	16,741	3,021	0
PM10 (Front & Back Half)	lb/yr	133,165	25,682	0	135,448	25,850	0	132,404	25,514	0
CO2	lb/yr	772,753,532	137,548,217	0	792,206,888	140,378,574	0	768,849,271	138,635,387	0
SO2	lb/yr	24,198	4,314	0	24,807	4,398	0	24,122	4,264	0
Stack Info										
Volume Flow (per Unit)	acfm	910,685	782,226	654,011	922,629	790,848	665,979	899,948	776,168	659,309
Exhaust Temperature	F	736	765	800	768	787	800	796	799	800
Stack Diameter	ft	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
Stack Velocity	fps	134.00	115.00	96.00	136.00	117.00	98.00	133.00	114.00	97.00
Stack Height	ft	125	125	125	125	125	125	125	125	125

Equipment		LMS100	LMS100	LMS100	LMS100	LMS100	LMS100	LMS100	LMS100	LMS100
Op Conditions										
NG Sulfur Content		-	-	-	-	-	-	-	-	-
Ambient Temperature (°F)		7	7	7	51	51	51	88	88	88
Relative Humidity		40	40	40	75	75	75	30	30	30
Unit Load (%)		100	75	50	100	75	50	100	75	50
Fuel		Dist.	Dist.	Dist.	Dist.	Dist.	Dist.	Dist.	Dist.	Dist.
Units		2	2	2	2	2	2	2	2	2
Operation per unit										
hrs/mo										
hrs/yr		275	61	0	275	61	0	275	61	0
Starts (and assume shutdowns) per unit										
per hour		1			1			1		
per month										
per year		14			14			14		
Op Emissions - Control (SCR/CO Cat; no SO2 scrub)										
NOX	ppmvd @ 15% O2	5	5	5	5	5	5	5	5	5
NOX as NO2	lb/h per stack	16.50	13.30	10.10	16.90	13.60	10.30	16.70	12.70	9.70
CO	ppmvd @ 15% O2	7.2	7.8	3.3	2.2	2.6	3.3	2.4	2.8	3.5
CO	lb/h per stack	4.4	4.7	4.0	4.6	4.3	4.1	4.6	4.3	4.1
VOC	ppmvd @ 15% O2	5.6	5.9	6.6	5.6	5.6	5.6	5.9	5.5	6.6
VOC as CH4	lb/h per stack	6.40	6.20	3.80	6.60	6.30	4.00	6.10	5.00	3.80
PM10 (Front & Back Half)	lb/h per stack	29.70	29.40	28.00	29.70	29.40	29.10	29.60	29.30	29.00
CO2	lb/h per stack	138,686	111,888	85,154	142,040	114,188	86,495	132,458	107,033	81,385
SOx as SO2	lb/h per stack	0.47	0.38	0.29	0.49	0.39	0.30	0.45	0.37	0.29
NH3 slip	ppmvd @ 15% O2	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
NH3 slip	lb/h per stack	6.0	4.9	3.7	6.2	5.0	3.8	5.8	4.7	3.5
Total Op Emissions (all units)										
NOX	lb/yr	9,084	1,615	0	9,304	1,657	0	8,844	1,542	0
CO	lb/yr	2,427	510	0	2,533	522	0	2,478	522	0
VOC	lb/yr	3,524	632	0	3,834	644	0	3,358	607	0
PM10 (Front & Back Half)	lb/yr	18,352	3,570	0	18,352	3,570	0	18,299	3,568	0
CO2	lb/yr	76,754,418	13,588,142	0	78,200,847	13,267,431	0	72,925,324	12,998,534	0
SO2	lb/yr	259	46	0	270	47	0	248	46	0
Start Emissions			lb/hr equiv.		Max w/ S/S	Max w/o				
NOX	lb	21.56	717.58		35.38	16.90				
CO	lb	15.46	[illegible]		[redacted]	10.80				
VOC	lb	0.45								
PM10 (Front & Back Half)	lb	3.47	16.91		27.72	[redacted]				
CO2	lb	12222								
SO2	lb	0.12	0.63		2.78	[redacted]				
Time per start	hrs	0.183								
Shutdown Emissions										
NOX	lb	22.26	[illegible]		[redacted]	16.90				
CO	lb	13.50	101.27		22.86	10.60				
VOC	lb	0.33								
PM10 (Front & Back Half)	lb	3.47	26.00		29.21	[redacted]				
CO2	lb	10068								
SO2	lb	0.03	0.68		2.92	[redacted]				
Time per shutdown	hrs	0.133								
Annual Total Start/Shutdown Emissions (all units)						Equiv. ops.	NG eq			
NOX	lb/yr				1,227	261	684			
CO	lb/yr				611	79	609			
VOC	lb/yr				22	94	2			
PM10 (Front & Back Half)	lb/yr				194	521	45			
CO2	lb/yr				624,128	2024527	485017			
SO2	lb/yr				5	7	46			
Total	hrs/yr				8.87					
					Note: not using distillate for starts/SDs					
ANNUAL TOTAL EMISSIONS (Op+Start/Shut - All units)						[lb/hr basis]				
NOX	tpy				5.83	34.67				
CO	tpy				1.83	10.80				
VOC	tpy				2.18	13.01				
PM10 (Front & Back Half)	tpy				10.22	80.64				
CO2	tpy				47046.60	280039				
SO2	tpy				0.18	1.09				
Total	hrs/yr/unit				336					
H2SO4 (no SU/SO emis)	tpy				0.62					
Stack Info										
Volume Flow (per Unit)	acfm	909,839	781,085	638,118	920,883	792,453	671,993	879,482	789,156	654,075
Exhaust Temperature	F	754	782	800	784	799	800	800	800	789
Stack Diameter	ft	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
Stack Velocity	fps	134.00	115.00	97.00	136.00	117.00	99.00	130.00	113.00	98.00
Stack Height	ft	125	125	125	125	125	125	125	125	125

Total Emissions from Turbines: Operations (standard load breakdown), Starts/Shutdowns (maximized), dual fuel (maximized), all units
(Data from Black & Veatch, 5/10)

PARAMETER NAME	DEFINITION	7FA.05 (same for 7FA.04)						SGT6-5000F4						LMS100					
		Natural Gas			Distillate Oil			Natural Gas			Distillate Oil			Natural Gas			Distillate Oil		
		Values	Units	Notes	Values	Units	Notes	Values	Units	Notes	Values	Units	Notes	Values	Units	Notes	Values	Units	Notes
SHUTDOWNTIME	The period of time starting with breaker opening and ending with the unit in a static state (i.e. 0 RPM).	19	Min.	Full load to fuel cut.	18	Min.	Full load to fuel cut.	9.4			19	min		8	Min.	Full load to fuel cut. "8 min shutdown." Full to no load is less than 3 min.	8	Min.	Full load to fuel cut. "8 min shutdown." Full to no load is less than 3 min.
STARTUPTIME	The minimum possible period of time starting with a unit start command and ending at minimum continuous load. Refer to the "NFPA 85 Discussion" tab for purge requirements.	29	min	Traditional start. Includes a ~12 minute purge.	29	min	Traditional start. Includes a ~12 minute purge.	23			33	min		11	min	Includes a 5 minute purge. GE published purge time is ~ 2 minutes. Refer to "NFPA 85 Discussion" for 5 min. purge details.	11	min	Includes a 5 minute purge. GE published purge time is ~ 2 minutes. Refer to "NFPA 85 Discussion" for 5 min. purge details.
Startup Emissions	Emissions are presented as pounds per event. Startup times will be provided on the same time basis as startup emissions. Assumed no effects of post-combustion emissions controls.			"Traditional GT Start" to full load.			"Traditional GT Start" to full load.									"10 min startup" to full load.			"10 min startup" to full load.
NOx (as NO2)		30	lb		84	lb		56.00	lb		119.00	lb		12.22	lb		21.56	lb	
CO		122	lb		318	lb		1343.00	lb		1458.00	lb		11.81	lb		15.46	lb	
VOC		17	lb		9	lb		154.00	lb		162.00	lb		0.04	lb	Assumed 20 percent of hydrocarbons.	0.45	lb	Assumed 20 percent of hydrocarbons.
PM10		6	lb	assuming 18 lb/hr from first fire.	11	lb	assuming 34 lb/hr from first fire.	3.27	lb		13.00	lb		0.80	lb	Front and back half estimated assuming 6 lb/hr from first fire.	3.47	lb	assuming 26 lb/hr from first fire.
CO2		32,554	lb	Fuel is 74.21 wt-% Carbon.	46,666	lb	Fuel is 85 wt-% Carbon.	38,547	lb			lb		9,116	lb		12,222	lb	
SO2		3.89	lb	Calculated at 5 gr/100 scf.	0.45	lb	Calculated at 15 ppm.	5.00	lb		0.70	lb		0.51	lb		0.12	lb	
Shutdown Emissions	Emissions are presented as pounds per event. Shutdown times will be provided on the same time basis as shutdown emissions. Assumed no effects of post-combustion emissions controls.			"Traditional Shutdown" from full load.			"Traditional Shutdown" from full load.									"8 min shutdown" from full load.			"8 min shutdown" from full load.
Nox (as NO2)		28	lb		79	lb		25.00	lb		90.00	lb		12.59	lb		22.25	lb	
CO		106	lb		196	lb		321.00	lb		709.00	lb		9.94	lb		13.50	lb	
VOC		13	lb		8	lb		36.20	lb		76.00	lb		0.03	lb	Assumed 20 percent of hydrocarbons.	0.33	lb	Assumed 20 percent of hydrocarbons.
PM10		6	lb	Front and back half estimated assuming 18 lb/hr.	10	lb	Front and back half estimated assuming 34 lb/hr.	1.50	lb		10.00	lb		0.80	lb	Front and back half estimated assuming 6 lb/hr.	3.47	lb	Front and back half estimated assuming 26 lb/hr.
CO2		31,512	lb	Fuel is 74.21 wt-% Carbon.	42,990	lb	Fuel is 85 wt-% Carbon.	18,400	lb			lb		7,635	lb	Fuel is 74.21 wt-% Carbon.	10,068	lb	Fuel is 85 wt-% Carbon.
SO2		3.77	lb	Calculated at 5 gr/100 scf.	0.41	lb	Calculated at 15 ppm.	2.38	lb		0.60	lb		0.85	lb		0.09	lb	

Total Emissions from Turbines: Operations (standard load breakdown), Starts/Shutdowns (maximized), dual fuel (maximized), all units

GE 7FA5 - 7F

Ave Time	Op	Unit ID	ht (ft)	T (F)	v (fps)	d (ft)	Emis (lb/hr) (Based on 1 unit/1 src) NOx	CO	PM	SO2	Notes:	Max Impact (ug/m3) (All Years) NOx	CO	PM	SO2	MODEL
1-hr	NG-100	7F-G100	125	800	132	13	20.70	19.8	47.70	6.22	NG, 3.48 gr/dscf; 7 deg F; 100% load			2.26		--
1-hr	NG-75	7F-G75	125	800	107	23	16.30	15.8	41.60	6.55	NG, 3.48 gr/dscf; 7 deg F; 75% load			2.57		--
1-hr	NG-50	7F-G50	125	800	93	23	12.70	12.4	36.50	5.13	NG; 3.48 gr/dscf; 7 deg F, 50% load			2.74		--
1-hr	D-100	7F-D100	125	800	124	23	44.10	42.30	38.50	1.26	Distillate; 7 deg F; 100% load.			1.97		--
1-hr	D-75	7F-D75	125	800	105	23	35.20	34.20	37.70	1.00	Distillate; 7 deg F; 75% load.			2.40		--
1-hr	D-50	7F-D50	125	799	87	23	26.70	27.20	36.80	0.79	Distillate; 7 deg F; 50% load.			[illegible]		24-hr PM

GE 7FA5 - 51F

Ave Time	Op	Unit ID	ht (ft)	T (F)	v (fps)	d (ft)	Emis (lb/hr) (Based on 1 unit/1 src) NOx	CO	PM	SO2	Notes	Max Impact (ug/m3) (All Years) NOx	CO	PM	SO2	MODEL
1-hr	NG-100	7F-G100	125	800	131	23	19.40	18.6	45.80	7.72	NG, 3.48 gr/dscf; 51 deg F; 100% load			2.19		--
1-hr	NG-75	7F-G75	125	800	109	13	15.50	15	40.50	6.24	NG; 3.48 gr/dscf; 51 deg F; 75% load			1.43		--
1-hr	NG-50	7F-G50	125	799	96	23	12.30	12	35.90	4.97	NG; 3.48 gr/dscf, 51 deg F; 50% load			2.59		--
1-hr	D-100	7F-D100	125	800	131	23	44.10	42.50	38.50	1.26	Distillate; 51 deg F; 100% load.			1.84		--
1-hr	D-75	7F-D75	125	800	110	23	35.00	34.00	37.70	0.99	Distillate; 51 deg F; 75% load			2.22		--
1-hr	D-50	7F-D50	125	799	92	23	26.90	26.30	36.80	0.79	Distillate; 51 deg F; 50% load			[illegible]		--

GE 7FA5 - 88F

Ave Time	Op	Unit ID	ht (ft)	T (F)	v (fps)	d (ft)	Emis (lb/hr) (Based on 1 unit/1 src) NOx	CO	PM	SO2	Notes:	Max Impact (ug/m3) (All Years) NOx	CO	PM	SO2	MODEL
1-hr	NG-100	7F-G100	125	800	129	23	17.90	17.2	43.80	7.14	NG; 3.48 gr/dscf, 88 deg F, 100% load			2.14		--
1-hr	NG-75	7F-G73	125	799	110	23	14.60	14.2	39.20	5.88	NG; 3.48 gr/dscf; 88 deg F; 75% load			1.31		--
1-hr	NG-50	7F-G50	125	800	98	23	11.90	11.6	35.40	4.81	NG; 3.48 gr/dscf; 88 deg F; 50% load			2.48		--
1-hr	O-100	7F-D100	125	800	131	13	41.40	40.70	38.40	1.11	Distillate; 88 deg F; 100% load.			1.82		--
1-hr	D-75	7F-D75	125	800	112	23	33.90	32.90	37.50	0.96	Distillate, 88 deg F; 75% load.			2.16		--
1-hr	D-50	7F-D50	125	799	94	23	16.00	25.50	36.70	0.77	Distillate; 88 deg F, 50% load.			[illegible]		--

GE 7FA5 - 7F

Ave Time	Op	Unit ID	ht (ft)	T (F)	v (fps)	d (ft)	Emis (lb/hr) (Based on 1 unit/1 src) NOx	CO	PM	SO2	Notes:	Max Impact (ug/m3) (All Years) NOx	CO	PM	SO2	MODEL
1-hr	NG-100	7F4-G100	125	800	135	21	17.40	16.2	46.40	7.01	NG; 3.48 gr/dscf; 7 deg F; 100% load			2.66		--
1-hr	NG-75	7F4-G75	125	799	114	21	14.10	13.2	41.20	5.73	NG, 3.48 gr/dscf; 7 deg F; 75% load			2.79		--
1-hr	NG-50	7F4-G50	125	799	102	11	11.90	11.4	37.60	4.82	NG, 3.48 gr/dscf; 7 deg F; 50% load			[illegible]		24-hr PM
1-hr	D-100	7F4-D100	125	800	135	21	39.20	34.80	38.40	1.12	Distillate, 7 deg F; 100% load			2.20		--
1-hr	D-75	7F4-D75	115	799	114	11	31.40	28.80	37.60	0.90	Distillate, 7 deg F, 75% load.			2.54		--
1-hr	O-50	7F4-D50	125	799	102	21	26.40	24.70	36.90	0.78	Distillate, 7 deg F; 50% load.			2.83		--

GE 7FA5 - 51F

Ave Time	Op	Unit ID	ht (ft)	T (F)	v (fps)	d (ft)	Emis (lb/hr) (Based on 1 unit/1 src) NOx	CO	PM	SO2	Notes	Max Impact (ug/m3) (All Years) NOx	CO	PM	SO2	MODEL
1-hr	NG-100	7F4-G100	125	800	138	21	16.80	15.6	45.40	6.75	NG; 3.48 gr/dscf, 51 deg F; 100% load			1.54		--
1-hr	NG-75	7F4-G75	125	800	116	11	13.60	12.7	40.20	5.47	NG; 3.48 gr/dscf; 51 deg F; 75% load			2.68		--
1-hr	NG-50	7F4-G50	125	799	103	21	11.30	10.8	36.50	4.56	NG, 3.48 gr/dscf; 51 deg F; 50% load			[illegible]		--
1-hr	D-100	7F4-D100	125	800	141	21	39.00	35.20	38.40	1.12	Distillate; 51 deg F; 100% load.			1.10		--
1-hr	D-75	7F4-D75	125	799	117	21	30.90	28.70	37.50	0.88	Distillate, 51 deg F, 75% load.			2.43		--
1-hr	D-50	7F4-D50	125	799	104	21	25.50	23.80	36.90	0.75	Distillate, 51 deg F; 50% load.			2.76		--

GE 7FA5 - 88F

Ave Time	Op	Unit ID	ht (ft)	T (F)	v (fps)	d (ft)	Emis (lb/hr) (Based on 1 unit/1 src) NOx	CO	PM	SO1	Notes:	Max Impact (ug/m3) (All Years) NOs	CO	PM	SO2	MODEL
1-hr	NG-100	7F4-G100	125	800	133	21	15.10	14.3	42.70	6.07	NG; 3.48 gr/dscf, 88 deg F; 100% load			2.49		--
1-hr	NG-75	7F4-G75	125	799	115	21	11.40	11.8	38.40	5.01	NG; 3.48 gr/dscf, 88 deg F; 75% load			7.58		--
1-hr	NG-50	7F4-G50	125	800	105	21	11.00	10.7	36.00	4.42	NG; 3.48 gr/dscf; 88 deg F; 50% load			[illegible]		--
1-hr	D-100	7F4-D100	125	800	138	21	36.20	31.10	38.10	1.03	Distillate, 88 deg F; 100% load			2.13		--
1-hr	D-75	7F4-D75	125	799	117	21	29.00	26.70	37.20	0.86	Distillate, 88 deg F; 75% load.			2.46		--
1-hr	D-50	7F4-D50	115	799	108	21	25.40	23.70	36.80	0.74	Distillate; 88 deg F; 50% load			2.65		--

Siemens SGT6-5000F4 - 7F

Ave Time	Op	Unit ID	ht (ft)	T (F)	v (fps)	d (ft)	Emis (lb/hr) (Based on 1 unit/1 src) NOx	CO	PM	SO2	Notes:	Max Impact (ug/m3) (All Years) NOx	CO	PM	SO2	MODEL
1-hr	NG-100	SM-G100	115	800	130	23	21.10	8.4	40.00	7.39	NG; 3.48 gr/dscf, 7 deg F, 100% load		0.41	1.93		--
1-hr	NG-75	SM-G75	125	799	108	23	17.10	6.8	33.20	6.01	NG; 3.48 gr/dscf, 7 deg F, 75% load		0.41	1.02		--
1-hr	NG-50	SM-G50	115	800	96	23	14.60	14.4	29.50	5.13	NG, 3.48 gr/dscf, 7 deg F, 50% load		1.04	2.13		--
1-hr	D-100	SM-D100	125	800	126	23	49.10	20.80	34.60	1.05	Distillate, 7 deg F, 100% load		1.05	1.74		--
1-hr	D-75	SM-D75	125	799	103	13	38.80	49.60	33.60	0.85	Distillate, 7 deg F, 75% load.		[illegible]	1.20		1-hr, 8-hr CO
1-hr	D-50	SM-D50	125	799	99	23	32.10	46.80	33.40	0.61	Distillate; 7 deg F, 50% load.		3.24	[illegible]		--

Siemens SGT6-5000F4 - 51F

Ave Time	Op	Unit ID	ht (ft)	T (F)	v (fps)	d (ft)	Emis (lb/hr) (Based on 1 unit/1 src) NOx	CO	PM	SO2	Notes:	Max Impact (ug/m3) (All Years) NOx	CO	PM	SO2	MODEL
1-hr	NG-100	SM-G100	125	800	129	23	19.70	7.6	37.00	6.91	NG; 3.48 gr/dscf; 51 deg F; 100% load		0.37	1.80		--
1-hr	NG-75	SM-G75	115	800	106	23	15.70	6	31.10	5.51	NG; 3.48 gr/dscf; 51 deg F; 75% load		0.38	1.95		--
1-hr	NG-50	SM-G50	125	799	94	23	13.40	13.2	27.70	4.71	NG; 3.48 gr/dscf; 51 deg F; 50% load		0.98	2.05		--
1-hr	D-100	SM-D100	125	800	121	23	38.80	18.80	34.10	0.98	Distillate, 51 deg F, 100% load.		0.99	1.80		--
1-hr	D-75	SM-D75	115	800	101	23	31.00	45.20	33.90	0.78	Distillate, 51 deg F, 75% load		3.04	2.24		--
1-hr	D-50	SM-D50	125	800	97	23	29.40	42.80	33.10	0.74	Distillate; 51 deg F; 50% load		[illegible]	[illegible]		--

Siemens SGT6-5000F4 - 88F

Ave Time	Op	Unit ID	ht (ft)	T (F)	v (fps)	d (ft)	Emis (lb/hr) (Based on 1 unit/1 src) NOx	CO	PM	SO1	Notes.	Max Impact (ug/m3) (All Years) NOx	CO	PM	SO1	MODEL
1-hr	NG-100	SM-G100	125	800	124	23	17.70	6.8	34.10	6.22	NG; 3.48 gr/dscf; 88 deg F; 100% load		0.35	1.75		--
1-hr	NG-75	SM-G75	125	799	104	23	14.30	5.6	29.00	5.02	NG; 3.48 gr/dscf; 88 deg F; 75% load		0.36	1.87		--
1-hr	NG-50	SM-G50	125	799	92	23	11.20	12	16.00	4.30	NG; 3.48 gr/dscf; 88 deg F; 50% load		0.91	1.98		--
1-hr	D-100	SM-D100	125	800	116	23	34.80	16.80	33.70	0.88	Distillate; 88 deg F; 100% load.		0.93	1.87		--
1-hr	D-75	SM-D75	125	799	98	23	28.10	41.20	33.00	0.71	Distillate, 88 deg F; 75% load		[illegible]	2.31		--
1-hr	D-50	SM-D50	125	799	95	23	26.70	38.80	32.80	0.67	Distillate, 88 deg F; 50% load		2.84	[illegible]		24-hr PM

LM6100 - 7F

Ave Time	Op	Unit ID	ht (ft)	T (F)	v (fps)	d (ft)	Emis (lb/hr) (Based on 2 units/2 srcs) NOx	CO	PM	SO2	Notes.	Max Impact (ug/m3) (All Years) NOx	CO	PM	SO2	MODEL
1-hr	NG-100	LM-G100	125	736	134	11	7.90	10.8	17.50	3.18	NG; 3.48 gr/dscf; T deg F; 100% load	1.91		4.23		--
1-hr	NG-75	LM-G75	125	765	115	12	6.40	8.7	15.30	2.57	NG; 3.48 gr/dscf, 7 deg F, 75% load	1.74		4.16		--
1-hr	NG-50	LM-G50	125	800	96	11	4.90	6.6	13.00	1.95	NG; 3.48 gr/dscf, 7 deg F; 50% load	1.57		4.16		--
1-hr	O-100	LM-D100	125	754	134	12	16.50	4.40	29.70	0.47	Distillate; 7 deg F; 100% load	[illegible]		[illegible]		--
1-hr	D-75	LM-D75	125	782	115	12	13.30	4.20	29.40	0.38	Distillate; 7 deg F; 75% load	3.58		[illegible]		--
1-hr	D-50	LM-D50	125	800	97	12	10.10	4.00	29.00	0.29	Distillate, 7 deg F; 50% load.	3.20		[illegible]		(No op. time at 50% Load)

LM6100 - 51F

Ave Time	Op	Unit ID	ht (ft)	T (F)	v (fps)	d (ft)	Emis (lb/hr) (Based on 2 units/2 srcs) NOx	CO	PM	SO1	Notes:	Max Impact (ug/m3) (All Years) NOx	CO	PM	SO1	MODEL
1-hr	NG-100	LM-G100	125	768	136	12	8.10	10	17.80	3.26	NG; 3.48 gr/dscf; 51 deg F; 100% load	1.92		4.23		--
1-hr	NG-75	LM-G75	125	787	117	12	6.50	8	15.40	2.62	NG; 3.48 gr/dscf; 51 deg F; 75% load	1.71		4.06		--
1-hr	NG-50	LM-G50	125	800	98	12	5.00	6.1	13.20	1.99	NG; 3.48 gr/dscf; 51 deg F; 50% load	1.57		4.13		--
1-hr	D-100	LM-D100	125	784	136	12	16.80	4.60	29.70	0.49	Distillate; 51 deg F, 100% load.	[illegible]		[illegible]		1-hr NOx
1-hr	D-75	LM-D75	125	799	117	12	13.60	4.30	29.40	0.39	Distillate, 51 deg F, 75% load	3.56		[illegible]		--
1-hr	D-50	LM-D50	125	800	99	12	10.30	4.10	29.10	0.30	Distillate; 51 deg F, 50% load	3.19		[illegible]		(No op. time at 50% Load)

LM6100 - 88F

Ave Time	Op	Unit ID	ht (ft)	T (F)	v (fps)	d (ft)	Emis (lb/hr) (Based on 2 units/2 srcs) NOx	CO	PM	SO2	Notes:	Max Impact (ug/m3) (All Years) NOx	CO	PM	SO2	MODEL
1-hr	NG-100	LM-G100	125	798	133	12	7.90	6.7	17.40	3.17	NG; 3.48 gr/dscf; 88 deg F, 100% load.	1.88		4.14		--
1-hr	NG-75	LM-G75	125	799	114	12	6.30	5.4	15.20	2.54	NG; 3.48 gr/dscf; 88 deg F; 75% load	1.69		4.09		--
1-hr	NG-50	LM-G50	125	800	97	12	4.80	4.1	13.00	1.93	NG; 3.48 gr/dscf; 88 deg F; 50% load	1.52		4.11		--
1-hr	D-100	LM-D100	125	800	130	12	15.70	4.50	29.60	0.45	Distillate; 88 deg F, 100% load	[illegible]		[illegible]		24-hr PM - 90% of time
1-hr	D-75	LM-D75	125	800	113	11	12.70	4.30	29.30	0.37	Distillate; 88 deg F; 75% load	3.44		[illegible]		24-hr PM - 10% of time
1-hr	D-50	LM-D50	125	799	96	11	9.70	4.10	29.00	0.28	Distillate; 88 deg F, 50% load	3.11		[illegible]		(No op. time at 50% Load)

Maximum fuel/load for each temperature condition
Maximum, as above, over all temperatures; this scenario used for refined analysis
Real maximum, but not used due to operations during averaging period

Total Emissions from Turbines: Operations (standard load breakdown), Starts/Shutdowns (maximized), dual fuel (maximized), all units

REFINED MODELING FOR TURBINES (Emergency generator model input shown on separate sheet)

GE 7FA.05

Ave Time	Op	Unit ID	ht (ft)	T (F)	v (fps)	d (ft)	NOx	NOx-1	CO-1	CO-8	PM	PM-24	SO2	SO2-3	SO2-24	Notes:
							Emis (lb/hr) (Based on 1 unit/1 src)									
Ann	NG-all	7F5-A	125	800	104	23					9.45					Annual NG and Distillate - all loads based on predicted use (op scenarios); NG at 2.25 gr/100dscf, ave temp (51F).
24-hr	D-50	7F5-24	125	799	87	23						36.80				Distillate; 50% load; 7 deg F.

GE 7FA.04

Ave Time	Op	Unit ID	ht (ft)	T (F)	v (fps)	d (ft)	NOx	NOx-1	CO-1	CO-8	PM	PM-24	SO2	SO2-3	SO2-24	Notes:
							Emis (lb/hr) (Based on 1 unit/1 src)									
Ann	NG-all	7F4-A	125	800	111	21					9.63					Annual NG and Distillate - all loads based on predicted use (op scenarios); NG at 2.25 gr/100dscf; ave temp (51F).
24-hr	NG-50	7F4-24	125	799	102	21						37.60				NG at 3.48 gr/100 dscf; 50% load; 7 deg F.

Siemens SGT6-5000F4

Ave Time	Op	Unit ID	ht (ft)	T (F)	v (fps)	d (ft)	NOx	NOx-1	CO-1	CO-8	PM	PM-24	SO2	SO2-3	SO2-24	Notes:
							Emis (lb/hr) (Based on 1 unit/1 src)									
Ann	NG-all	SG-A	125	800	101	23					7.02					Annual NG and Distillate - all loads based on predicted use (op scenarios); NG at 2.25 gr/100dscf; ave temp (51F).
1-hr, 8-hr	D-75	SG-1	125	799	103	23			2066.88	2066.88						Distillate; 75% load; 7 deg F; 1 NG start and 1 distillate shutdown.
24-hr	D-50	SG-24	125	799	95	23						32.80				Distillate; 50% load, 88 deg F.

LMS100

Ave Time	Op	Unit ID	ht (ft)	T (F)	v (fps)	d (ft)	NOx	NOx-1	CO-1	CO-8	PM	PM-24	SO2	SO2-1	SO2-3	SO2-24	Notes:
							Emis (lb/hr) (Based on 2 units/2 srcs)										
Ann	NG-all	LMS-A	125	771	114	12	5.49				8.44						Annual NG and Distillate - all loads based on predicted use (op scenarios); NG at 2.25 gr/100dscf; ave temp (51F).
1-hr	D-100	LMS-1	125	784	136	12		27.23									Distillate; 100% load; 1 shutdown on NG; 51 deg F.
24-hr	D-100/75	LMS-24	125	800	128	12						22.18					Distillate; 75% (combined for 2 units) use factor over 24 hr period; 90% use at 100% load, 10% use down to 75% load; 88 deg F.

Total Emissions from Turbines: Operations (standard load breakdown), Starts/Shutdowns (maximized), dual fuel (maxir

Caterpillar C18

Rating:	600	kW	(Caterpillar Specification Sheet, 2009)
Exhaust Temperature:	994	F	(Black & Veatch, 8/5/10)
Exhaust Flow Rate:	146	fps	(Black & Veatch, 8/5/10)
Stack Diameter:	10	inches	(Black & Veatch, 8/5/10)
Fuel Use (100% load):	43	Gal/hr	(Caterpillar Specification Sheet, 2009)
Stack Height:	35	ft	(PSE)
Fuel Sulfur Content:	0.0015	%	
Operation:	252	hrs/yr	(includes 52 hrs of testing/maintenance plus 200 hrs of emergency u

	Emission Factor		Emission Rate		MODELING RATES: Short Term	Long Term
Pollutant	g/hp-hr	lb/hp-hr	lb/hr	lb/yr	(1-hr to 24-hr)	(Annual)
NOX	5.53		9.80	2469	9.797	0.2818
CO	0.14		0.25	62.5	0.248	0.00713
VOC	0.01		0.02	4.46		
PM	0.014		0.02	6.3	0.0248	0.00071
CO2		1.16	933	235109		
SO2		1.2E-05	0.01	2.46	0.00976	0.00028

Notes:

NOx, CO, VOC (HC), and PM emission factors from Caterpillar Spec Sheet (2009); CO2 and SO2 emission factors from AP-42, Table 3.4.1.
SDO = shutdown only; engine ops that potentially occur during the same hour as turbine ops.

Total Emissions from Turbines: Operations (standard load breakdown), Starts/Shutdowns (maximized), dual fuel (maximized), all units

MAXIMUM LB/HR ON A 24-HR BASIS (including one emergency engine for the frame turbine options)

		Turbine Option			
		GE 7FA.05	GE 7FA.04	Siemens SGT6	GE LMS100
NOX	lb/hr	47	42	47	27
PM10 (Front & Back Half)	lb/hr	48	46	40	45
SO2	lb/hr	8	7	7	7
H2SO4	lb/hr	22	19	23	17

MAXIMUM EMISSIONS PRORATED TO ANNUAL BASIS ("Q")

		Turbine Option			
		GE 7FA.05	GE 7FA.04	Siemens SGT6	GE LMS100
Q (Based on 8760 hrs op)	tpy	549	502	516	415

Q/D SCREENING

Nearest Class I Site: North Cascades NP

Distance: 66 km km

Turbine Option			
GE 7FA.05	GE 7FA.04	Siemens SGT6	GE LMS100
8.31	7.61	7.82	6.29

TOXIC/HAZARDOUS AIR POLLUTANTS

Common Name	CAS #	TAP	HAP	Averaging Period	SQER (lb/averaging period)	ASIL (µg/m3)	De Minimis (lb/averaging period)	Maximum Emission Factors: Turbine NG	Turbine Distillate	Emerg. Engine Distillate
								lb/MMBtu	lb/MMBtu	lb/MMBtu
Washington Toxic Air Pollutants (TAPs) per 173-460-150										
1,1-Dichloroethylene	75-35-4	Yes	Yes	24-hr	28.3	200	1.31	0.00E+00	2.02E-05	0.00E+00
1,3-Butadiene	106-99-0	Yes	Yes	year	1.13	0.00588	0.0564	8.79E-07	1.58E-05	0.00E+00
Acetaldehyde	75-07-0	Yes	Yes	year	71	0.37	3.55	8.76E-05	0.00E+00	2.12E-05
Acrolein	107-02-8	Yes	Yes	24-hr	0.00789	0.06	0.000394	3.62E-06	0.00E+00	7.89E-06
Arsenic & Inorganic Arsenic Compounds	—	Yes	Yes	year	0.0581	0.000303	0.00291	0.00E+00	1.06E-05	0.00E+00
Benz(a)anthracene	56-55-3	Yes		year	1.74	0.00909	0.0872	0.00E+00	0.00E+00	6.22E-07
Benzene	71-43-2	Yes	Yes	year	8.62	0.0345	0.331	1.36E-06	5.48E-05	7.16E-04
Benzo(a)pyrene	50-32-8	Yes		year	0.174	0.000909	0.00872	0.00E+00	0.00E+00	2.57E-07
Benzo(b)fluoranthene	205-99-2	Yes		year	1.74	0.00909	0.0872	0.00E+00	0.00E+00	1.11E-06
Benzo(k)fluoranthene	207-08-9	Yes		year	1.74	0.00909	0.0872	0.00E+00	0.00E+00	2.18E-07
Beryllium & Compounds (NOS)	—	Yes	Yes	year	0.08	0.000417	0.004	0.00E+00	2.07E-07	0.00E+00
Cadmium & Compounds	7440-43-9	Yes	Yes	year	0.0457	0.000238	0.00228	0.00E+00	4.80E-06	0.00E+00
Chrysene	218-01-9	Yes		year	17.4	0.0909	0.872	0.00E+00	0.00E+00	1.52E-06
Dibenz(a,h)anthracene	53-70-3	Yes		year	0.16	0.000833	0.00799	0.00E+00	0.00E+00	3.44E-07
Ethylbenzene	100-41-4	Yes	Yes	year	76.8	0.4	3.84	1.70E-05	0.00E+00	0.00E+00
Formaldehyde	50-00-0	Yes	Yes	year	32	0.167	1.6	8.80E-04	3.82E-04	2.09E-05
Indeno(1,2,3-cd)pyrene	193-39-5	Yes		year	1.74	0.00909	0.0872	0.00E+00	0.00E+00	4.14E-07
Lead and compounds (NOS)	—	Yes	Yes	year	18	0.0833	10	0.00E+00	2.42E-05	0.00E+00
Manganese & Compounds	—	Yes	Yes	24-hr	0.00526	0.04	0.000263	0.00E+00	2.89E-04	0.00E+00
Mercury, Elemental	7439-97-6	Yes	Yes	24-hr	0.0118	0.09	0.000591	0.00E+00	1.20E-04	0.00E+00
m-Xylene	108-38-3	Yes	Yes	24-hr	29.0	221	1.45	6.38E-05	0.00E+00	1.27E-04
Naphthalene	91-20-3	Yes	Yes	year	5.64	0.0294	0.282	1.37E-06	3.52E-05	1.30E-04
Nitrogen dioxide	10102-44-0	Yes		1-hr	1.03	470	0.457	2.26E-02	2.34E-02	0.00E+00
o-Xylene	95-47-6	Yes	Yes	24-hr	29.0	221	1.45	6.39E-05	0.00E+00	1.27E-04
Perchloroethylene	127-18-4	Yes	Yes	year	32.4	0.169	1.62	0.00E+00	9.24E-05	0.00E+00
Propylene	115-07-1	Yes		24-hr	394	3000	19.7	0.00E+00	0.00E+00	2.79E-03
Propylene oxide	75-56-9	Yes	Yes	year	51.8	0.27	2.59	2.86E-05	0.00E+00	0.00E+00
p-Xylene	106-42-3	Yes	Yes	24-hr	29.0	221	1.45	3.18E-05	0.00E+00	4.15E-04
Selenium & Selenium Compounds (other than Hydrogen Selenide)	—	Yes	Yes	24-hr	2.63	20	0.131	0.00E+00	2.31E-05	0.00E+00
Toluene	108-88-3	Yes	Yes	24-hr	657	5000	32.9	1.34E-04	0.00E+00	2.31E-04
Trichloroethylene	79-01-6	Yes	Yes	year	95.9	0.5	4.8	0.00E+00	2.75E-05	0.00E+00
Vinyl Chloride	75-01-4	Yes	Yes	year	2.46	0.0128	0.123	0.00E+00	5.27E-05	0.00E+00
Additional Federal Hazardous Air Pollutants (HAPs) (per CAA 112(b)) not identified above (or shown as grouped compounds) (but are included again in total HAP calculation)								0.00E+00	0.00E+00	0.00E+00
Xylenes (isomers and mixtures)	1330207		Yes					2.39E-05	0.00E+00	1.93E-04
Chromium Compounds								0.00E+00	1.06E-05	0.00E+00
Nickel Compounds								0.00E+00	8.63E-06	0.00E+00
Selenium Compounds								0.00E+00	3.52E-05	0.00E+00
Total HAP Compounds										

Common Name	Maximum Hourly Emissions: 7FA.05	[illegible]	SGT6	LMS100	Maximum 24-Hour Emissions: 7FA.05	[illegible]	SGT6	LMS100
	lb/hr	lb/hr	lb/hr	lb/hr	lb/day	lb/day	lb/day	lb/day
1,1-Dichloroethylene					1.03E+00	1.75E-01	1.04E+00	2.63E-01
Acrolein					2.24E-01	2.04E-02	2.22E-01	1.50E-01
Manganese & Compounds					4.26E+01	5.83E+00	2.87E+01	3.29E+01
Mercury, Elemental					8.46E-02	5.02E-02	6.18E-02	5.03E-02
m-Xylene					4.12E+03	8.61E+00	0.00E+00	1.75E+00
Nitrogen dioxide	2.30E+02	1.36E+02	1.48E+02	7.30E+01				
o-Xylene					2.12E+00	2.61E+00	4.09E+00	2.76E+00
Propylene					9.87E+00	9.87E+00	9.47E+00	
p-Xylene					6.12E+00	5.31E+00	6.09E+00	2.75E+00
Selenium & Selenium Compounds (other than Hydrogen Selenide)					1.96E+00	1.22E+00	1.30E+00	1.05E+00
Toluene					2.74E+00	3.16E+00	8.18E+00	2.78E+00

Common Name	Maximum Annual Emissions: 7FA.05	[illegible]	SGT6	LMS100
	lb/yr	lb/yr	lb/yr	lb/yr
1,3-Butadiene	1.86E+01	1.33E+01	2.82E+01	2.28E+01
Acetaldehyde	7.61E+01	6.46E+01	1.55E+01	1.47E+02
Arsenic & Inorganic Arsenic Compounds	8.02E+00	7.39E+00	2.63E+00	6.39E+00
Benz(a)anthracene	3.24E-04	3.24E-04	3.24E-04	
Benzene	5.67E+01	5.03E+01	3.47E+01	5.92E+01
Benzo(a)pyrene	3.02E-04	3.82E-04	3.02E-04	
Benzo(b)fluoranthene	1.65E-03	1.25E-03	1.65E-03	
Benzo(k)fluoranthene	3.24E-04	3.24E-04	3.24E-04	
Beryllium & Compounds (NOS)	9.32E-01	2.00E-01	2.75E-01	1.79E-01
Cadmium & Compounds	2.35E+00	3.26E+00	3.44E+00	[illegible]
Chrysene	2.27E-03	7.27E-03	2.27E-03	
Dibenz(a,h)anthracene	3.14E-04	5.14E-04	3.14E-04	
Ethylbenzene	1.38E+02	1.18E+02	1.07E+02	2.37E+02
Formaldehyde	2.71E+05	1.52E+05	1.73E+05	2.37E+05
Indeno(1,2,3-cd)pyrene	6.15E-04	2.19E-04	6.15E-04	
Lead and compounds (NOS)	1.07E+01	9.04E+00	1.07E+01	2.30E+00
Naphthalene	3.23E+01	2.88E+01	2.36E+01	8.12E+00
Perchloroethylene	2.45E+01	3.20E+01	2.94E+01	1.89E+01
Propylene oxide	3.54E+02	1.06E+02	1.20E+02	2.09E+02
Trichloroethylene	2.06E+01	1.87E+01	1.98E+01	2.61E+01
Vinyl Chloride	2.00E+00	6.58E+00	[illegible]	[illegible]
Xylenes (isomers and mixtures)	2.76E+02	2.85E+02	3.24E+02	5.13E+02
Chromium Compounds	8.51E+00	2.31E+00	7.79E+00	6.31E+00
Nickel Compounds	2.49E+00	3.13E+00	3.51E+00	7.09E+00
Selenium Compounds	1.21E+01	1.71E+01	1.87E+01	1.37E+01

Common Name	Maximum Annual HAP Emissions: 7FA.05	[illegible]	SGT6	LMS100
	lb/yr	lb/yr	lb/yr	lb/yr
1,1-Dichloroethylene	1.55E+01	2.97E+01	1.44E+01	5.10E+01
1,3-Butadiene	1.38E+01	2.29E+01	1.32E+01	1.78E+02
Acetaldehyde	7.25E+01	6.48E+01	7.36E+01	2.87E+02
Acrolein	1.57E+01	1.23E+01	1.55E+01	3.02E+01
Arsenic & Inorganic Arsenic Compounds	8.02E+00	2.19E+00	3.65E+00	4.19E+00
Benzene	5.87E+01	5.02E+01	5.47E+01	2.92E+01
Beryllium & Compounds (NOS)	2.31E-01	2.02E-01	2.21E-01	1.79E-01
Cadmium & Compounds	2.82E+00	3.26E+00	2.46E+00	1.80E+00
Ethylbenzene	1.38E+02	1.10E+02	1.13E+02	3.67E+02
Formaldehyde	1.57E+05	2.52E+05	1.73E+05	2.17E+05
Lead and compounds (NOS)	1.07E+01	3.84E+00	1.02E+01	[illegible]
Manganese & Compounds	5.37E+02	2.36E+02	2.69E+02	4.81E+02
Mercury, Elemental	9.08E-01	2.15E-01	8.66E-01	2.01E-01
m-Xylene	3.79E+02	2.35E+02	2.74E+02	5.32E+02
Naphthalene	2.33E+01	3.88E+01	2.50E+01	5.12E+01
o-Xylene	2.76E+02	2.35E+02	2.24E+02	5.37E+02
Perchloroethylene	2.45E+01	1.70E+01	2.16E+01	1.89E+01
Propylene oxide	1.24E+01	1.08E+02	1.23E+02	2.78E+02
p-Xylene	2.76E+02	2.35E+02	2.38E+02	5.32E+02
Selenium & Selenium Compounds (other than Hydrogen Selenide)	5.91E+01	8.93E+01	5.82E+01	1.47E+01
Toluene	2.80E+02	4.94E+02	5.75E+02	5.12E+02
Trichloroethylene	2.06E+01	1.87E+01	1.98E+01	3.81E+01
Vinyl Chloride	1.99E+00	4.58E+01	3.80E+01	[illegible]
Xylenes (isomers and mixtures)	3.79E+02	2.95E+02	2.74E+02	5.33E+02
Total HAP Compounds	2.87E+03	3.30E+03	3.75E+03	6.38E+03
Total HAPs (tpy)	1.33	1.65	1.92	3.09

Common Name	Modeling Emissions: 7FA.05	[illegible]	SGT6	LMS100	Emerg Eng
	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr
1,3-Butadiene	2.58E-03	1.40E-03	2.53E-03	7.51E-04	0.00E+00
Acetaldehyde	8.69E-03	7.40E-03	8.61E-03	1.38E-03	4.27E-06
Acrolein	9.27E-03	3.65E-03	9.20E-03	3.15E-03	4.64E-05
Arsenic & Inorganic Arsenic Compounds	9.15E-04	8.21E-04	8.79E-04	2.54E-04	0.00E+00
Benzene	6.34E-03	2.22E-03	2.11E-03	3.38E-03	1.32E-04
Beryllium & Compounds (NOS)	2.35E-05	2.38E-05	2.23E-05	1.02E-05	0.00E+00
Cadmium & Compounds	6.35E-04	5.72E-04	9.99E-04	2.40E-04	0.00E+00
Ethylbenzene	1.58E-01	1.34E-02	1.37E-02	1.52E-02	0.00E+00
Formaldehyde	7.07E-03	7.13E-03	5.99E-01	1.61E-01	6.94E-05
Manganese & Compounds	1.70E+00	1.59E+00	1.60E+00	8.60E-01	0.00E+00
Mercury, Elemental	5.76E-03	2.47E-03	2.58E-03	5.03E-04	0.00E+00
Naphthalene	2.67E-02	3.29E-01	2.21E-03	1.78E-04	2.20E-05
Nitrogen dioxide	5.10E+02	3.06E+02	1.58E+02	8.40E+01	3.80E+00
Propylene oxide	2.41E-02	1.20E-02	2.40E-02	3.94E-02	0.00E+00
Vinyl Chloride	4.93E-03	4.00E-03	4.04E-03	2.76E-03	0.00E+00

Notes:

[1] XCN where X = H' or any other group where a formal dissociation may occur. For example KCN or Ca(CN)2

[2] Includes mono- and di- ethers of ethylene glycol, diethylene glycol, and triethylene glycol R-(OCH2CH2)n -OR' where n = 1, 2, or 3, R = alkyl or aryl groups.

[3] Includes mineral fiber emissions from facilities manufacturing or processing glass, rock, or slag fibers (or other mineral derived fibers) of average diameter 1 micrometer or less.

[4] Includes organic compounds with more than one benzene ring, and which have a boiling point greater than or equal to 100° C. (Including: Acenaphthene, Acenaphthylene, Anthracene, Benz[a]anthracene, Benzo[a]pyrene, Benzo[b]fluoranthene, Benzo[k]fluoranthene, Benzo[g,h,i]perylene, Chrysene, Dibenzo[a,h]anthracene, Fluoranthene, Fluorene, Indeno[1,2,3-cd]pyrene, Naphthalene, Phenanthrene, Pyrene)

[5] A type of atom which spontaneously undergoes radioactive decay

Only compounds that have emissions >0 are shown (not a comprehensive list of TAPS/HAPS)

Compounds in BOLD indicate emission rates exceeding SQER (requiring modeling analysis to compare with ASIL)

Emission Factor References:

AP-42 Background Document (Emission Factor Documentation for AP-42 Section 3.1 Stationary Gas Turbines, April 2000)

NOx Emissions are from vendor data (turbines and emergency engine)

URS Response to Comments from Herman Wong (EPA) on *Modeling Protocol for Puget Sound Energy Fredonia Generating Station Proposed Development Project, Mount Vernon, Washington* (Draft, June, 2010)

Herman Wong comments (by email, forwarded June 21, 2010) are shown in *blue italic*. URS responses shown in normal type.

----- Forwarded by Nancy Helm/R10/USEPA/US on 06/21/2010 01:00 PM -----
From: Herman Wong/R10/USEPA/US
To: Bryan Holtrop/R10/USEPA/US@EPA
Cc: Nancy Helm/R10/USEPA/US@EPA, islam.mahbubul@epa.gov
Date: 06/21/2010 11:49 AM
Subject: PSE-Fredonia.

Bryan:

I conducted a quick review of the "Draft Modeling Protocol for Puget Sound Energy Fredonia Generating Station, Proposed Development Project" dated June 2010. Its not that exhaustive and I don't believe the protocol is acceptable.

Overall, the Draft Modeling Protocol was not intended to provide the detail that would be presented in the final modeling analysis as part of the permit application, but rather only to present methodology. Based on these EPA comments, URS has revised the Protocol to include more specific project information; this level of detail will likely be rolled directly into the permit application. However, specific details have more potential to change over the course of application development, so we request that the Protocol be reviewed more for methodology, and not be tied to specific emission rates or operational levels. These are provided in the revised Protocol for information only; if changes in these values trigger different regulatory assessments than are presented, URS will submit addendums to the Protocol, as needed to revise methodology for agency approval(s). Complete project details will be presented in the permit application.

PSE should provide

1. Readable Figures 2-2 and 2-3.
Revised figures have been included in the Protocol at a larger scale.

2. Tables showing criteria PTE pollutant emission rates per turbine option, fuel, load, and startup/shutdowns.
These specific tables have been included as an Attachment to the Protocol (subject to change in the final permit application).

3. Specific information about the availability of an allowable and actual emissions inventories from Ecology. Ecology may not have these inventories readily available.
Preliminary analyses show that the modeled impacts will be below Significant Impact Levels (SILs), therefore, cumulative analyses will not be required, and these inventories will not be necessary. If modeling shows that SILs are exceeded, and a cumulative analysis is required, URS will obtain the Actual emission inventories from Ecology and

NWCAA (available, according to Ecology), and will work with these agencies to prepare a protocol for developing an Allowable inventory.

4. Details on the five years of meteorological data (e.g., why is representative, collected in accordance with PSD requirements, audits, data validation...etc.).

As stated in the Draft Protocol, this meteorological data set was previously used in the modeling analyses for Sierra Pacific Industries (SPI) Burlington NOC/PSD permit application, as prepared by Geomatrix. The SPI site is located adjacent to the PSE Fredonia site. Details from the SPI application follow. This text will be added to the Protocol.

> "A representative data set was prepared [by Geomatrix] using a combination of surface data from a meteorological station located at the nearby Puget Sound Refinery owned and operated by Shell Oil Company, supplemented by National Weather Service (NWS) observations from nearby airports including Whidbey Island Naval Air Station (located approximately 12 miles to the southwest of the site), Arlington Municipal Airport (approximately 23 miles southeast of the site), and Burlington-Skagit Regional Airport (approximately 2 miles north-northeast of the site), and NWS upper air data from Quillayute, Washington. Missing data were treated according to EPA guidance (Atkinson, D. and R. F. Lee. *Procedures for Substituting Values for Missing NWS Meteorological Data for Use in Regulatory Air Quality Models*. U.S. EPA, Office of Air Quality Planning and Standards, July 7, 1992).
>
> "According to the *Guidelines* [EPA's *Guideline on Air Quality Models*], five years of representative meteorological data are considered adequate for dispersion modeling applications. Hourly wind speed and wind direction data from January 1995 through December 1999 were obtained from the Shell meteorological station. The station is located approximately 5 miles west of SPI's Burlington facility. A wind rose describing the wind speed and wind direction data recorded at the Shell meteorological monitoring station over the entire five-year dataset is shown in Figure 4-3 [of the SPI Application]. The wind rose shows that the winds are generally bimodal, with winds from the south and southeast following the broad Skagit River Valley, and the winds from the northwest coming from Padilla Bay. Twice-daily mixing height data for the same period were obtained for the monitoring station at Quillayute, Washington, approximately 104 miles west-southwest of the facility.
>
> "Additional meteorological variables and geophysical parameters are required for use in the AERMOD dispersion modeling analysis to estimate the surface energy fluxes and construct boundary layer profiles. Surface characteristics including albedo, Bowen ratio, and surface roughness length were determined for the area surrounding the Shell meteorological station using the AERMET surface characteristic preprocessor, AERSURFACE (version 08009), and the USGS 1992 National Land Cover (NLCD92) land use data set. (The USGS NLCD92 data set is described and can be accessed at http://landcover.usgs.gov/natlandcover.php.) The NLCD92 data set used in the analysis has a 30 m mesh size and 21 land use

categories. Seasonal surface parameters were determined using AERSURFACE according to the EPA's guidance [The AERMET Implementation Guide (EPA, 2008) and AERSURFACE User's Guide (EPA-454/B-08-001, January 2008)].

"Seasonal albedo and Bowen ratio values were based on averaging over a 10-km by 10-km region centered on the Boise [sic] Airport meteorological site [note: per discussion with Clint Bowman at Ecology, this was a typo in the original report; it should refer to the Burlington-Skagit Regional Airport]. An unweighted arithmetic average was used for calculating seasonal albedo; and an unweighted geometric average was used for calculating seasonal Bowen ratio. Seasonal surface roughness values were calculated for 12 30-degree sectors within one kilometer of the Shell meteorological station. An inverse-distance weighted geometric average was used to calculate seasonal surface roughness length values for each of the 12 sectors.

"The AERSURFACE input file requires the user to provide additional location and climatological information regarding the primary meteorological site (Shell). The following information was used to process seasonal surface parameters for the meteorological station:

- The site was assumed to not have continuous snow cover most of the winter. There is typically little or no snowfall at March Point, where the meteorological station is located, and the annual average total snowfall for Anacortes, Washington is zero inches. (Western U.S. Climate Historical Summaries can be accessed at http://www.wrcc.dri.edu/Climsum.html.)
- The site is not located at an airport.
- The site was assumed to not be located in an arid region.
- The surface moisture condition at the site was assumed to be average.

"The EPA meteorological program AERMET (version 06341) was used to combine the Shell meteorological station surface meteorological observations with twice-daily upper air soundings from Quillayute, and to derive the necessary meteorological variables and profiles for AERMOD."

The audit information is not available for this data set, however, because the data has been used in a previous PSD permit application that was acceptable to the relevant agencies, including EPA Region X, we believe it meets all of the proper auditing and data validation requirements.

5. Discuss the sources of background air quality data and its representativeness.

As discussed above, the project impacts are expected to be below all SILs. Therefore, cumulative analyses will not be required; hence background air quality data will not be required.

6. Information and data on the use of OLM (e.g., hourly ozone and NOx/NO2/NO data).

Based on preliminary analyses, OLM will not be necessary for the impact assessment. OLM information has been deleted from the Protocol text.

7. Source of in-stack NO2/NOx ratios.
See above.

8. A request to use OLM in AERMOD with assumptions and input data (i.e., Region 10 approves its use, not Ecology).
See above.

9. Permit limit on number of startups and shutdowns (i.e., daily and annually).
As noted in Item #2 above, this information is provided in the detailed tables (Attachment to Protocol).

10. Justification that a 25% load is not needed. Otherwise, there will be a permit condition to 100%, 75% and 50%.
Peakers typically do not operate below 50% load. However, there may be short-term events for the LMS100's where loads are below 50% (in the 36% range) while operating on natural gas. As shown in the Attachment to the Protocol, the trend for these units on natural gas at lower loads is reduced emissions *and* reduced impacts, and it is expected that this trend will follow down to the 36% load range. Therefore, during permitting, PSE will request additional leverage on these types of permit conditions, where necessary, to account for these short-term events.

11. Run AERMOD at all loads for the three options. There is not AERSCREEN available.
An analysis for each turbine option at each load and temperature will be completed. The wording in the Protocol has been clarified to explain that the 'worst-case scenario analysis' is not a screening tool.

12. Model startup and shutdown emissions.
As noted in Item #2 above, this information has been provided in the detailed tables (Attachment to Protocol).

13. Identify the source of ambient temperature (i.e., 7F, 51F and 88F).
Historical climate data from the National Climate Data Center (NCDC) and Western Regional Climate Center (WRCC) from Mt. Vernon Anacortes were used to determine annual mean ambient temperature. Historic extreme minimum and maximum temperatures from these data sets, along with average days with temperature below and above normal minimum and maximum temperatures, were evaluated to determine 90th percentile extreme minimum and maximum temperatures over a 69-year data period. This data was used by the turbine manufacturers to evaluate stack operating parameters and emission estimates.

14. If stacks are short and there is building downwash, receptors along the fenceline should be 10-meters apart.
Building downwash is included in the analysis, although the effects are expected to be insignificant for the tall turbine stacks. However, we have revised the fenceline receptor to 10-meter spacing. This change has been made in the Protocol.

15. Identify the SILS for Class I areas as these criteria have not

been promulgated by EPA.

These values have been included in the revised Protocol, and will be used as a metric for impact comparison for Class I areas.

16. Justification for the use any non-guideline technique to Region 10 for concurrence (i.e., PM2.5 secondary formation using Ecology's methodology and CALPUFF).

Based on comments from the U.S. Forest Service (USFS), the Protocol has been revised to show that guideline methodologies (CALPUFF) will be used in the analyses.

17. Include a Class II area visibility analysis, growth impacts and impacts to soils and vegetation.

The methodology for a visibility analysis has been added to the Protocol. Because this analysis is near-field, the VISCREEN model will be used. There are no metrics for evaluation, so the data will be presented as informational only. The other Class II area analyses will be performed on a qualitative basis only, as there is no regulatory driver for a detailed assessment.

On the Class I area analysis, the NPS Q/D the areas out. Forest Service is considering its options on how to model impacts at its Class I areas. FWS has no nearby Class I or II areas of concern.

As requested by USFS, guideline methodologies will be included in the analyses for nearby Class I areas. This information has been added to the Protocol.

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Christy Schmitt/Portland/URSCorp

09/24/2010 02:43 PM

To "Ogulei, David (ECY)" <dogu461@ECY.WA.GOV>

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Subject PSE Fredonia - Revised Model Protocol

Hi David et. al. - attached Modeling Protocol for PSE's Fredonia project. The revisions incorporate changes/comments as requested by the EPA and USFS regarding the draft version, along with updated equipment and operating information. The Protocol also includes Attachment A (attached in a separate email), which has detailed emission and modeling information, as requested by EPA (referenced and summarized in the text). Also attached is a Response to EPA Comments document, which shows the individual responses to each of EPA's comments on the draft, as provided in an email dated 6/21/10 (Herman Wong to Bryan Holtrop). There is not a huge amount of detail included on the CALPUFF inputs (as requested by Rick Graw (USFS), who wanted to see example input files) because we have not begun this portion of the modeling. We are still in the process of collecting data for this, but will keep working with Ecology (Bowman) and USFS (Graw) as we proceed.

I think I have included everybody in this email, but feel free to forward as necessary if I missed someone. Hopefully we can get this approved, and get the application in shortly thereafter. Please call/email w/ comments/questions. I appreciate the reviews and your time. Also, I am not sending Attachment A to everybody on this list because it might bog down your system (>7MB). If you do not receive it (email to follow) and want it, please let me know.

Thanks,
Christy

(See attached file: Response to EPA Comments 100924.pdf)(See attached file: PSE-Fredonia Model Protocol 100924.pdf)

Christina C. Schmitt, P.E.
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[attachment "Response to EPA Comments 100924.pdf" deleted by Rick Graw/R6/USDAFS] [attachment "PSE-Fredonia Model Protocol 100924.pdf" deleted by Rick Graw/R6/USDAFS] *(See attached file: Addendum to PSE Fredonia Modeling Protocol 101004.doc)* [attachment "Addendum to PSE Fredonia Modeling Protocol 101004.doc" deleted by Sunghye Chang/Houston/URSCorp] *(See attached file: MtBakerWildernessReceptors.TXT)*

Rick Graw <rgraw@fs.fed.us>

06/11/2010 03:35 PM

To Christy_Schmitt@URSCorp.com

cc "Newman, Alan (ECY)" <anew461@ECY.WA.GOV>, "Bowman, Clint (ECY)" <cbow461@ECY.WA.GOV>, Dee_Morse@nps.gov, "Ogulei, David (ECY)" <dogu461@ECY.WA.GOV>, Holtrop.Bryan@epamail.epa.gov, "Henderson, Joey" <Joey.Henderson@pse.com>, "Boyle, Lea M" <lea.boyle@pse.com>, "Blain, Lindsay (ECY)" <LIBL461@ECY.WA.GOV>, "Lyn Tober" <ltober@nwcleanair.org>, "Adams, Nathan" <nathan.adams@pse.com>, William_Steiner@URSCorp.com

Subject Re: Preapplication Meeting w/ Puget Sound Energy (Fredonia Generating Station) - Draft Modeling Protocol

Christy,

Thank you for the modeling protocol. Unfortunately, I will not be able to participate in the pre-application meeting. As such, I'd like to pass along to you the same comments I provided to Ecology. As the FLAG 2008 document is still draft, it is the USDA Forest Service policy to follow FLAG 2000 until the new FLAG guidance becomes final. Note, this is different from the Department of Interior policy in which they are already accepting FLAG 2008. Currently, I'm using this opportunity to get a feel for the Q/D screening thresholds in the Pacific NW. I don't yet have a feel for the screening thresholds near Mt. Vernon. Hence, I'd like to see a visibility impact analysis for Glacier Peak Wilderness, Alpine Lakes Wilderness and the Mt. Baker Wilderness. Even though the Mt. Baker Wilderness is not a Class I area, we routinely ask applicants to assess impacts on this sensitive Class II area. You need only evaluate impacts to visibility, as the annual increase in N and S are small, so I'm not too concerned about the impacts of deposition.

I'd like to see a more detailed Class I area modeling protocol prepared, which sample CALMET and CALPUFF input files.
Please use the 2003 - 2005, UW 4 km MM5 dat following the EPA-FLM CALMET guidance memo of August 31, 2009. Additionally, if you are going to use hourly ozone data instead of a single background value, there's an issue with the lack of data from high elevation sites. I will be glad to discuss this with you if you'd like.

Thanks.

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Natural Resources
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DRAFT

MODELING PROTOCOL FOR PUGET SOUND ENERGY FREDONIA GENERATING STATION
PROPOSED DEVELOPMENT PROJECT

MOUNT VERNON, WASHINGTON

Prepared for:

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Submitted to:

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P.O. Box 47600
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June, 2010

URS

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Project No. 33762289

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1.1 BACKGROUND

Puget Sound Energy (PSE) owns and operates the Fredonia Generating Station (FGS) at 13085 Ball Road, in Mount Vernon, Washington. The current site is approximately 43 acres and is located approximately five miles northwest of the town of Mount Vernon, south of Skagit Regional Airport. The existing FGS facility consists of two Westinghouse W501D simple cycle combustion generators, and two Pratt & Whitney Model FT-8 Twin Pac simple cycle turbines. All four turbines can be fired on either natural gas or distillate fuel. The Westinghouse turbines (Units 1 and 2) have a base load rating of 104 megawatts (MW) each, and the Pratt & Whitney turbines (Units 3 and 4) have a base load rating of 54 MW each.

The proposed Fredonia Development Project (Project) is a simple cycle electric generating unit addition to the existing FGS. The Project will consist of one or more additional gas combustion turbines totaling approximately 206-210 MW. The Project base design will consist of one of the following simple cycle turbine options:

- One GE 7FA frame turbine, approximately 210 MW;
- One Siemens SGT6-5000F frame turbine, approximately 208 MW; or
- Two 103 MW GE LMS100 high-efficiency aeroderivative turbines, totaling approximately 206 MW.

The purpose of the new generating unit(s) will be to serve future peak load and support PSE's Integrated Resource Plan. Turbine selection will be made on the basis of a commercial and technical evaluation by PSE after further engineering and procurement efforts, possibly after air permits are issued. The selected equipment's thermodynamic and environmental performance will meet or exceed the performance of the turbines analyzed for the permit application. The plant's primary fuel will be natural gas delivered to the site by the adjacent transmission pipeline owned by Cascade Natural Gas. Ultra-low sulfur (0.0015% sulfur) No. 2 distillate (ULSD) is planned as backup fuel, stored onsite in an existing 100,000 barrel tank. Back-up fuel oil will be needed/used when natural gas supply is low. PSE anticipates that operation of the new unit(s) on ULSD will occur no more than 336 hours per year. PSE proposes to interconnect the new unit(s) to the adjacent FGS substation, which is the nearest connection point to PSE's electrical grid.

The existing facility is a major Prevention of Significant Deterioration (PSD) stationary source per 40 CFR 52.21(b)(1)(i), and operates under PSD Permit PSD-01-04, issued on July 29th, 2003, and Northwest Clean Air Agency (NWCAA) Air Operating Permit (AOP) 003-R1, issued March 7, 2005. The proposed Project is expected to be a major modification under PSD (per 40 CFR 52.21(b)(40)). Washington State Department of Ecology (Ecology) is the permitting lead for PSD, with concurrence from the regional agency, NWCAA. Separately, NWCAA will conduct a Notice of Construction (NOC) review and issue an Order of Approval for the proposed Project. At present, the project region is attainment for all criteria air pollutants. It is anticipated that this Project will be permitted prior to adoption of the Environmental Protection Agency's (EPA) proposed revised 1-hour ozone standard.

1.2 PURPOSE

This document presents a summary of the procedures to be used for the air quality dispersion modeling for Project permitting. Modeling of operating impacts will be performed per EPA and Ecology guidance. This protocol is submitted to Ecology for review and approval. Because the facility is within 100 kilometers of PSD Class I areas, Federal Land Managers (FLM's) will be included in the PSD review process for the Project. The proposed model selection and modeling approach has been based on applicable regulations and agency communications.

1.3 ORGANIZATION

The balance of this protocol is organized into the following sections: **2.0** - Project Description; **3.0** - Regulatory Setting; **4.0** - Model Selection; **5.0** - Modeling Approach; and **6.0** - Presentation of Results.

2.1 PROJECT LOCATION

The PSE facility is located at 13085 Ball Road in Mount Vernon, Skagit County, Washington (see Figure 1). The site is on south side of Ovenell Road, south of the west end of the Skagit Regional Bayview Airport, approximately 2.5 miles inland of Padilla Bay. The terrain surrounding the facility is essentially flat. The elevation of the facility is approximately 50 feet above mean sea level (MSL). There are no known sensitive receptors nearby to the facility.

2.1.1 Land Use

The region surrounding the PSE site is primarily agricultural and forest, with a few municipal and industrial facilities in the immediate vicinity, including the Skagit Regional Bayview Airport and the Paccar Technical Center, both north of the PSE facility.

2.2 DESCRIPTION OF THE PROPOSED SOURCE

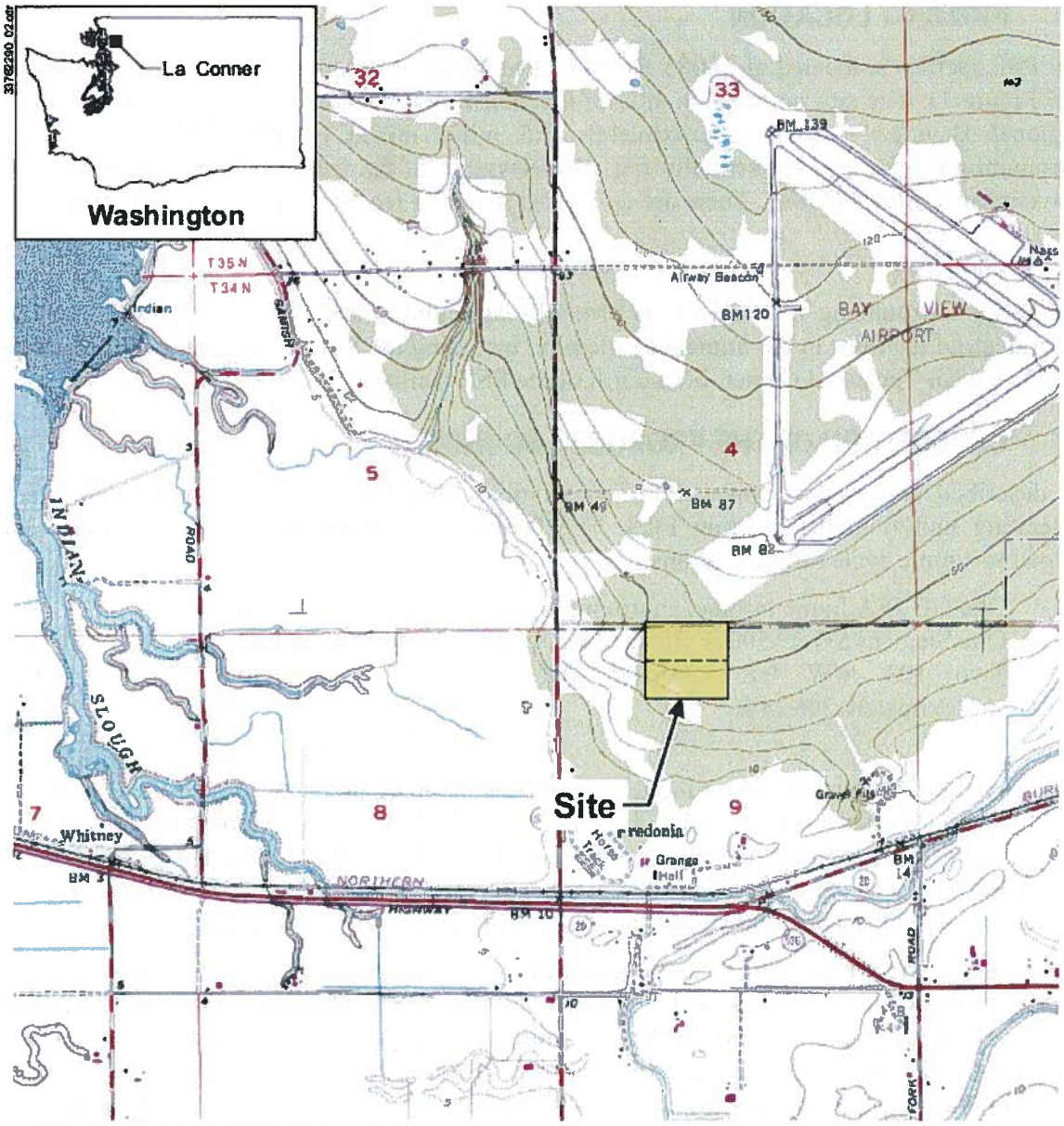
As described above, the proposed Project involves the addition of a simple cycle electric generating unit(s) to the existing FGS. The Project base design will consist of one of the following simple cycle turbine options:

- One GE 7FA frame turbine, approximately 210 MW;
- One Siemens SGT6-5000F frame turbine, approximately 208 MW; or
- Two 103 MW GE LMS100 high-efficiency aeroderivative turbines, totaling approximately 206 MW.

The permit application, including modeling analysis, is being prepared to address each of these options. Final turbine selection will be made on the basis of a commercial and technical evaluation by PSE after further engineering and procurement efforts, possibly after air permits are issued. The selected equipment's thermodynamic and environmental performance will meet or exceed the performance of the turbines analyzed for the permit application.

The plant's primary fuel will be natural gas. Back-up fuel oil (ULSD) will be needed/used when natural gas availability at the site is low. In addition to the turbine(s), the Project will include one diesel emergency generator to serve the new unit(s) in the unlikely event of black starts (loss of the utility grid power). Normally, turbine starts will occur using power from the grid. Testing and maintenance operations for the emergency generator are expected to occur 1 hour per week, or 52 hours per year. The LMS100 turbine options will also include a cooling tower. This cooling tower will serve the LMS100 intercoolers and will be much smaller than a typical combined-cycle power plant cooling tower. Cooling tower equipment and operational details are not available at this time.

A conceptual plot plan for the Frame turbine options (GE 7FA and Siemens SGT6-5000F) is presented in Figure 2. A plot plan for the two GE LMS100 turbine option is presented in Figure 3.



Source: USGS 7.5 minute quadrangle map La Conner, WA
Dated 1956, photorevised 1968 and 1973.

0 0.5 1
Approximate Scale in Miles

Job No. 33762290

Figure 1
USGS Quadrangle Map

URS

Fredonia Development Project

Figure 2-1 – General Location Map

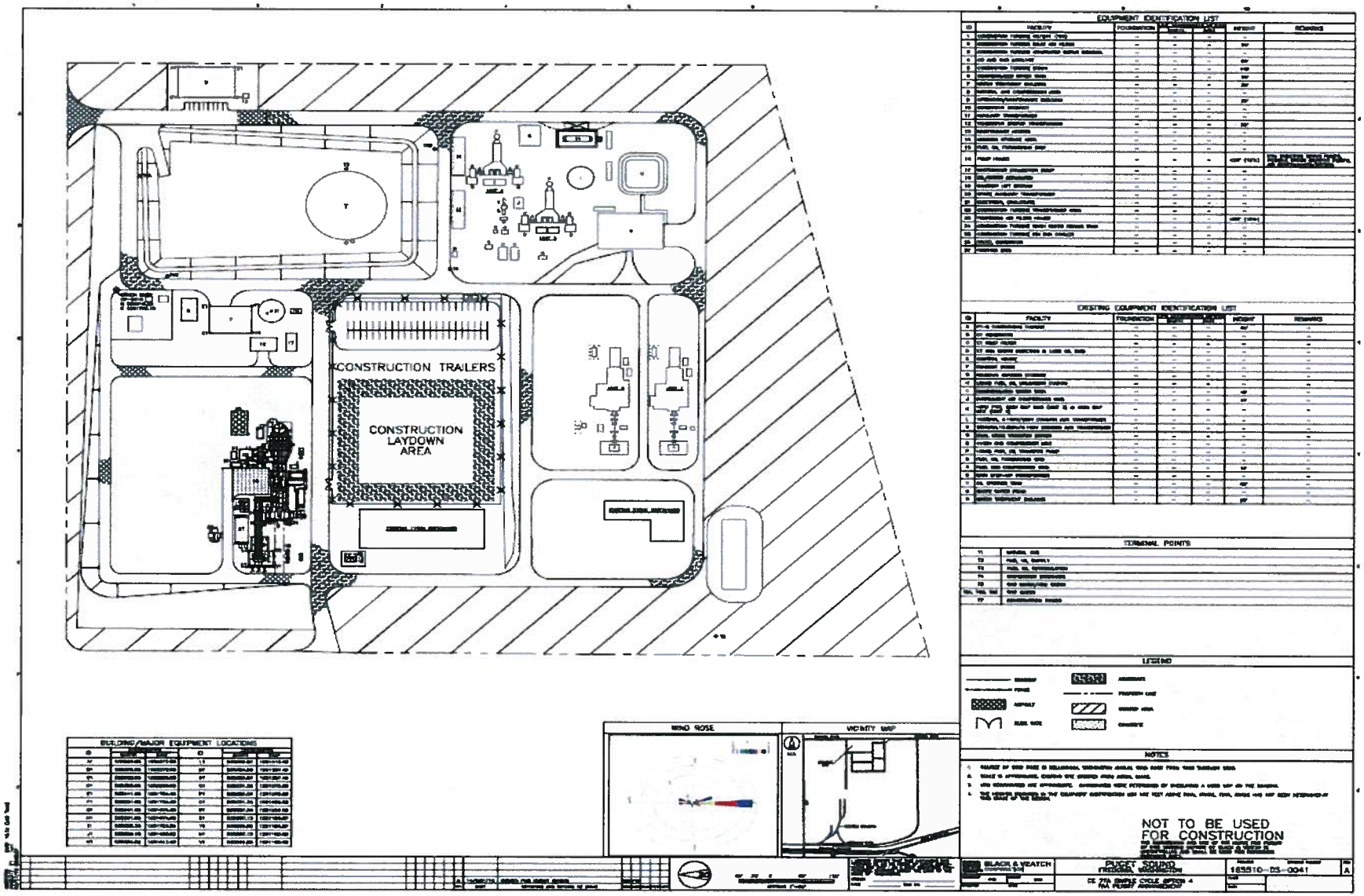


Figure 2-2 – Conceptual Frame Turbine Site Layout (GE 7FA and Siemens SGT6-5000F4)

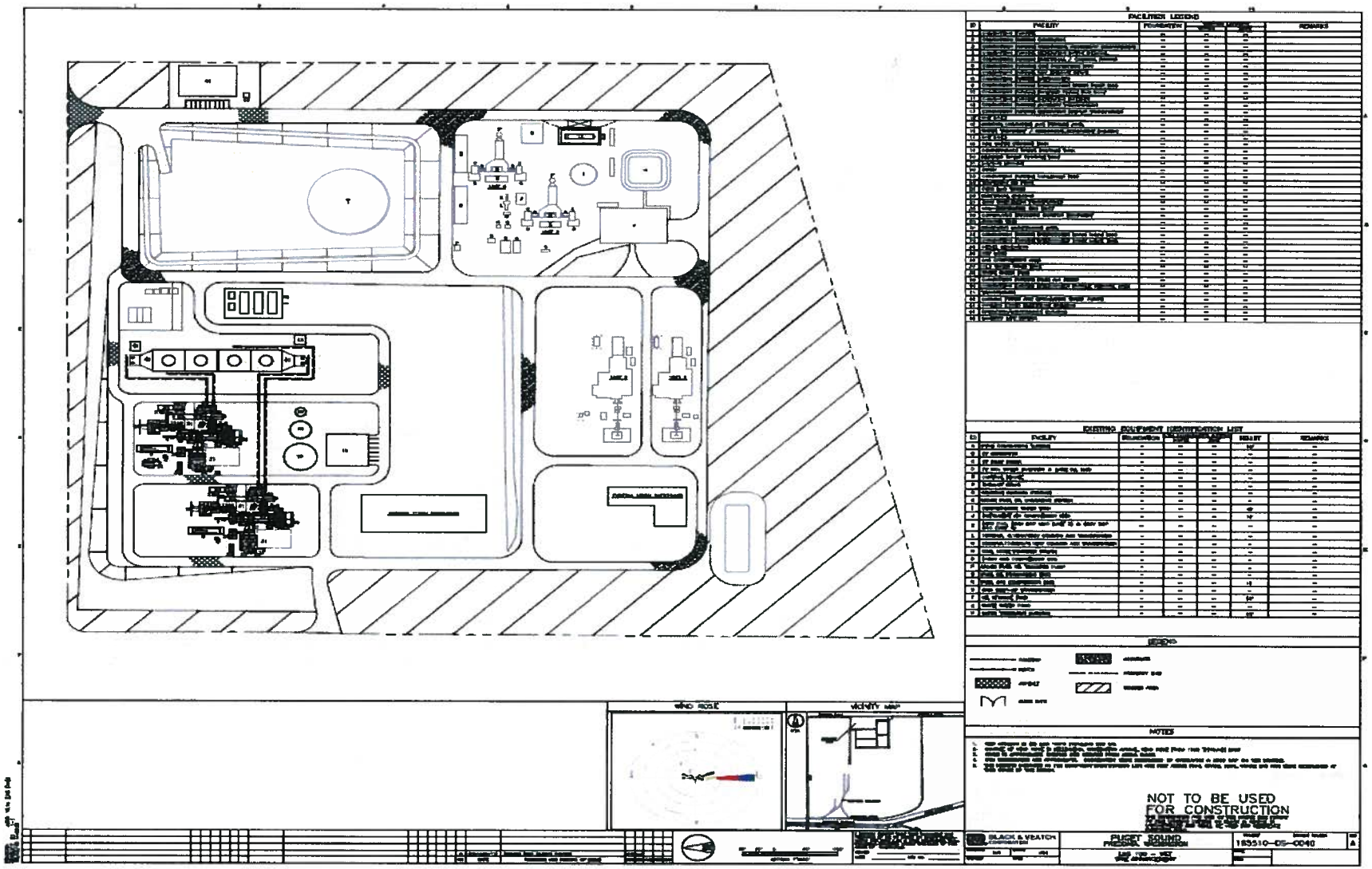


Figure 2-3 – Conceptual GE LMS100 Turbine Site Layout

2.3 ESTIMATED EMISSIONS FOR PSD AND MODELING APPLICABILITY ANALYSES

Annual emissions for the new unit(s) and auxiliary equipment are based on operating scenarios developed by PSE, and were generated from forecast power requirements. Maximum annual operating hours for the Frame turbines (GE 7FA and Siemens 5000 F4) are expected to be approximately 2700 hours per year. Maximum annual operating hours for the GE LMS100's are expected to be approximately 5500 hours per year. A maximum of 336 hours (14 days) firing on distillate is included in the annual emission estimates. A worst-case maximum of 336 hours (consecutive or nonconsecutive) firing on backup ULSD is included in the annual emission estimates. NO_x and CO emissions assume a combination of gas turbine combustion controls, SCR, and oxidation catalyst to achieve 2.5 ppm NO_x under normal operating conditions. CO emissions with oxidation catalyst controls vary for the turbine options; preliminary data show a range of approximately 2-13 ppm CO under normal operating conditions. A worst-case maximum number of start-ups and shutdowns on both natural gas and ULSD are also included in the annual estimates. Table 2-1 summarizes preliminary potential annual emission estimates for the three turbine options.

Table 2-1
Estimated Annual Emissions for the Potential Turbine Options

Pollutant	Expected Increased Emissions (tpy)			Significant Emission Rate (tpy)
	GE 7FA	Siemens SGT6-5000F4	GE LMS100 (2 Units)	
NO_x	33	34	*51*	40
CO	46	*146*	*142*	100
SO_2	6	5	*42*	40
TSP	*46*	*34*	*83*	25
PM_{10}	*46*	*34*	*83*	15
$PM_{2.5}$	*46*	*34*	*83*	10
VOC	8	19	10	40
H_2SO_4	*14*	*15*	*33*	7
Pb	0.0053	0.0045	0.0040	0.6

Notes:
Emissions estimates are based on equipment vendor data (as provided by Black & Veatch) and operating scenarios provided by PSE.
Emissions estimates are inclusive of turbine(s) and one emergency generator; cooling tower emissions are not yet included (for the LMS100 only), so particulate emission totals are underestimated by a small amount (but exceed SER, therefore no change in applicability).
SO_2 and particulate emissions are based on historic annual average sulfur content in natural gas of 2.24 gr/100 dscf reported at the Willliams Northwest Pipeline Sumas compressor station.
Significant Emission Rate (SER) per 40 CFR 52.21(b)(23)(i) and WAC 173-400-030.
Values shown in *italic* indicate exceedance of the SER.

Emissions are expected to exceed the PSD Significant Emission Rates (SER) for all project development options for particulate matter (Total Suspended Particulate (TSP), particulate matter less than 10 microns in diameter (PM_{10}), and particulate matter less than 2.5 microns in

diameter ($PM_{2.5}$)). Emissions may also exceed the SER for nitrogen oxides (NO_x), carbon monoxide (CO), and sulfur dioxide (SO_2) for some options. The project will require air quality evaluations in accordance with Washington Administrative Code (WAC) rules for pollutants that exceed the SER. Applicable regulations and guidelines require that the project use dispersion modeling to demonstrate compliance with applicable ambient air quality standards and PSD increments. The ambient air quality impact and increment analyses will be performed for the worst-case turbine scenarios, which will be determined for each turbine option, and for each pollutant and averaging period. The project's potential annual emissions for volatile organic compounds (VOC) are not expected to exceed the SER.

The proposed Project also has the potential to emit non-criteria air pollutants, known as hazardous and/or toxic air pollutants. These will also be addressed for the Project. Emissions will be compared to Washington State's Small Quantity Emission Rates (SQERs) and Acceptable Source Impact Levels (ASILs), as necessary. Non-criteria pollutant emission rates have not yet been evaluated for the available preliminary Project data.

3.1 REGULATORY APPLICABILITY REVIEW

As described above, Ecology is the state-level governing body for air quality in Washington. In addition, the state is divided into multiple air pollution control agencies. The Mount Vernon site is located within the NWCAA. The air pollution control agencies defer to Ecology for major source attainment permitting issues, such as PSD.

The existing facility is a PSD major source. The New Source Review (NSR) process is triggered for sources that emit emissions in excess of those listed in WAC 173-400-030 (27 – Emission Threshold), and 40 CFR 52.21(b)(23)(i). As shown above in Table 2-1, these SERs are expected to be exceeded for the facility, depending on the pollutant and option. As a result, the Project will have to go through the PSD NSR process.

Requirements for ambient air quality impact modeling to demonstrate compliance with ambient air quality standards and PSD increments include the following:

- Description of the project, including emissions, fuel type(s), control technologies, and stack characteristics;
- The basis for all emission estimates and/or calculations;
- Existing baseline data for all regulated pollutants;
- A description of the meteorological data; and
- A worst-case air quality impact assessment, including an assessment of cumulative impacts if necessary.

3.2 AMBIENT AIR QUALITY STANDARDS (AAQS)

The Clean Air Act of 1970 mandated that the EPA establish ambient ceilings for certain pollutants based upon the identifiable effects that pollutants might have on the public health and welfare. Subsequently, EPA promulgated regulations which set National Ambient Air Quality Standards (NAAQS) for SO_2, TSP, NO_2, CO, non-methane hydrocarbons (NMHC), photochemical oxidants as ozone (O_3), and lead (Pb). The standard for NMHC was eventually changed to a guideline and the ozone standard was revised. After further review, the NAAQS for NMHC was revoked in 1983. A new ambient standard to control ambient concentrations of PM_{10} was promulgated by EPA on July 1, 1987 to replace ambient standards for TSP. In 1997, EPA added standards for $PM_{2.5}$. Pollutants having NAAQS are collectively referred to as criteria pollutants.

Pursuant to the Clean Air Act and its amendments, Washington has adopted the Federal standards for some criteria pollutants, promulgated more stringent standards for others, and promulgated standards for additional pollutants. Ecology has retained the TSP air quality standard. The Federal and Washington Ambient Air Quality Standards are shown in Table 3-1. [Note: this table does *not* include the new federal SO_2 standards (finalized June 2, 2010), which replaces the annual and 24-hour standard with a 1-hr standard of 0.075 ppm. The effective date of this change is not yet available, but it is expected to be in place prior to Project permitting. PSE will use the new 1-hour federal SO_2 standard for analysis, as it is more stringent than the short-term Washington State and local NWCAA SO_2 standards. The permit application will provide further detail on the new standard and its computation.]

Table 3-1
Federal and State Ambient Air Quality Standards

Pollutant	Averaging Period	National Standards Primary	National Standards Secondary	Washington State Standards	Details
Ozone	8-hour	0.075 ppm	0.075 ppm		The 3-year average of the annual 4th highest daily 8-hour maximum is not to be above this level.
	1-hour (Daily Maximum)			0.12 ppm (235 mg/m³)	Not to be above this level on more than 1 day in a calendar year.
Particulate Matter ($PM_{2.5}$)	Annual (Arithmetic Mean)	15.0 µg/m³	15.0 µg/m³		The 3-year average from a community-oriented monitor is not to be above this level.
	24-hour	35 µg/m³	35 µg/m³		The 3-year average of the annual 98th percentile for each population-oriented monitor within an area is not to be above this level.
Particulate Matter (PM_{10})	Annual (Arithmetic Mean)			50 µg/m³	The 3-year average of annual arithmetic mean concentrations at each monitor within an area is not to be above this level.
	24-hour	150 µg/m³	150 µg/m³	150 µg/m³	Not to be above this level on more than three days over 3 years with daily sampling.
Carbon Monoxide	8-hour	9 ppm (10 mg/m³)		9 ppm (10 mg/m³)	Not to be above this level more than once in a calendar year.
	1-hour	35 ppm (40 mg/m³)		35 ppm (40 mg/m³)	Not to be above this level more than once in a calendar year.
Nitrogen Dioxide	Annual (Arithmetic Mean)	0.053 ppm (100 µg/m³)	0.053 ppm (100 µg/m³)	0.05 ppm (100 µg/m³)	Not to be above this level in a calendar year.
	1-hour	0.100 ppm			The 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor is not to be above this level.
Sulfur Dioxide	Annual (Arithmetic Mean)	0.03 ppm		0.02 ppm	Not to be above this level in a calendar year.
	24-hour	0.14 ppm		0.10 ppm	Not to be above this level more than once in a calendar year.
	3-hour		0.5 ppm (1300 µg/m³)		Not to be above this level more than once in a calendar year.
	1-hour			0.40 ppm	Not to be above this level more than once in a calendar year.
	1-hour			0.25 ppm	Not to be above this level more than twice in a consecutive 7-day period.
	5-minute			0.60 ppm	This is the Northwest Clean Air Agency's standard, which applies in Island, Skagit, and Whatcom counties.
Lead	Rolling 3-Month Average	0.15 µg/m³	0.15 µg/m³		Not to be above this level.
	Quarterly Average	1.5 µg/m³	1.5 µg/m³		
Total Suspended Particulate	Annual (Geometric Mean)			60 µg/m³	Not to be above this level.
	24-hour			150 µg/m³	Not to be above this level more than once in a calendar year.

Source: Ecology, April 2010.

Section 107 of the 1977 Clean Air Act Amendments required both the EPA and individual states to evaluate the attainment of the NAAQS. Areas not meeting the NAAQS are designated as non-attainment areas. For these non-attainment areas, states are required to revise their State Implementation Plan (SIP) to provide for attainment of the NAAQS as expeditiously as practical, within certain time limits. Areas lacking in sufficient data for determination of attainment or non-attainment status are designated as unclassifiable, but are treated as being attainment areas until designated otherwise. The classification of an area is made on a pollutant specific basis. The PSE facility is located in Skagit County. Air quality throughout Skagit County is currently designated as unclassifiable or in attainment of each State and/or Federal AAQS.

3.3 AMBIENT AIR QUALITY ANALYSES

As part of the PSD permitting process, continued compliance with the State and Federal air quality standards must be demonstrated through the use of dispersion models. The modeling simulation predicts the impact of the proposed facility and, where applicable, existing background sources. To account for regional background levels and unmodeled sources of the relevant pollutants, a measured background concentration is added to the predicted concentration. This total concentration is then compared to the ambient air quality standards to assess compliance.

EPA has defined a set of impact levels that are used to determine whether a multi-source air quality impact analysis needs to be performed to assess compliance with the NAAQS. These significant impact levels (SILs), which have been adopted by Washington, are shown in Table 3-2. The SILs are generally 1 to 5 percent of the NAAQS (typically 4 percent), and are thus well below any levels which could lead to adverse health or welfare impacts. Impacts below these SILs are presumed to be insignificant. The SILs for the recently revised 24-hour $PM_{2.5}$ and 1-hour NO_2 standards have not yet been finalized. The values shown in Table 3-2 are conservative estimates based on current available information from EPA and recent communication with Ecology staff. SILs for $PM_{2.5}$ are expected to be finalized by EPA by June 20, 2010; modeling for the Project will use these final levels for the permit application analyses when they are released. EPA allows individual states from adopting interim de minimis impact levels to determine whether a cumulative impact analysis will be necessary. PSE will work with Ecology to define an acceptable SIL for 1-hour NO_2 for this project, and will use this value to determine continued (cumulative) modeling analyses, as described below.

The primary purpose of comparing a proposed source's modeled concentrations with the SILs is to establish the source's significant impact area (SIA) for each pollutant and averaging period. The SIA is defined as all locations at which predicted impacts from the Project are above the SILs for the pollutant being considered. EPA and Ecology typically require an applicant to evaluate cumulative impacts of all sources at locations where predicted concentrations attributable to the proposed facility are above the SILs. If the source does not exceed the SILs, evaluation of cumulative impacts is not required. Major background sources located within 50 km of the proposed source's pollutant-specific SIA are generally modeled as part of the multi-source air quality impact analysis. Also, major sources located beyond the SIA, but which themselves have significant impacts within the SIA of the proposed source, are also included in the multi-source impact analysis. Therefore, the SILs are a regulatory tool that define procedures and are not of themselves measures of adverse health impacts. Ecology is expected to provide all applicable source information for the analysis, if required.

Table 3-2
Significant Impact Levels[1]
(micrograms per cubic meter (μg/m³))

Pollutant	Annual	24-Hour	8-Hour	3-Hour	1-Hour
CO	- -	- -	500	- -	2,000
$PM_{2.5}$	0.3 (est.)[2]	1.2 (est.)[2]	- -	- -	- -
PM_{10}	1.0	5.0	- -	- -	- -
SO_2	1.0	5.0	- -	25.0	30.0
NO_2	1.0	- -	- -	- -	7.5 (est.)[3]

[1] WAC 173-400-720

[2] Proposed $PM_{2.5}$ SILs were published in the Federal Register on September 27, 2007 (72 FR 54112) under *Prevention of Significant Deterioration (PSD) for Particulate Matter Less Than 2.5 Micrometers (PM2.5)—Increments, Significant Impact Levels (SILs) and Significant Monitoring Concentration (SMC)*, EPA-HQ-OAR-2006-0605. The three options proposed for Class II areas range between 0.3 and 1.0 μg/m³ for the annual average, and 1.2 and 5.0 μg/m³ for the 24-hour average. The estimated values shown in Table 3-2 are from EPA's most stringent option, or Option 3.

[3] As a general rule, SILs are typically set at 4 percent of the NAAQS, based on EPA's definition of de minimis emission rates for NAAQS impact demonstration purposes (45 FR 52676, August 8, 1980). Using the 1-hr NO_2 NAAQS of 189 μg/m³, the SIL would be 7.5 μg/m³. Unless EPA provides further guidance or finalizes the NO_2 SIL, PSE will use 7.5 μg/m³. The use of this interim SIL has been confirmed with Ecology (Phone conversation between Christy Schmitt (URS) and Clint Bowman (Ecology), June 2, 2010).

For the proposed project, the impact assessment will be performed using dispersion models. (The modeling approach is discussed in more detail in Section 5.0 of this protocol.) PSD modeling requirements include an ambient air quality analysis and an increment consumption analysis for attainment pollutants.

3.4 AIR QUALITY RELATED VALUES (AQRV) AND VISIBILITY

Because the Project is subject to PSD, an analysis of Air Quality Related Values (AQRV) at Class I areas within 100 km of the facility may also be required for this facility. WAC 173-400-030-16 lists the Class I areas in Washington. North Cascades National Park (NCNP), Olympic National Park (ONP), and Glacier Peak Wilderness (GPW) are the only Class I areas within this range. AQRVs include: regional visibility or haze; the effects of primary and secondary pollutants on sensitive plants; the effects of pollutant deposition on soils and receiving bodies of water; and other effects associated with secondary aerosol formation. A modeling approach for addressing impacts of the proposed project on AQRVs in the Class I area is described in Section 5.4.

Visual impacts to Class I areas must also be considered for project permitting. Visibility impairment is defined in WAC 173-400-030-91 as "any humanly perceptible change in visibility (light extinction, visual range, contrast, or coloration) from that which would have existed under natural conditions". In addition, a cumulative impact study that assesses the impacts from multiple sites in the area may be required. Currently, if the visibility impact of the proposed source is less than a 5% change in extinction, a cumulative impact analysis would not be required.

3.5 TOXICS

The proposed Project also has the potential to emit toxic/hazardous non-criteria air pollutants. These are regulated by EPA as hazardous air pollutants (HAPs) under Clean Air Act (CAA) Section 112, and by Ecology as toxic air pollutants (TAPs) under WAC 173-460. Ecology also has a NSR requirement for TAP sources (WAC 173-460-040); an analysis must indicate that the proposed project is in compliance with ASILs.

4.1 METEOROLOGICAL DATA

Representative hourly meteorological data for 1995-1999 were obtained from Shell's March Point Refinery, located approximately 5 miles west northwest of the FGS site. The data are in the standard AERMET meteorological input file format. Upper air data was from the NWS site at Quillayute, WA. This data was recently used for the permitting at Sierra Pacific Industries (SPI) in Mount Vernon, Washington (located adjacent to the FGS site). The processed data was approved for use by Ecology (Phone conversation between Christy Schmitt (URS) and Clint Bowman (Ecology), January 28, 2010).

4.2 BACKGROUND AIR QUALITY DATA

Ozone data for the same five year period was obtained through EPA's Air Quality System (AQS) for the Jackson Visitors Center monitoring station at Mt. Rainier, WA. Ecology recommended use of this data for completeness and because it shows relatively high values, as compared to other ozone monitoring sites within the state, thereby providing a conservative data set for ozone limiting analyses (Email from Clint Bowman (Ecology) to Christy Schmitt (URS), March 2, 2010).

If ambient data are necessary (i.e., if project impacts are above significance thresholds (SIL's)), all background concentrations used to demonstrate compliance with ambient air quality standards will be obtained from Ecology, or through sources approved by Ecology.

Additionally, if cumulative analyses are required, all increment-consuming sources will be included in the modeling emissions inventory. Again, if necessary, all source data will be obtained from Ecology, or through sources approved by Ecology.

5.1 INTRODUCTION

Modeling for a PSD analysis must adequately simulate the concentration increases of emitted pollutants, which are used to demonstrate compliance with ambient air quality standards. The facility emissions include criteria pollutants that will be assumed to be inert for the purpose of NAAQS analyses. In keeping with EPA and Ecology policy, no photochemical modeling for ozone will be conducted since VOC emissions do not exceed the SER.

EPA's *Guideline on Air Quality Models* (Appendix W to 40 CFR 51) recommends the use of the AERMOD dispersion model for PSD analyses of criteria pollutants. AERMOD is the preferred dispersion model for sources located in all types of terrain (simple and/or complex), and for sources subject to aerodynamic building downwash. The modeling analysis will be done using the current version of the AERMOD model (Version 09292). The modeling will provide an indication of the project impact area, and will dictate the extent (if any) of cumulative analyses.

5.2 MODEL INPUT

5.2.1 Emissions

PSE is currently considering three gas turbine options for the proposed FGS Development Project. The individual turbine options will be modeled for the increases in emissions of criteria pollutants that meet applicability levels (exceed SER), as shown above in Table 2-1. These are summarized below, by turbine option:

- GE 7FA – TSP/PM_{10}/$PM_{2.5}$ [note: particulate emissions are assumed to all be fine particulate for each of the turbine options, so modeled emissions are for the grouping];
- Siemens SGT6-5000F - CO, and TSP/PM_{10}/$PM_{2.5}$.; and
- GE LMS100 (2 units) – NO_x, CO, TSP/PM_{10}/$PM_{2.5}$, and SO_2.

Each of these pollutants for analysis has different averaging periods for comparison to NAAQS (and SILs). Therefore, emission rates will be developed for each averaging period. Annual average impacts, for NOx, SO_2, and TSP/PM_{10}/$PM_{2.5}$, will be modeled using the annual average emission rates, as shown in Table 2-1.

Short-term emission rates will be developed using worst-case operating scenarios for the specific pollutant over the time period. These worst-case scenarios are dependent upon both the emission rate *and* the stack parameters under each scenario. For example, operation at higher loads may have increased emissions, but a lower load with lower emissions may have stack exhaust features (such as lower flow rate and temperature) that produce higher impacts. A preliminary load-check screening analysis will be conducted to determine worst-case scenarios. This analysis will include modeling for 1-hour impacts at each load basis (100%, 75%, and 50%), each ambient temperature (7F, 51F, and 88F), and each fuel type (natural gas and ULSD) to determine worst-case load scenarios. The worst-case averaging period scenario for full modeling will then be developed using a combination of worst-case load (that is operationally feasible for the time duration) and start ups and shutdowns when they are operationally feasible for the time duration *and* have the potential to cause higher impacts due to increased emissions (such as in the case of NO_2, but unlikely in the case of particulate emissions which are more dependent on fuel usage than combustion properties). Preliminary results of the worst-case screening have been

completed for the three turbine options. Table 5-1 shows the expected worst-case turbine parameters and emissions that will be included in the refined modeling analyses, along with the corresponding operating conditions which dictate these stack parameters and emissions. Please note that this Modeling Protocol presents preliminary screening results; additional operation and emission data are pending for the turbine options. Final screening results and model scenarios will be presented in the modeling section of the air permit application.

The emergency generator and cooling tower (for the LMS100 only) will also be included in the refined modeling analyses. Emissions from the emergency generator will include one hour of engine testing/maintenance emissions for modeled averaging periods up to 24-hours, and 52 hours of testing/maintenance emissions for annual average modeling. Cooling tower emissions (for the LMS100 turbine option only) are continuous whenever the turbines operate, and will be included at the same hourly rate for all averaging periods.

Emissions of TAPs will be developed for each pollutant by specific averaging period (1-hr, 24-hr, or annual, depending on pollutant ASIL period). HAP and TAP emissions from the turbine options and auxiliary equipment will be determined using vendor data, where available, or AP-42 factors. TAPs that have emissions exceeding SQERs will be modeled using the same methodology as the criteria pollutant analyses, and resultant impacts will be compared to ASILs.

Equipment data, including emissions and stack parameters, will be included in an appendix in the final modeling report.

5.2.2 Building Downwash

For each turbine option, the facility layout, including structure elevations, will be used to enter building locations and dimensions into the Building Profile Input Program for the PRIME algorithm (BPIP-PRIME). The BPIP-PRIME program produces a file of wind-direction specific downwash characteristics for input to AERMOD. The facility layout diagrams are provided in Figures 2 and 3 for the three turbine options. Structures exceeding 20 feet in height will be included in the model setup.

5.2.3 Elevation Data and Receptor Grid

Terrain elevations and hill height scale values for the sources, buildings, and receptors will be calculated using the AERMAP preprocessor with USGS 7.5-minute digital elevation model (DEM) data. The DEM data for the area surrounding the Fredonia site includes the Mt. Vernon and La Conner quadrangles.

Receptors will be located on a Cartesian grid system as follows: 25-meter grid from fenceline out to a distance 100m; 50-meter grid out to 250m; 100-meter grid out to 500m; 250-meter grid out to 1000m, and; 500-meter grid out to 2000m. (Additional receptors will be added further out than 2 km at a 500 meter spacing, if needed to show impacts beyond the normal grid to show impacts above the SIL's.) Nested 25-meter resolution grids will be placed around the initial maximum receptor location (found using the above grid) for each pollutant and averaging period in order to better resolve the maximum impact magnitude and location. Receptor elevations will be based on USGS 7.5-minute DEM data, as described above.

Table 5-1
Turbine Modeling Parameters and Emission Rates

Pollutant	Averaging Period	Stack Temp. (F)	Stack Exit Velocity (fps)	Emission Rate (lb/hr)	Operating Scenario
GE 7FA					
NO_2	Annual	--	--	--	No further analysis; expected below SER.
	1-hour	--	--	--	No further analysis; expected below SER.
CO	1-hour	--	--	--	No further analysis; expected below SER.
	8-hour	--	--	--	No further analysis; expected below SER.
PM	Annual	800	104	10.55	Either 100% natural gas @ average sulfur content (2.24 gr/100dscf) or maximum ULSD use, if greater; annual load mix; average ambient temperature (51F); average start-up and shutdowns.
	24-hour	800	107	41.60	Natural gas @ maximum sulfur content (3.48 gr/100dscf); 75% load; minimum ambient temperature (7F); no start-ups or shutdowns.
SO_2	Annual	--	--	--	No further analysis; expected below SER.
	3-hour	--	--	--	No further analysis; expected below SER.
	24-hour	--	--	--	No further analysis; expected below SER.
Siemens SGT6-5000F4					
NO_2	Annual	--	--	--	No further analysis; expected below SER.
	1-hour	--	--	--	No further analysis; expected below SER.
CO	1-hour	799	103	1480.32	ULSD; 1 start-up; remainder of hour at 75% load; minimum ambient temperature (7F).
	8-hour	799	103	315.10	ULSD; 1 start-up and 1 shutdown; remainder of period at 75% load; minimum ambient temperature (7F).
PM	Annual	800	101	7.87	Either 100% natural gas @ average sulfur content (2.24 gr/100dscf) or maximum ULSD use, if greater; annual load mix; average ambient temperature (51F); average start-up and shutdowns.
	24-hour	800	126	34.60	ULSD; 75% load; minimum ambient temperature (7F); no start-ups or shutdowns.
SO_2	Annual	--	--	--	No further analysis; expected below SER.
	3-hour	--	--	--	No further analysis; expected below SER.
	24-hour	--	--	--	No further analysis; expected below SER.

Table 5-1 (continued)
Turbine Modeling Parameters and Emission Rates

Pollutant	Averaging Period	Stack Temp. (F)	Stack Exit Velocity (fps)	Emission Rate (lb/hr)	Operating Scenario
GE LMS100 (each unit)					
NO_2	Annual	774	129	5.82	Natural gas, with 336 hrs ULSD; annual load mix; average ambient temperature (51F); maximum start-up and shutdowns.
	1-hour	794	131	36.81	ULSD; 1 shutdown; remainder of hour at 100% load; minimum ambient temperature (7F).
CO	1-hour	794	131	34.13	ULSD; 1 shutdown; remainder of hour at 100% load; minimum ambient temperature (7F).
	8-hour	794	131	32.34	ULSD; 1 start-up and 1 shutdown; remainder of period at 100% load; minimum ambient temperature (7F).
PM	Annual	774	129	9.47	Either 100% natural gas @ average sulfur content (2.24 gr/100dscf) or maximum ULSD use, if greater; annual load mix; average ambient temperature (51F); average start-up and shutdowns. Plus cooling tower emissions whenever gas turbines are operating.
	24-hour	776	110	26.70	ULSD; 75% load; minimum ambient temperature (7F); no start-ups or shutdowns.
SO_2	Annual	774	129	4.75	Either 100% natural gas @ average sulfur content (2.24 gr/100dscf) or maximum ULSD use, if greater; annual load mix; average ambient temperature (51F); average start-up and shutdowns.
	3-hour	777	133	8.55	Natural gas @ maximum sulfur content (3.48 gr/100dscf); 100% load; minimum ambient temperature (7F); no start-ups or shutdowns..
	24-hour	777	133	8.55	Natural gas @ maximum sulfur content (3.48 gr/100dscf); 100% load; minimum ambient temperature (7F); no start-ups or shutdowns.

5.2.4 Meteorological Data

The meteorological data set from Shell's March Point Refinery will be input to AERMOD. This meteorological data set is described above in Section 4.1.

5.3 CUMULATIVE AND INCREMENT MODELING

If the project is found to have potentially significant impacts (i.e., greater than applicable SILs), a cumulative modeling analysis will be performed which considers the proposed project's emissions (entire facility) combined with other permitted stationary sources within a 50-kilometer radius of the project's SIA. It is anticipated that Ecology would be able to provide sufficient data from permits or applications for modeling of other proposed stationary sources.

Should the project show impacts of PSD pollutants greater than SILs identified in Table 3-2, increment modeling will be performed. This analysis will include increment-consuming sources within the area of significant impact plus 50 km, as defined by the project impact analysis. PSE will work with Ecology to construct the appropriate increment inventory for this analysis, if required.

In addition to these Class II area analyses (if necessary), an evaluation of PM_{10} and $PM_{2.5}$ incremental impact at the nearby Class I Areas will also be conducted. At this time, URS expects that a screening level evaluation will show insignificant impacts (below SILs) and therefore the screening will be sufficient to establish compliance with the PSD Class I increments. (Note: as with the $PM_{2.5}$ SIL, $PM_{2.5}$ increment levels are expected to be finalized on June 20, 2010.) Initial modeling will be performed using AERMOD (following methodology described above), with a maximum receptor distance of 50 km (model limit), and receptor height set at the maximum terrain height within the Class I area. An estimate of secondary particulate formation will be made using the technique described in *A Screening Method Using AERMOD to Estimate the Conversion of NO_x to Nitrate* (email from Clint Bowman (Ecology) to Christy Schmitt (URS), June 2, 2010), which uses transport time due to wind speed, as used in the model analysis, to determine nitrate conversion based on experimental data, and relates this to distance. The resulting screening impact will be compared to the Class I SIL. If this screening analysis does not show compliance with these PM_{10} and $PM_{2.5}$ SILs, a standard CALPUFF analysis will be used to determine a more refined result. An addendum methodology protocol will be submitted to the appropriate federal and state agencies if this level of analysis is required. If the SILs are exceeded, a complete increment analysis will be performed. This will also be described in any required protocol addendum.

5.4 AQRV AND VISIBILITY MODELING

As discussed in Section 3.4, AQRV analyses will be performed at Class I areas to determine potential impacts on sensitive plants, soils, and receiving bodies of water, and whether regional haze (visibility) would be degraded significantly as a result of emissions from the proposed Project.

Federal Land Managers' Air Quality Related Values Workgroup (FLAG) draft guidance (Phase I Report, Revised 6/27/08) includes a threshold ratio of emissions to distance, below which AQRV review is not required. Specifically, this "10D" Rule is:

If Q (tpy)/d (km) is less than 10, no AQRV analysis is required, where:

- Q is the emissions increase of sulfur dioxide (SO2), oxides of nitrogen (NOx), particulate matter less than 10 microns (PM10), and sulfuric acid mist (H2SO4), combined in tons per year (tpy)
- d is the nearest distance to a Class I Area in kilometers (km)

If Q/d is less than 10 for a Class I Area, then presumptively, there is no adverse impact and a project "screens out" of a Class I AQRV analysis. If Q/d results in a value above 10, a Class I analysis is required.

Based on FLAG 2008, estimates are made for the Project's maximum 24-hour emission rates, and then prorated to an annual emission rate assuming full-time (8760 hours) operation. These estimates are made for each turbine option. Table 5-2 provides preliminary estimates of both the specific pollutant emission rates, and the total, Q, for each turbine technology option. These values are then divided by the distance to the nearest Class I area (NCNP at 66 kilometers from the Project site). Using these conservative estimates for emissions, none of the Project options are expected to require a Class I analysis. [Note: The preliminary emissions estimates are based on current data for the three Project options, using worst-case operations profiles, by pollutant, for a 24-hour period. This may include startups and shutdowns, and either natural gas or distillate fuel, depending on the pollutant (see operation scenarios in Table 5-1 above). It also includes one hour of emergency engine use. This screening will be refined as more information on Project emissions is obtained during permit application preparation.]

Table 5-2
Preliminary Project AQRV Screening for Potential Turbine Options

	Turbine Option		
	GE 7FA	**Siemens SGT6-5000F4**	**GE LMS100 (2 Units)**
Maximum Emissions (lb/hr) on a 24-hour Basis:			
NO_x (lb/hr)	47	47	36
SO_2 (lb/hr)	8	7	17
PM_{10} (lb/hr)	42	35	53
H_2SO_4 (lb/hr)	22	23	14
Sum of Emissions Prorated to Full-Time Annual Basis (tpy):			
Q (tpy)	522	489	524
AQRV Screening:			
Q/d	**7.91**	**7.41**	**7.94**

Notes:
Annual emissions (Q) assume 8760 hrs at maximum 24-hour emission rate (lb/hr).
Distance to nearest Class I Area is 66 km (NCNP).

If refined emission data shows that full AQRV modeling analyses are required (ie, Q/d greater than or equal to 10), analyses will be conducted using the air quality dispersion model CALPUFF following regulatory guidance documents *FLAG Phase I Report-Revised* (Draft, June 2008) and *Interagency Workgroup on Air Quality Modeling (IWAQM) Phase 2 Summary Report and Recommendations for Modeling Long Range Transport Impacts* (December 1998).

CALPUFF is a transport and dispersion model that simulates the advection and dispersal of "puffs" of material emitted from modeled sources. The IWAQM report recommends CALPUFF for use in long-range transportation and dispersion analyses involving one or more emission sources. If the analyses are necessary, inputs to the CALPUFF modeling (meteorology, emissions speciation, background concentrations/extinction values, receptor grids, etc...) and output evaluations will be developed following the guidance documents listed above. An addendum methodology protocol will be submitted to the appropriate federal and state agencies if this level of analysis is required.

The modeling results will be presented as a stand-alone report in support of the PSD Application. This report will describe the models used, modeling options and the derivation of all model inputs, such as emission estimates. Model results will be presented in tabular and graphical form. Maximum impacts will be summarized to show controlling meteorological conditions as well as maximum impact locations and elevations. Model input and output files will be provided in electronic format.