



*Serving Island, Skagit & Whatcom Counties*

**PUGET SOUND ENERGY  
PSE Encogen Generating Station  
Bellingham, Washington**

**AIR OPERATING PERMIT**

**STATEMENT OF BASIS**

**FINAL MODIFICATION**

**August 18, 2006**

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## **SECTION 1 - INTRODUCTION**

The Puget Sound Energy PSE Encogen Generating Station (PSE Encogen), located in Bellingham, Washington, is required to obtain an operating permit because it has the potential to emit 100 tons or more of oxides of nitrogen (NO<sub>x</sub>) and carbon monoxide (CO). These criteria pollutants are emitted during the burning of liquid and gaseous fossil fuels in three combustion turbines and an auxiliary boiler. Electrical power is produced for the Puget Sound Energy grid and steam is produced for the adjacent Georgia Pacific tissue plant. The primary sources of emissions are the three GE Model MS6001B combustion turbines, the 93 MMBtu/hr natural gas-fired Nebraska boiler, and the storage and transfer of fuel oil.

The purpose of this Statement of Basis is to set forth the legal and factual basis for the conditions of the PSE Encogen Air Operating Permit No. 004R1. This document also provides background information to facilitate review of the permit by interested parties. The Statement of Basis is not a legally enforceable document in accordance with WAC 173-401-700(8).

## **SECTION 2 - FACILITY DESCRIPTION**

### **2.1 General Overview**

The PSE Encogen facility is located on approximately 5 acres in the 900 block of Cornwall Avenue in Bellingham, Washington. The plant is approximately 1,000 feet east of Bellingham Bay. The surrounding area is predominantly industrial or commercial; however, there is a small residential area on the hillside east of the plant. Puget Sound Energy assumed complete ownership of the facility in November 1999. The plant was originally constructed and operated by the Enserch Development Corporation.

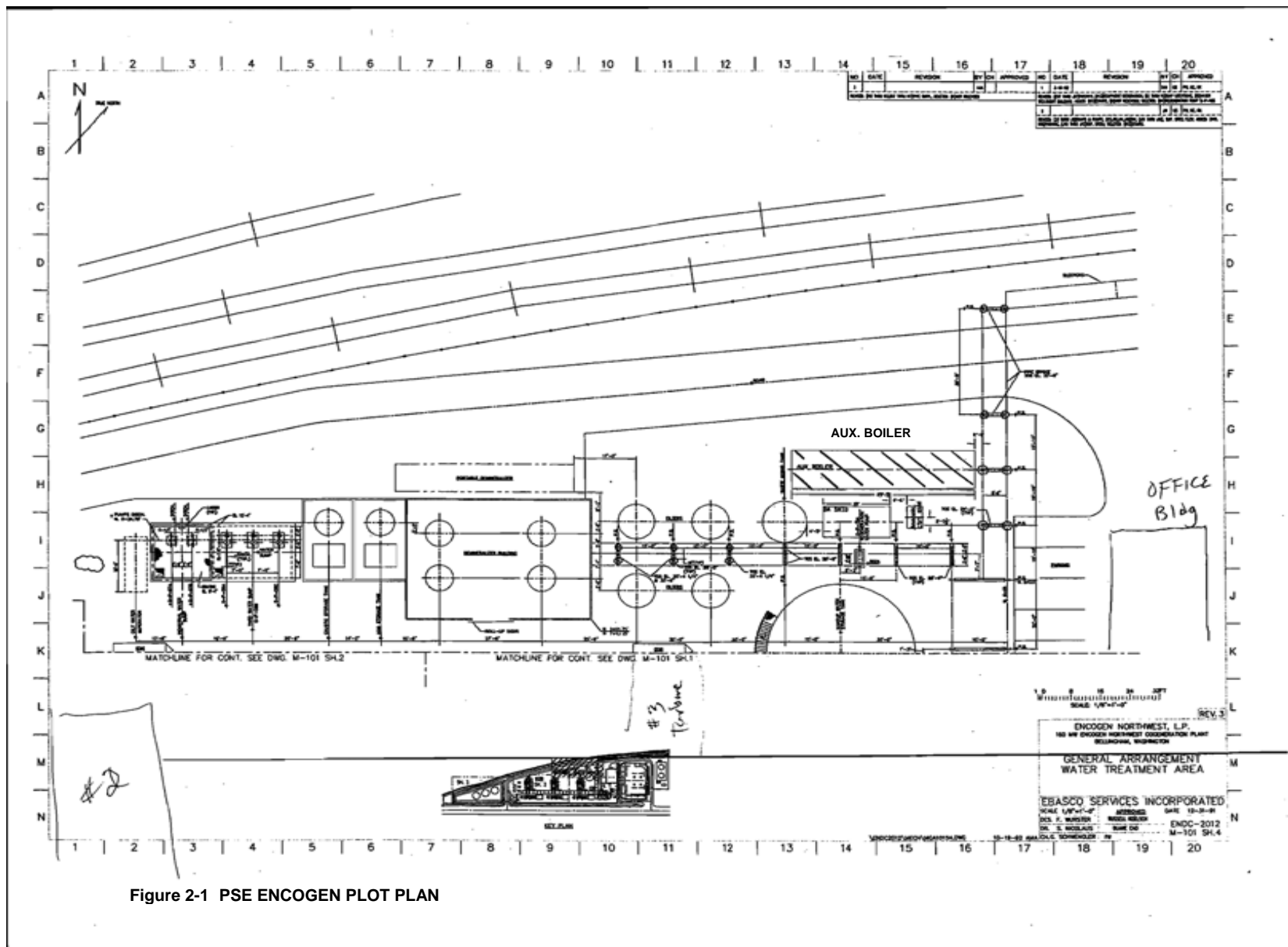
### **2.2 Plant Information**

PSE Encogen contains three combustion gas turbine generator systems and associated heat recovery steam generators (HRSGs), a steam turbine-generator system, an auxiliary natural gas-fired steam boiler, fuel oil storage, an electrical switchyard, and equipment for feed water treatment and combustion turbine exhaust gas cleaning. A facility plot plan is included as Figure 2-1.

PSE Encogen is a combined-cycle cogeneration facility which produces electric power, steam, and hot water from the combustion of fossil fuels. The electric power generated is transferred to the distribution system operated by Puget Sound Energy. The steam and hot water are transferred to the adjacent Georgia-Pacific tissue plant for use in their manufacturing process. In early 2006 a 93 MMBtu/hr Nebraska boiler was added to the facility to provide steam to the Georgia-Pacific plant during times when the turbines are not in operation. A process flow diagram is included as Figure 2-2.

The cogeneration plant uses natural gas as the primary fuel source, but distillate fuel oil is available as a backup fuel to facilitate continued generation of power in the event of a natural gas curtailment. A small amount of fuel oil is used for periodic readiness testing of the turbines. This testing typically consumes less than 100,000 gallons of distillate fuel per year. The backup fuel is maintained in two 470,000-gallon tanks. A third 470,000-gallon tank exists on-site, but is not used nor connected to a fuel supply system. The fuel oil is delivered to the PSE Encogen site by tanker truck from various suppliers.

Natural gas is provided to the facility via pipeline from Canada and is consumed at a maximum nominal rate of 1,320 million British Thermal Units per hour (MMBTU/hr). Electrical output to PSE at full nominal rating is 160 megawatts per hour. Full steam output to Georgia Pacific is about 140,000 pounds per hour.





## **2.3 EMISSION UNITS**

### **2.3.1 Turbine Units**

The combustion turbines are GE Frame 6, Model MS6001B combined cycle combustion gas turbine generator systems and associated heat recovery steam generators. These turbines are designated as Turbine Units 1, 2, and 3, and they each have a separate exhaust stack. Each turbine is rated at 440 million British thermal units of heat input per hour (MMBtu/hr) and 41.5 megawatts (Mw) electrical output when burning primary fuel, natural gas. PSE Encogen employs various techniques to control pollutants generated by the turbines during the combustion process.

Nitrogen oxides (NO<sub>x</sub>) are controlled by injection of steam into the turbine combustors and the use of a selective catalytic reduction (SCR) system. Steam injection limits peak combustion temperatures thereby limiting formation of thermal NO<sub>x</sub>. To facilitate SCR operation ammonia is injected ahead of a catalyst grid in the HRSG section. Most of the NO<sub>x</sub> reacts to form elemental nitrogen and water in the presence of ammonia and catalyst. Ammonia (NH<sub>3</sub>) emissions are controlled by carefully regulating the rate of ammonia injection to the SCR system.

Sulfur dioxide emissions are controlled by use of natural gas and “on-road spec” diesel fuels, both of which are considered to be low sulfur fuels.

Emissions of particulate matter, nearly all of which is composed of particles with a mean aerodynamic diameter smaller than 10 microns (PM<sub>10</sub>), as well as carbon monoxide (CO) and volatile organic compounds (VOCs), is minimized by the use of “good combustion practices.” Stationary turbines generate the least amount of combustion byproducts such as PM<sub>10</sub>, CO, and VOC when they are operating most efficiently.

Continuous emission monitoring systems (CEMS) continuously measure emissions of NO<sub>x</sub>, and O<sub>2</sub> from the turbine exhaust stacks.

### **2.3.2 Auxiliary Boiler**

In early 2006, a 93 MMBtu/hr natural-gas fired Nebraska Model NOS 2A/S-55 boiler was added to the operating equipment at the facility in order to provide steam to the adjacent Georgia-Pacific tissue plant during periods when operating the turbines are uneconomical. Sulfur emissions from the boiler are controlled by limiting the fuel to only natural gas. Natural gas supplied to the facility typically contains less than 1 grain/100 scf hydrogen sulfide. Nitrogen oxides (NO<sub>x</sub>) emissions from the boiler will be controlled by low NO<sub>x</sub> burners and a selective catalytic reduction system (SCR) which utilizes ammonia in the presence of a catalyst to remove NO<sub>x</sub> from boiler combustion exhaust gases. NO<sub>x</sub> emissions are limited to 9 ppmv – a very low emission level representative of “best available control technology” (BACT) for these types of combustion units. Compliance with NO<sub>x</sub> limits will be determined by annual source testing at the boiler stack.

### **2.3.3 Distillate Oil Storage Tanks**

The facility has two distillate oil storage tanks with each tank having a capacity of 470,000-gallons. On March 20, 2004 a third tank used for distillate storage was decommissioned due to reduced requirement for on-site storage of backup fuel. “Good engineering practices” are used to minimize evaporative emissions of VOCs from the oil storage tanks. Good engineering practices consist of painting the tanks a light color, using them only for storage of low vapor pressure diesel fuel and taking precautions to minimize spillage during fuel transfer activities.

### 2.3.4 Ammonia Storage

The anhydrous ammonia storage and delivery system used in conjunction with the SCR system to reduce emissions of NO<sub>x</sub> at the combustion turbines is scheduled to be converted to an aqueous storage and delivery system in 2006. Switching to the aqueous system will reduce the inherent risk associated with the storage and handling of large quantities of anhydrous ammonia to plant personnel and the public in the surrounding area.

In addition, a small amount of anhydrous ammonia is injected into the SCR system at the auxiliary boiler. The anhydrous ammonia for this separate system will be stored in small cylinders with a capacity of about 150 pounds each.

## 2.4 Emissions Data

The facility qualifies as a major source subject to the requirements of the Title V program because it has the potential to emit more than 100 tons per year (tpy) of nitrogen oxides (NO<sub>x</sub>) and carbon monoxide (CO). The primary sources of emissions are the three combustion turbines.

Table 2.1 below shows the recent emissions history of the facility as identified in the annual emissions inventory submitted to NWCAA for the five year period from 2000 through 2004.

**Table 2.1 Summary of Emission Inventory Data 2000-2004**

Pollutant tons/year	2000	2001	2002	2003	2004
PM <sub>10</sub>	15	11	16	9	6
NH <sub>3</sub>	36	36	33	28	13
SO <sub>2</sub>	4	12	8	7	4
CO	37	38	26	22	13
NO <sub>x</sub>	143	144	100	82	51
VOC	2	3	1	1	1
Formaldehyde	1.4	1.4	0.9	0.8	0.5

## 2.5 Facility History

### 2.5.1 Cogeneration Facility

The facility was permitted in 1991 to burn only natural gas and was issued both a Prevention of Significant Deterioration (PSD) Permit No. 91-02 from the Washington Department of Ecology (Ecology) and an Order of Approval to Construct (OAC #310) from the Northwest Clean Air Agency (NWCAA). The OAC included specific conditions for operation of the facility. Those approvals were modified by OAC #400 in December 1993 to accommodate the use of distillate (diesel oil) as a backup fuel. In addition, OAC #400 contains language to state that it replaces the previously issued OAC #310.

### 2.5.2 Auxiliary Boiler

In January 2006 OAC #951 was issued to construct an auxiliary steam at the facility for the purpose of providing steam to the adjacent Georgia-Pacific plant during periods when the combustion turbines are not operating.

## **2.6 Compliance**

### **2.6.1 Enforcement Actions**

The PSE Encogen Generating Station is a major source, meaning that it has the potential to emit 100 tons or more of any criteria pollutant. The facility has been either a registered air pollution source or a Title V Air Operating Permit source since its startup in 1993. NWCAA conducts unannounced annual inspections at all major sources. NWCAA inspectors will respond to citizen complaints when PSE Encogen is named as a potential source of undesirable air emissions. This response may involve a site visit as well as general surveillance around the plant. NWCAA personnel periodically observe scheduled source emission tests, continuous emission monitoring system (CEMS) certification tests and annual Relative Accuracy Test Audits (RATAs).

PSE Encogen is required to notify NWCAA if events such as a breakdown or start-up/shutdown occur that result in excess emissions to the atmosphere. NWCAA then makes a determination as to whether there was a violation. All excess emissions are reviewed to determine if they were unavoidable or not. The criteria used to determine this is found in the Washington Administrative Code 173-400-107. If an event that results in an excess emission is found to be avoidable, then additional enforcement action is taken. This would include the issuance of a Notice of Violation, reporting on the AIRS database, and could result in listing with EPA Region 10 as high priority violator (HPV). If the violation is an HPV, the source is then tracked until the source returns to compliance and the appropriate penalties are collected. If the excess emissions were found to be unavoidable, no further enforcement action is taken.

Monthly, the facility submits a summary report of emissions and process information. The monthly report must identify all excess emissions and provide a discussion as to their cause and what was done to correct the problem.

Quarterly reports are submitted which contain information about continuous emission monitoring systems. NWCAA Regulations - Appendix A , 40 CFR 60 Appendix F and 40 CFR Part 75 require specific quality assurance methods including daily calibration checks, quarterly cylinder gas audits, and annual Relative Accuracy Test Audits (RATAs) that will assure precise and accurate CEM information is collected.

NWCAA Regulation Section 460 requires sulfur dioxide ambient monitoring plan for sources with a heat input greater than 500 MMBtu/hour. NWCAA has determined that the requirement to burn only natural gas or “on-road spec” oil satisfies this requirement.

On October 26, 2005 PSE Encogen was cited for not registering as a source under the Acid Rain regulations. The status of the PSE Encogen facility changed when they became a wholly owned entity of Puget Sound Energy in November 1999. Because PSE is an electric utility, PSE Encogen lost its exemption under the Acid Rain program and became subject to 40 CFR Part 72 and Part 75. This fact was not noted by PSE or the permitting agencies at the time of PSE's acquisition of the Encogen facility, but was reported by PSE upon their discovery of this fact in early 2005. The facility then applied for an Acid Rain Permit which was approved in May 2005. The facility was assessed a penalty, as a result of the delay in getting their permit and the issue was resolved.

### **2.6.2 New Source Performance Standards**

The PSE Encogen facility is subject to 40 CFR Subpart GG - New Source Performance Standards (NSPS) for Stationary Gas Turbines. The heat recovery steam generators (HRSG's) are not subject

to NSPS Subparts D, Da, Db or Dc (steam generating units), because they are not directly fired using duct burners. The auxiliary boiler, however, is subject to the requirements of 40 CFR Part 60 Subpart Dc.

PSE Encogen has been previously released by EPA from the daily monitoring of fuel sulfur and nitrogen content as required in Subpart GG. The basis for this determination was that they operate and maintain continuous emission monitors for nitrogen oxides, and they monitor the sulfur content of fuels. EPA Region 10 granted relief from these requirements in a letter dated March 10, 1993.

PSE Encogen has also been granted relief from the semi-annual reporting requirements under Subpart GG for excess emission reports by NWCAA in a letter dated January 31, 1995. PSE Encogen monitors NO<sub>x</sub> continuously and reports these data on a monthly basis as noted in their permit. In the current NSPS water and steam rates do not need to be monitored because of post-combustion NO<sub>x</sub> control and CEM monitoring employed by PSE Encogen.

### **2.6.3 National Emissions Standards for Hazardous Air Pollutants (NESHAPS)**

PSE Encogen has no activities/emission units that are subject to various subparts of the NESHAPS rules found either in 40 CFR 61 or 63. The cooling tower has never used chromium as a biocide.

On January 14, 2003, the proposed combustion turbine MACT (Section 112(b)) was published as 40 CFR 63 Subpart YYYY. This proposed MACT standard would apply if a single HAP exceeded 10 tons per year or if the total HAPs from the plant exceed 25 tons per year. Based on 1993 source test data taken at PSE Encogen, formaldehyde emissions are estimated at 0.075 lb/hr per stack or about 1.0 ton per year for the entire plant. This emission rate is represented in the NWCAA annual Emission Inventory Reports and summarized in Table 2.2. Because formaldehyde is the overwhelming driver for MACT applicability and because the facility's potential to emit (PTE) formaldehyde is less than 10 tons per year, the MACT standard is not applicable.

### **2.6.4 Prevention of Significant Deterioration and Major New Source Review**

As stated previously, PSE Encogen applied for and received a PSD Approval to construct and operate on natural gas only (PSD No. 91-02). This approval was modified in 1993 to allow use of distillate as a backup fuel (PSD No. 91-02 Amendment 1). On March 16, 1998, PSE Encogen submitted an application to revise the PSD permit to allow higher daily NO<sub>x</sub> emission levels. This application was determined to be complete on April 20, 1998. The Preliminary Approval to amend the PSD Approval was then drafted and published for comment. PSD No. 91-02 Amendment 2 was issued on July 23, 1998.

The entire jurisdiction of NWCAA is designated as in attainment for all criteria pollutants. For this reason no other federal new source review programs for new or modified sources of air pollution are applicable.

### **2.6.5 Acid Rain Rule**

Elements of the Acid Rain Program are found in 40 CFR 72, 73, 75, 77, and 78. Cogeneration systems may be subject to these requirements if the source meets the size threshold, began construction after the effective date of the rule, or is part of a public utility. The purchase of PSE Encogen in November 1999 by Puget Sound Energy changed the status of the facility with respect to acid rain applicability because Puget Sound Energy is a public electric generating utility and, therefore, subject to the rule. PSE Encogen did not come into compliance with the rule until 2005 when their Acid Rain Permit application was submitted and approved.

PSE converted its CEMS systems on the turbines from performance and quality assurance/quality control requirements under 40 CFR 60 to those under 40 CFR 75. These systems will be operated under 40 CFR 75, which takes precedence over the requirements in 40 CFR 60 in accordance with NWCAA Appendix A.

#### **2.6.6 Other Federal Programs**

PSE Encogen is not subject to the Compliance Assurance Monitoring (CAM) Rule (40 CFR 64). PSE Encogen is subject to a nitrogen oxide emission limitation. The facility employs control devices, selective catalytic reduction, to achieve compliance. Their pre-control emissions exceed major source status (greater than 100 tons per year). These criteria would generally make PSE Encogen subject to the CAM rule. However, 40 CFR 64.2(b)(1)(vi) exempts sources from the rule if this permit specifies a continuous compliance determination method. In the case of PSE Encogen, they are required to operate a NO<sub>x</sub> continuous emission monitor on the combustion turbines and monitor performance specifications of the selective catalytic reduction system on the auxiliary boiler.

Ammonia is a regulated substance under 40 CFR 68, the accidental release program. PSE Encogen uses ammonia in selective catalytic reduction (SCR) systems for nitrogen oxide control at the combustion turbines and at the auxiliary boiler. PSE Encogen is subject to the provisions of this program which was implemented in 1999.

#### **2.6.7 Minor New Source Review**

On January 14, 1991, PSE Encogen submitted a "Notice of Construction and Application for Approval (NOC)" to the Northwest Clean Air Agency to construct and operate three natural gas-fired gas turbine/heat recovery steam generator trains and a single steam turbine generator. NOC Order of Approval #310 was issued on September 11, 1991 for that project. On September 8, 1992 PSE Encogen Northwest L.P. submitted a NOC requesting permission to burn up to 10,600,000 gallons of low sulfur diesel oil in the three combustion turbines. NWCAA issued Order of Approval to Construct #400 on December 2, 1993 to accommodate the use of distillate (diesel oil) as a backup fuel. The original NOC Approval 310 was incorporated into and superceded by NOC Approval #400. NOC Approval has been revised three times since original issue; on May 4, 1995, August 17, 1995, and May 29, 1998.

On March 25, 1993 Lone Star Energy submitted a NOC to the Northwest Clean Air Agency to construct three fixed-roof distillate fuel storage tanks. NOC Order of Approval #428 was issued on April 19, 1993 for that project.

In late 2005 PSE Encogen submitted a NOC for construction of a 93 MMBtu/hr auxiliary boiler fueled by natural gas. A subsequent OAC (#951) was issued in January 2006 that limited the boiler to natural gas fuel only and required current BACT levels of NO<sub>x</sub> emissions.

All of the NOCs were reviewed under the minor new source review program as required by NWCAA Regulation Section 300 and WAC 173-400-110.

NOC approval conditions are federally enforceable. The NWCAA minor new source review program is SIP approved as is the minor new source review program for the Washington State Department of Ecology. "Notices of Construction and Applications for Approval" have been reviewed under guidance of NWCAA Regulation Sections 300 and 302 and Washington Administrative Code (WAC) 173-400-110.

## **SECTION 3 - GENERAL PERMIT ASSUMPTIONS**

### **3.1 Permit Content**

Applicable requirements that were satisfied by a single past action on the part of the source are not included in this permit. An example of this would be performance testing to demonstrate compliance with applicable emission limitations as a requirement of initial startup. Also, regulations that require action by a regulatory agency, but not of the regulated source are not included as applicable permit conditions.

### **3.2 One-time Requirements**

The following actions were noted as having been completed as required by Notice of Construction Approvals or Federal New Source Performance Standards:

- PSE Encogen submitted a NOC Application in April 1991.
- PSE Encogen submitted a PSD Application in February 1991. PSE Encogen submitted a supplemental NOC Application in April 1991.
- PSE Encogen demonstrated that emissions of criteria and hazardous pollutants would not exceed ambient limits or ASILs as applicable by satisfying WAC 173-400-110, WAC 173-460-070 and NWCAA 300 ambient impact modeling requirements prior to commencement of construction.
- PSE Encogen submitted notification of commencement of construction to Ecology and NWCAA in December 1991.
- PSE Encogen submitted a complete quality assurance manual for all CEMs in October 1992
- PSE Encogen submitted a quality assurance plan for pre-construction ambient PM<sub>10</sub> monitoring in February 1993, and revisions to that plan in May 1993.
- PSE Encogen submitted a source test plan for turbine units to Ecology in May 1993.
- PSE Encogen submitted notification of start-up to Ecology in March 1993. Actual start-up was July 1993.
- PSE Encogen submitted Applications for Amendment 1 to their NOC Approval Order and PSD Approval for use of oil in August 1992.
- An operation and maintenance manual was submitted February 1993.
- Source tests and CEM certifications for turbine units were conducted May 1993. Results were submitted to NWCAA in July 1993.
- Testing and monitor certification was done in September 1996. Results were submitted to NWCAA in November 1996.
- Testing and monitor certification was completed in August 1997. Results were submitted to NWCAA in September 1997.
- In March of 2006 the facility was required to conduct performance testing on a newly constructed steam boiler. Testing was completed and the report issued as required.

- In early 2006 PSE Encogen was required to certify the NO<sub>x</sub> CEMs at the combustion turbines in accordance with 40 CFR Part 75 of the Acid Rain Rule.

### **3.3 Federal Enforceability**

Federally enforceable requirements are terms and conditions required under the Federal Clean Air Act or under any of its applicable requirements such as NSPS or NESHAPS. Local and state regulations become federally enforceable if they are adopted into the State Implementation Plan (SIP). Federally enforceable requirements are enforceable by the EPA and citizens of the United States. All applicable requirements in the permit including standard terms and conditions, generally applicable requirements, and specifically applicable requirements are federally enforceable unless they are specifically identified as enforceable by only the state. If there are similar versions of the same rule, but one is federally enforceable and one is not, then both will be in the permit. Upon issuance of this permit, the permit terms based on Chapter 173-401 WAC will become federally enforceable.

### **3.4 Future Requirements**

Applicable requirements promulgated with future effective compliance dates may be included as applicable requirements in the permit. Some requirements that are not applicable until triggered by an action, such as the requirement to file an application prior to constructing a new source, are addressed within the standard terms and conditions section of the permit.

There are presently no pending applications to construct or modify PSE Encogen in such a way as to trigger New Source Review. PSE Encogen has certified in the permit renewal application that the facility will meet any future applicable requirements on a timely basis.

### **3.5 Compliance Options**

PSE Encogen did not request emissions trading provisions or specify more than one operating scenario in the air operating permit application; therefore, the permit does not address these options as allowed under WAC 173-401-650. This permit does not condense overlapping applicable requirements (streamlining) nor does it provide any alternative emission limitations.

### **3.6 Gap Filling**

There are some air pollution rules and regulations and "Notice of Construction" approval conditions that do not specifically call out a monitoring, reporting, or recordkeeping method(s) that would demonstrate compliance with the applicable requirement. In this case the permitting agency would develop a site-specific requirement that the source must follow. The inclusion of these customized requirements is called "gap filling". PSE Encogen has many specific monitoring, reporting, and recordkeeping (MR&R) requirements in the form of continuous emission monitors and periodic reporting. In some instances, though, NWCAA has gap filled. Nuisance rules and opacity requirements commonly have specific gap filled obligations for the source.

## **SECTION 4 - PERMIT ELEMENTS AND BASIS FOR TERMS AND CONDITIONS**

### **4.1 Permit Organization**

The permit is organized in the following sequence:

Permit Information

Attest

Table of Contents

Emission Unit Identification

Standard Terms and Conditions

Generally Applicable Requirements

Specifically Applicable Requirements for Emission Units

Inapplicable Requirements

### **4.2 Permit Information, Attest, and Emission Unit Description Sections**

The Permit Information section identifies the source, the responsible corporate official, and the agency personnel responsible for permit preparation, review, and issuance. The Attest section provides authorization by NWCAA for the source to operate under the terms and conditions contained in the permit. The Emission Unit Identification section lists the significant Emission Units, associated control equipment and fuel type. This section is a general overview of the facility. Detailed information about the plant can be found in the permit application and supporting files.

### **4.3 Standard Terms and Conditions**

The Standard terms and Conditions section contains administrative requirements and prohibitions that do not have ongoing compliance monitoring requirements. The citations giving legal authority to the Standard Terms and Conditions are provided in the section. At times some requirements are paraphrased. The language of the cited regulation takes precedence. For understanding and readability the terms and conditions have been grouped by function. Where possible, similar requirements by both the state and NWCAA have been grouped together. There are several requirements included that are not applicable until triggered. Examples of these would be the requirement to file a "Notice of Construction and Application for Approval".

### **4.4 Generally Applicable Requirements**

The Generally Applicable Requirements section identifies requirements that apply broadly to the facility. These requirements are generally not called out in "Notice of Construction" approvals. They are found as general air pollution rules in NWCAA Regulation or the Washington Administrative Codes.

The first column contains the permit term number and pollutant type. The requirements are numbered consecutively so that the reader may easily locate a listed requirement. The second column is the legal citation. The citation may be a federal, state or local requirement. If the requirement is a state only requirement it will be specifically noted. The third column is a paraphrase of the requirement, for descriptive purposes only, not intended to be a legal requirement. The fourth column is the monitoring, recordkeeping and reporting (MR&R) method(s) the source is required to do to indicate that equipment is being maintained and operated so that it will remain in compliance with the corresponding requirement. It also identifies the legal test method that the enforcement agency would use to confirm compliance with the requirement. This test method is

typically required only once, upon initial startup of a new source, in order for the source operator to demonstrate that the source can meet emission limits contained in a Notice of Construction Approval. It is not an on-going requirement of the source unless stated in the MR&R column.

More detail on Generally Applicable Requirements in Section 4 is provided in Appendix 2.

#### **4.5 Specifically Applicable Requirements**

This section contains three tables which list applicable requirements that specifically apply to the main emission unit types – combustion turbines, the auxiliary boiler and the fuel tanks. Many of the emission limitations are derived from best available control technology (BACT) determinations and included as conditions of OAC's for specific operating units. In addition, the NSPS subparts have emission limits and record keeping and monitoring requirements. The format and organization of this section is the same as the table for Generally Applicable Requirements.

Many of the permit conditions do not need to be explained in this Statement of Basis, because the legal and factual bases for the condition are self-evident as stated in the Air Operating Permit (AOP). Some of the conditions in the AOP, however, contain terms which are not defined for MR&Rs and for which the rationale is not readily apparent. These definitions and monitoring, recording, and recordkeeping requirement discussions are provided in Appendix 2.

Some permit conditions in Section 5 show emission limits in the "Description" column but no test frequency in the "MR&R" column. This is the result of an OAC or PSD condition that required an initial performance test that has been completed so there is no requirement for ongoing testing. The limit, however, remains as an underlying condition of the permit and is, therefore, included

## SECTION 5 - INSIGNIFICANT EMISSION UNITS

Some categorically exempt insignificant emission units as defined in WAC 173-401-532 are present at PSE Encogen and are not listed in the permit, but are listed in the table below.

**Table 5-1 PSE Encogen - Insignificant Activities and Emission Units**

<b>Exempt Unit</b>	<b>WAC Citation</b>	<b>Comment</b>
Emissions from Fuel Oil Transfer System	WAC 173-401-530 (1) (d)	Fugitive emissions
Emissions from Natural Gas Fuel System	WAC 173-401-530 (1) (d)	Fugitive emissions
Emissions from Roadways	WAC 173-401-530 (1) (d)	Fugitive emissions
Pressure Sprayer Engine - Gasoline-Powered	WAC 173-401-533 (2) (f)	Unit rated at 7.5 HP
Pump Engine - Gasoline-Powered	WAC 173-401-533 (2) (f)	Unit rated at 5 HP
Space Heaters (3) - Diesel-Fueled	WAC 173-401-533 (2) (f)	Units rated at 50,000 Btu/hour
Space Heaters (4) - Diesel-Fueled	WAC 173-401-533 (2) (f)	Units rated at 150,000 Btu/hour
Welder Engine - Gasoline-Powered	WAC 173-401-533 (2) (f)	Unit rated at 20 HP
Welding	WAC 173-401-533 (2) (i)	Less than 1 ton per day
2,000-Gallon Sulfuric Acid Tank	WAC 173-401-533 (2) (s)	Tank with lid (less than 99% solution)
4,000-Gallon Sodium Hydroxide Tank	WAC 173-401-533 (2) (s)	Tank with lid
550-Gallon Corrosion Control Tank	WAC 173-401-533 (2) (s)	Tank with lid

## DEFINITIONS AND ACRONYMS

Definitions are assumed to be those found in the underlying regulation. A short list of definitions has been included to cover those not previously defined.

An "applicable requirement" is a provision, standard, condition or requirement in any of the listed regulations or statutes as it applies to an emission unit or facility at a stationary source.

"Ecology" means the Washington State Department of Ecology.

An "emission unit" is any part or activity of a stationary source that emits or has the potential to emit any regulated air pollutant.

"PSE Encogen " means PSE Encogen Northwest Cogeneration Plant.

"Oil" means "on-road specification diesel fuel," containing no more than 0.05 percent sulfur by weight, as specified in 40 CFR § 80.29.

A "permit" means for the purposes of the air operating permit program an air operating permit issued pursuant to Title 5 of the 1990 Federal Clean Air Act.

"Technology-Based Emission Standard" means a standard, the stringency of which is based on determinations of what is technologically feasible considering relevant factors.

"State" means for the purposes of the air operating permit program NWCAA or the Washington State Department of Ecology.

The following is a list of Acronyms used in the Air Operating Permit and/or Statement of Basis:

AIRS	Aerometric Information Retrieval System
ASTM	American Society for Testing and Materials
ASIL	Acceptable Source Impact Level
CAM	Compliance Assurance Monitoring (40 CFR 64)
CEM	continuous emission monitor
CEMS	continuous emission monitoring system
CFR	Code of Federal Regulations
EPA	The United States Environmental Protection Agency
FCAA	Federal Clean Air Act
HRSG	heat recovery steam generator
ISO	International Standards Organization
MACT	Maximum Achievable Control Technology
MMBtu	Million British Thermal Units
MR&R	monitoring, recordkeeping and reporting requirements
NESHAP	National Emission Standards for Hazardous Air Pollutants

NOC	Notice of Construction
NO <sub>x</sub>	oxides of nitrogen
NSPS	New Source Performance Standard
NSR	New Source Review
NWCAA	Northwest Clean Air Agency
OAC	Order of Approval to Construct
O <sub>2</sub>	oxygen
PM	particulate matter
PM <sub>10</sub>	particulate matter less than 10 microns in diameter
ppmvd	parts of pollutant per million parts of dry stack gas on a volumetric basis
PSD	Prevention of Significant Deterioration (federally required program for pre-construction review of sources)
psia	pounds per square inch absolute
QA/QC	quality assurance/quality control
RCW	Revised Code of Washington
SCR	selective catalytic reduction
SIP	state implementation plan
SO <sub>2</sub>	sulfur dioxide
STP	standard temperature and pressure (0° C and 14.7 psia)
WAC	Washington Administration Code

## **PUBLIC DOCKET**

Copies of PSE Encogen's air operating permit and permit application and any technical support documents are available online at [www.nwcleanair.org](http://www.nwcleanair.org) or at the following location:

Northwest Clean Air Agency  
1600 South Second Street  
Mount Vernon, WA 98273-5202

**APPENDICES**

Appendix A - DISCUSSION OF PERMIT TERMS

Appendix B - CHANGES INCOPORATED INTO 2006 PERMIT

## **APPENDIX A - DISCUSSION OF PERMIT TERMS**

The following discussion of permit terms provides some insight on how the facility exhibits compliance with these terms.

### **SECTION 4 – GENERALLY APPLICABLE REQUIREMENTS**

- **Visual Emissions Standard (Permit Term 4.6)**

The gas turbine exhaust stacks and the boiler stack are the only process stacks, and are the only likely sources of visible emissions in the PSE Encogen facility. Modern gas turbines, when fueled by natural gas or low-sulfur oil, are extremely unlikely to exceed visible emission standards if the units are properly maintained. Since the boiler only operates on natural gas, visible emissions from its stack are very unlikely.

Performance tests which were conducted during May and June 1993, using EPA Reference Method 9, demonstrated zero percent opacity for the gas turbines. Tests were conducted on units operating at loads between 85 and 100 percent of full load, during both natural gas and oil firing. Prior to permit issuance, PSE Encogen conducted a series of daily opacity readings during worst-case conditions, and demonstrated that the units are able to consistently perform without emitting any visible plume. Demonstration of compliance with the permit visible emission limits will be based on monthly visual opacity observations. Any observed visible emissions will require immediate corrective action, followed by consecutive daily opacity observations until an opacity level less than the applicable limit is achieved. When this level is reached, the facility may revert to monthly opacity observations. As an alternative, the source may use Ecology Method 9a to determine compliance after visual emissions are observed.

- **Particulate Matter (Permit Terms 4.7, 4.8 and 4.9)**

The gas turbine exhaust stacks and the boiler stack are the only process stacks, and are the only likely sources of particulate matter emissions in the PSE Encogen facility. Modern gas turbines, when fueled by natural gas or low-sulfur oil, are extremely unlikely to exceed particulate matter emission standards if the units are properly operated and maintained. The boiler which only burns natural gas would never be expected to emit particulate material. Permit conditions require that PSE Encogen visually monitor emissions from these stacks as a surrogate to stack testing.

Performance tests which were conducted during May and June 1993, using EPA Reference Method 5, demonstrated compliance with all particulate matter emission standards for the gas turbines. Tests were conducted on units operating at loads between 85 and 100 percent of full load, during both natural gas and oil firing. Test results averaged less than one percent of the required limits.

PSE Encogen will provide assurance of compliance with these requirements in the annual compliance certification.

- **Fugitive Emissions (Permit Terms 4.10 through 4.13)**

These requirements were written for facilities that have the potential to emit large quantities of fugitive particulate emissions if proper controls are not applied. All areas within the PSE Encogen facility are paved. PSE Encogen does not conduct activities that typically generate fugitive emissions such as material handling, storage or transport of solid materials. PSE Encogen will provide assurance of compliance with these requirements in the annual compliance certification.

- **Sulfur Dioxide, Ambient Impacts (Permit Term 4.14)**

Ambient impacts due to SO<sub>2</sub> emissions were demonstrated to not exceed any of the ambient air quality standards during modeling studies conducted prior to original construction of the facility. PSE Encogen is prohibited from commencing construction of any new or modified emission units without undergoing new source review. PSE Encogen will provide assurance of compliance with Permit Term 4.14 by burning low sulfur content fuels.

- **Sulfur Dioxide, Stack Emissions (Permit Terms 4.15 through 4.18)**

The gas turbines are limited by the conditions specified under Permit Terms 4.15 – 4.18 of the AOP to burning either natural gas or fuel oil containing no more than 0.05% sulfur. The boiler is limited to firing by natural gas only.

“Natural gas” means a mixture of gaseous hydrocarbons, with at least 80 percent methane (by volume), and of pipeline quality, such as the gas sold or distributed by any utility company regulated by the Washington Utilities and Transportation Commission. Natural gas may also be referred to as “pipeline quality natural gas.” PSE Encogen receives its natural gas from the Northwest Pipeline Corporation. This same natural gas is used by all of the other natural gas consumers, private and industrial, in the Northwest. Natural gas contains approximately 1.0 grain per 100 cubic feet of sulfur, including the 0.25 gr/100 ft<sup>3</sup> of methyl mercaptan added to this otherwise odorless gas for the purposes of leak detection.

“On-road spec oil” means “on-road specification No. 2 diesel fuel” containing no more than 0.05 percent sulfur by weight, as specified in 40 CFR 80.29, as amended through July 1, 1992. The terms “No. 2 distillate”, “diesel fuel”, “diesel oil”, “No. 2 diesel”, and “oil” all are synonymous with the term “on-road spec oil” within the context of the PSE Encogen AOP and SOB.

- **Sulfur Dioxide, Stack Emissions (Permit Term 4.15)**

This condition limits SO<sub>2</sub> emissions to 1.5 pounds per million Btu of energy consumed.

According to the EPA’s AP-42 emission factor manual, the SO<sub>2</sub> emission factors (lb/MMBtu) for a stationary gas turbine are 0.94×S when fired on oil and 1.10×S when fired on oil, where “S” is the percent sulfur.

When natural gas is burned, the gas turbines and the boiler will emit about 0.0028 lb/MMBtu SO<sub>2</sub> as shown in the following calculation:

$$\frac{1.0 \text{ gr. Sulfur}}{100 \text{ ft}^3} \times \frac{1 \text{ lb Sulfur}}{7000 \text{ gr. Sulfur}} \times \frac{1000 \text{ ft}^3}{1.05 \text{ MMBTU}} \times \frac{2 \text{ lb SO}_2}{1 \text{ lb Sulfur}} = \frac{0.0028 \text{ lb SO}_2}{\text{MMBTU}}$$

Note:

A “lb-mole” of a pure gas weighs the molecular weight of that gas in pounds and occupies 359 ft<sup>3</sup> at 32° F and 1 atmosphere pressure. A “lb-mole” of sulfur (S) weighs 32 lb and reacts with a lb-mole of oxygen (O<sub>2</sub>) which also weighs 32 lb to form a lb-mole of sulfur dioxide, which weighs 64 lb. Therefore, 2 lb of SO<sub>2</sub> are generated for every lb of sulfur in the fuel. Because one lb-mole of sulfur reacts to form one lb-mole of sulfur dioxide, each cubic foot of sulfur in the fuel results in one cubic foot of sulfur dioxide out the stack.

The energy content of the natural gas used by PSE Encogen is 1,050 British thermal units per cubic foot.

When oil is burned, the gas turbines will emit 0.0505 lb/MMBtu SO<sub>2</sub> as calculated from the EPA’s AP-42 emission factors (AP-42, Section 3.1 Stationary Gas Turbines for Electricity Generation,

10/96). The emission factor is:  $1.01 \times S$ , where “S” is the percent sulfur, and the calculation is shown below:

$$1.01 \frac{lb}{MMBtu - \%S} \times 0.05\% S = 0.0505 \frac{lb}{MMBtu}$$

Note that both of the calculated SO<sub>2</sub> emission rates are below the 1.5 lb/MMBtu limit. PSE Encogen can adequately show compliance with this requirement by burning only pipeline quality natural gas or “on-road spec” oil, and maintaining fuel oil supplier-provided records of fuel oil specification, including sulfur content, for all oil burned.

- **Sulfur Dioxide, Stack Emissions (Permit Terms 4.16 and 4.17)**

This condition limits emissions to 1,000 parts of sulfur dioxide per million parts of stack gas, on a dry volumetric basis, corrected to 7 percent oxygen, calculated on an hourly average. During performance testing conducted in May and June of 1993 the turbines emitted an average of 0.3 ppm SO<sub>2</sub> when fired on natural gas and 9.6 ppm SO<sub>2</sub> when fired on 0.078% sulfur oil (which is equivalent to 6.2 ppm SO<sub>2</sub> with 0.05% sulfur oil as shown in Section 4.8 below).

When natural gas is burned, the gas turbines and the boiler will emit about 0.7 ppm (corrected to 7 percent oxygen) as shown in the following calculation:

$$0.3 \text{ ppm corrected to } 15\% O_2 \times \frac{(21-7)\% O_2}{(21-15)\% O_2} = 0.7 \text{ ppm corrected to } 7\% O_2$$

When oil is burned, the gas turbines will emit about 14.4 ppm (corrected to 7 percent oxygen) as shown in the following calculation:

$$6.2 \text{ ppm corrected to } 15\% O_2 \times \frac{(21-7)\% O_2}{(21-15)\% O_2} = 14.4 \text{ ppm corrected to } 7\% O_2$$

Note that both of the calculated SO<sub>2</sub> emission rates are below the 1,000 ppm limit. PSE Encogen can adequately show compliance with this requirement by burning only pipeline quality natural gas or “on-road spec” oil, and maintaining fuel oil supplier-provided records of fuel oil specification, including sulfur content, for all oil burned.

- **Sulfur Dioxide, Fuel Content (Permit Term 4.18)**

This condition limits sulfur content in the fuels used at the facility. Natural gas, the only gaseous fuel allowed at PSE Encogen is limited to 412 ppm, and No.2 distillate, the only liquid fuel allowed at PSE Encogen, is limited to 0.05% sulfur. Natural gas contains approximately 1.0 grain of sulfur per 100 cubic feet as it comes from the pipeline.

Natural gas contains about 16 parts per million sulfur, as shown in the following calculation:

$$\frac{1.0 \text{ gr. Sulfur}}{100 \text{ ft}^3} \times \frac{1 \text{ lb}}{7000 \text{ gr.}} \times \frac{1 \text{ lb-mole}}{32 \text{ lb S}} \times \frac{359 \text{ ft}^3}{1 \text{ lb-mole}} = 16 \text{ ppm S}$$

On-road specification oil is limited to 0.05% sulfur which is 1/10<sup>th</sup> of the allowable level under NWCAA 520. PSE Encogen can adequately show compliance with this requirement by burning only natural gas or “on-road spec” oil, and maintaining fuel oil supplier-provided records of fuel oil specification, including sulfur content, for all oil burned.

## SECTION 5 – SPECIFICALLY APPLICABLE REQUIREMENTS

- **General, Sampling Ports (Permit Term 5.1)**

PSE Encogen is required to have sampling ports which meet the requirements of 40 CFR 60 Subpart A. For compliance NWCAA determined that once a year PSE Encogen personnel shall visually confirm that the platforms and sampling platforms are intact and have not corroded away, and include the results of the inspection as a line item in the annual compliance certification.

- **Sulfur Dioxide, Stack Emissions (Permit Term 5.17)**

This Permit Term covers Conditions 2D and 3D in NWCAA Order of Approval #400, and Condition 3 in PSD 91-02 Amendment 2, which limit SO<sub>2</sub> emissions from each turbine exhaust to 9.0 ppm corrected to 15% O<sub>2</sub> on a daily average when fired on oil. SO<sub>2</sub> emissions from the facility are limited to 100 pounds per day when fired on natural gas or 1,584 pounds per day when fired on oil.

Sulfur dioxide (SO<sub>2</sub>) is formed when sulfur in the fuels reacts with oxygen in the air during the combustion process. Two pounds of sulfur are emitted out the stack for every pound of sulfur in the fuel.

When the turbines are operated at capacity on natural gas, the most SO<sub>2</sub> they can emit is 88.7 lb/day as shown in the following calculation:

$$\frac{0.0028 \text{ lb } SO_2}{MMBTU} \times \frac{440 \text{ MMBTU}}{\text{turbine-hr}} \times 3 \text{ turbines} \times \frac{24 \text{ hr}}{\text{day}} = 88.7 \text{ lb } SO_2/\text{day}$$

Note that this emission rate is less than the 100 pound per day SO<sub>2</sub> limit for the facility when firing natural gas.

During performance testing conducted in May and June of 1993 the turbines emitted an average of 9.6 ppm SO<sub>2</sub> when fired on .078% sulfur oil. This test was run before the 0.05% sulfur oil was available, and was done with the knowledge that 0.05% sulfur would be required for all future operations and that the SO<sub>2</sub> emissions were directly proportional to the sulfur content of the oil. So the maximum theoretical SO<sub>2</sub> concentration is the measured value multiplied by a ratio of the maximum allowable fuel sulfur to the fuel sulfur measured at the time of the test, as shown below:

$$9.6 \text{ ppm } SO_2 \times \frac{0.05\% S_{\text{allowable}}}{0.078\% S_{\text{one-time}}} = 6.2 \text{ ppm } SO_2$$

Note that this SO<sub>2</sub> concentration is less than the allowable 9.0 ppm.

When the turbines are operated at capacity on 0.05% sulfur oil the most SO<sub>2</sub> they can emit is 1,549 lb/day as shown in the following calculation:

$$0.0550 \text{ lb } SO_2 / \text{MMBtu} \times 426 \frac{\text{MMBtu}}{\text{turbine-hr}} \times 3 \text{ turbines} \times \frac{24 \text{ hr}}{\text{day}} = 1,549 \text{ lb } SO_2 / \text{day}$$

Note that this emission rate is less than the 1,584 pound per day SO<sub>2</sub> limit for the facility when firing 0.05% sulfur oil.

PSE Encogen can adequately show compliance with this Permit Term by burning only pipeline quality natural gas or “on-road spec” oil, and maintaining fuel oil supplier-provided records of fuel oil specification, including sulfur content, for all oil burned.

- **Visual Emissions Standard (Permit Terms 5.10 and 5.24)**

The gas turbine exhaust stacks and the boiler stack are the only process stacks, and are the only likely sources of visible emissions in the PSE Encogen facility. Modern gas turbines, when fueled by natural gas or low-sulfur oil, are extremely unlikely to exceed visible emission standards if the units are properly maintained. The boiler because it can be fired on natural gas only would never be expected to produce visible emissions.

Performance tests which were conducted during May and June 1993, using EPA Reference Method 9, demonstrated zero percent opacity for the gas turbines. Tests were conducted on units operating at loads between 85 and 100 percent of full load, during both natural gas and oil firing. Prior to permit issuance, PSE Encogen conducted a series of daily opacity readings during worst-case conditions, and demonstrated that the units are able to consistently perform without emitting any visible plume. Demonstration of compliance with the permit visible emission limits will be based on monthly visual opacity observations. Any observed visible emissions will require corrective action.

- **Particulate Matter (PM<sub>10</sub>) (Permit Term 5.11)**

This Permit Term covers Condition 5 in PSD 91-02 Amendment 2, which limits PM<sub>10</sub> emissions from each turbine exhaust to 60 pounds per day when fired on gas and 408 pounds per day when fired on oil. PM<sub>10</sub> emissions from the facility are limited to 180 pounds per day when fired on natural gas or 1,224 pounds per day when fired on oil.

The gas turbine exhaust stacks are the only process stacks, and are the only likely sources of particulate matter emissions in the PSE Encogen facility. Particulate matter emissions from turbines primarily result from carryover of noncombustible trace constituents in the fuel, or from agglomerated soot particles, particularly during liquid fuel firing. Particulate matter emissions are typically very nearly non-detectable with natural gas firing and marginally detectable with distillate oil firing because of the very low ash content in both fuels. Modern gas turbines, when fueled by natural gas or low-sulfur oil, are extremely unlikely to exceed fine particulate matter emission standards if the units are properly operated and maintained.

EPA Reference Method 5 performance tests which were conducted on the gas turbines operating at loads between 85 and 100 percent of full load with both natural gas and oil firing during May and June 1993, demonstrating compliance with all particulate matter emission standards. The highest results when the units were operated on natural gas were less than 50 percent of the limits in Permit Term 5.11. The highest results when the units were operated on oil were less than 40 percent of the limits in Permit Term 5.11.

- **Oxides of Nitrogen (NO<sub>x</sub>) (Permit Term 5.13 and 5.26)**

Permit Term 5.13 (40 CFR 60.332(a)(1)) limits NO<sub>x</sub> emissions from each turbine to 0.0075% (equivalent to 75 ppm), corrected to 15% oxygen, plus allowances for heat rate and fuel bound nitrogen. According to PSE Encogen, the manufacturer's rated heat rate at load is 10,660 Btu/kW-hr, and the fuel-bound nitrogen is essentially zero. The allowable NO<sub>x</sub> concentration under 40 CFR 60.332(a)(1) is 96 ppm, calculated from the equation given in § 60.332(a)(1):

$$STD = 0.0075\% \times \frac{(14.4)}{Y} + F = 0.0075 \times \frac{(14.4)}{(11.249)} + F = 0.009601\% \equiv 96.01 \text{ ppmv}$$

where:

$$Y = 10,660 \frac{\text{Btu}}{\text{kW-hr}} \times \frac{1.055 \text{ kJ}}{1 \text{ Btu}} \times \frac{1 \text{ kW}}{1,000 \text{ W}} = 11.249 \frac{\text{kJ}}{\text{W-hr}}$$

$$F (\text{fuel bound nitrogen content}) = 0$$

The NO<sub>x</sub> limitations in permit Term 5.12 are generally more stringent than those found in permit Term 5.13. It should be noted however, that the limit set forth in Term 5.13 is based the NSPS and has a one hour averaging period, so it is conceivable that may be a case where the daily average NO<sub>x</sub> limit of Term 5.12 is met but due to a short term emission spike, the higher one hour NO<sub>x</sub> limit of Term 5.13 is exceeded. PSE Encogen demonstrates compliance both NO<sub>x</sub> emission limit by utilizing a continuous emission monitoring system (CEMS).

Under 40 CFR 64 Compliance Assurance Monitoring (CAM), PSE Encogen would be obligated to submit a CAM plan for NO<sub>x</sub> at the time of this permit renewal because this source has an uncontrolled potential to exceed 100 tons per year of this pollutant. However, because PSE Encogen has a continuous emission monitor (CEM) for NO<sub>x</sub>, they are exempt from CAM applicability for the combustion turbines in accordance with 40 CFR 64.2(b)(1)(vi).

The steam boiler is equipped with low-NO<sub>x</sub> burners and a selective catalyst reduction system (SCR) ahead of the stack to minimize NO<sub>x</sub> emissions. Emissions of NO<sub>x</sub> from the stack are limited to 9 ppmvd by Permit Term 5.26. Source testing will demonstrate that this limit can be easily met when these controls are operated properly.

- **Ammonia (NH<sub>3</sub>) (Permit Term 5.16 and 5.28)**

Permit Term 5.16 (NWCAA Order of Approval #400 Condition No. 2E and 3E) limits NH<sub>3</sub> emissions from each turbine exhaust stack to 10 ppmvd corrected to 15% O<sub>2</sub> and ISO on an hourly average, and NH<sub>3</sub> emissions from the project to 437 pounds per day.

The selective catalytic reduction (SCR) unit is the final part of the NO<sub>x</sub> control system. The SCR involves injection of ammonia into the turbine exhaust stream ahead of the catalyst grid in the HRSG section. Most of the NO<sub>x</sub> reacts to form elemental nitrogen and water in the presence of ammonia and the catalyst. Some of the ammonia gets through the HRSG without reacting with the NO<sub>x</sub>. This excess ammonia, or "ammonia slip," is limited by the Conditions under permit Term 5.16.

NO<sub>x</sub> is the only air pollutant that actually costs PSE Encogen money to control. In fact, the costs to control NO<sub>x</sub> go up as control efficiency increases. PSE Encogen can further reduce the NO<sub>x</sub> concentration after the catalyst grid simply by increasing the rate of ammonia injection, but this means that PSE Encogen has to buy more ammonia. PSE Encogen controls their NO<sub>x</sub> concentration and emission rate to a relatively constant fraction of the emission standard by varying

the amount of ammonia that is injected into the exhaust stream of each gas turbine. Initial performance source test results showed ammonia slip averaged 3.6 ppm with gas-firing and 6.1 ppm with oil-firing when ammonia is regulated such that the units are running around 80% of the NO<sub>x</sub> standard.

Essentially, the only way that the amount of ammonia required to adequately control NO<sub>x</sub> could increase over time would be if the catalyst started to degrade. Currently, PSE Encogen has CEMs for NO<sub>x</sub> at the outlet to the catalyst grid on each gas turbine/HRSG unit. PSE Encogen also records the ammonia flow regulator valve setting (displayed as percent open) for each gas turbine/HRSG unit. An increase in ammonia purchases would indicate a problem with the NO<sub>x</sub> control system, such as possible degradation of the catalyst. So far the catalyst used to control NO<sub>x</sub> in gas turbines has exceeded the original manufacturer's estimated useful life.

PSE Encogen demonstrates compliance with permit Term 5.16 by conducting an annual source test for ammonia and by maintaining the ammonia injection rate relative to NO<sub>x</sub> concentration and stack flow.

Permit Term 5.28 provides a 10 ppmvd limit on ammonia exiting the boiler stack. When properly operated, the ammonia slip will be less than the permitted level. PSE Encogen will rely on manufacturer's recommendations and source testing to determine the optimal level of ammonia injection to control NO<sub>x</sub> and limit ammonia emissions.

- **Fuel Sulfur Content (Permit Term 5.19)**

Permit Term 5.19 (40 CFR 60.333) limits sulfur content of fuels burned in the turbine to 0.8% by weight and resulting SO<sub>2</sub> out the stack to 0.015% (150 ppm) corrected to 15% O<sub>2</sub> on a dry basis.

As previously stated, natural gas contains about 1 grain of sulfur per 100 cubic feet. The sulfur content of natural gas is about 0.0021 percent by weight, as shown below:

$$\frac{1 \text{ gr Sulfur}}{100 \text{ ft}^3 \text{ n.g.}} \times \frac{1 \text{ lb Sulfur}}{7000 \text{ gr. S}} \times \frac{359 \text{ ft}^3}{28.97 \text{ lb air}} \times \frac{1.0 \text{ lb air}}{0.645 \text{ lb n.g.}} = \frac{0.000027 \text{ lb Sulfur}}{\text{lb n.g.}}$$

**Note:**

A "lb-mole" of a mixed gas weighs the molecular weight of that gas in pounds and occupies 359 ft<sup>3</sup> at 32° F and 1 atmosphere pressure. The molecular weight of a mixed gas is calculated from the weight fractions of the various pure gases combining to form that gas. Air is composed of 79% nitrogen (N<sub>2</sub>) and 20.95% oxygen (O<sub>2</sub>) plus trace elements. A "lb-mole" air weighs 28.97 lb. The specific gravity of natural gas varies, but it is about 0.645, relative to air, according to Perry's Chemical Engineers' Handbook. The maximum sulfur content of low sulfur diesel oil is 0.05 percent.

As shown above, SO<sub>2</sub> was measured from the turbines at 0.7 ppm when fired on natural gas and 14.4 ppm when the units were fired on oil.

Natural gas and low sulfur oil do not contain enough sulfur to exceed the limits in 40 CFR 60.333. Therefore, the use of natural gas and low sulfur No. 2 diesel oil will adequately demonstrate compliance with this requirement.

- **Carbon Monoxide (CO) and Volatile Organic Compounds (VOC) (Permit Terms 5.21, 5.22 and 5.27)**

Permit Term 5.21 (NWCAA Order of Approval #400 Condition No. 2B and 3B and PSD 91-02 Amendment 2 Condition 4) limits CO emissions from each turbine exhaust stack to 10 ppmvd corrected to 15% O<sub>2</sub> and ISO on an hourly average, and CO emissions from the project to 718 pounds per day. During the initial performance testing the gas turbine/HRSG exhausts were tested for emissions of CO. During natural gas-firing the CO emissions averaged 2.6 ppmvd and 69.8 pounds per day. During oil-firing the CO emissions averaged 2.1 ppmvd and 57.6 pounds per day. Note that the measured CO concentration is approximately 25% of the standard and the CO emission rate is less than 10% of the standard.

Under 40 CFR 64 - Compliance Assurance Monitoring (CAM), PSE Encogen is required to submit a CAM plan for CO at the time of permit renewal, if the source has an uncontrolled CO potential to emit (PTE) greater than 100 tons per year and the source is equipped with an active CO control device. PSE Encogen initially monitored CO emissions for two years and CO emissions were consistently less than 30% of the CO limit (limits are 10 ppmvd and 131 ton per year). Therefore, PSE Encogen does not meet the PTE applicability requirement of 40 CFR 64.2(a)(3). In addition, because there is no active CO control device, the source is exempt from CAM under 40 CFR 64.2(a)(2).

Permit Term 5.22 (NWCAA Order of Approval #400 Condition No. 2C and 3C) limits VOC emissions from each turbine exhaust stack to 7.0 ppmvd corrected to 15% O<sub>2</sub> and ISO on an hourly average, and VOC emissions from the project to 362 pounds per day. During the initial performance testing the gas turbine/HRSG exhausts were tested for emissions of VOC. During natural gas-firing the VOC emissions averaged 0.1 ppmvd and 3.8 pounds per day. During oil-firing the VOC emissions averaged 1.3 ppmvd and 56.0 pounds per day. The maximum measured VOC concentration is approximately 10% of the standard and the maximum measured VOC emission rate is approximately 15% of the standard.

The gas turbines are designed to operate at maximum efficiency in order to generate the most electricity per unit of fuel consumed. Any increase in CO or VOC from nominal levels would be due to some anomaly within the combustion section of the turbine, which, at a minimum, would cause a decrease in operating efficiency. Some combustion anomalies can lead to rapid and catastrophic failure of the gas turbine. The gas turbines are fitted with several temperature sensors downstream of each combustor to rapidly detect any temperature fluctuations. The signal from each of these sensors goes to an automatic control system which, during normal operation, will either shut the gas turbine down or signal the operator, depending upon the degree of temperature fluctuation. Automatic shutdown or operator notification will occur long before CO or VOC emissions exceed permitted levels. NWCAA has therefore determined that operation of the turbines and their instrumentation systems in accordance with the O&M Plan and manufacturer's instructions, including performance of necessary maintenance whenever automatic shutdowns occur, will adequately demonstrate compliance with CO and VOC limits.

Emissions of CO from the boiler are limited to 50 ppmvd by Permit Term 5.27. Because the boiler can only burn natural gas, good operating practices and adherence to the manufacturer's operating instruction should allow the facility to easily meet this level. Compliance will be demonstrated by an initial and annual source testing.

- **ISO Conditions**

In accordance with various conditions stated in the PSE Encogen's PSD Permits and NWCAA Order of Approval to Construct #400, pollutant stack concentration are adjusted to 15% oxygen by volume, and corrected for ISO conditions. The ISO correction applied at the plant is based on the equation in 40 CFR 60.335(c)(1). Although the federal rule is used to adjust the NO<sub>x</sub> emissions, this has also been used to adjust CO, SO<sub>x</sub> and ammonia emissions as indicated underlying permits. Under normal weather conditions for Bellingham (temperature and humidity) this correction factor only adjusts the measured value by approximately plus or minus 5% and is, therefore, does not result in a significant adjustment to the reported emission values.

## **APPENDIX B – CHANGES INCOPORATED INTO 2006 PERMIT**

### Permit Information Page

- Updated Corporate Information Contact (Charles Morton)
- Changed facility name to PSE Encogen here and in remainder of permit
- Changed permit applicability dates

### Section 1 - Emission Unit Group Identification

- Included the new Auxiliary Boiler in the listing of sources at PSE Encogen

### Section 2 – Standard Terms and Conditions

- Included the latest version (May 2006) of this section with new dates and language from revisions to WAC 173-040 and NWCAA Regulations

### Section 3 - Standard Terms and Conditions for NSPS

- Added a new section that includes Standard Terms for New Source Performance Standards

### Section 4 – Generally Applicable Requirements

- Changed WAC 173-040 and NWCAA Regulations applicability dates

### Section 5 – Specifically Applicable Terms and Conditions

- Added statement to introduction for this section relative to one-time performance testing
- Added new NSPS Subpart GG requirements for NO<sub>x</sub> and SO<sub>2</sub> for gas turbines
- Added permit terms for auxiliary boiler per OAC #951
- Added Subpart Dc regulations for auxiliary boiler
- Removed references to testing requirements from 40 CFR Part 60 and included the Appendix A requirement for monitoring and testing that references 40 CFR Part 75

### Section 6 – Acid Rain Permit for Turbines 1, 2 and 3

- Added new section with Acid Rain provisions including applicability information, the Acid Rain permit application for PSE Encogen, and the Certificate of Representation

### Section 7 – Inapplicable Requirements

- Removed the Acid Rain provisions since these rules are no longer inapplicable
- Removed NSPS Subpart Dc provisions since these rules are no longer inapplicable