BEFORE THE STATE OF WASHINGTON
ENERGY FACILITY SITE EVALUATION COUNCIL

IN RE APPLICATION NO. 99-1

SUMAS ENERGY 2 GENERATION FACILITY

EXHIBIT _____ (EH-T)

APPLICANT'S PREFILED DIRECT TESTIMONY

WITNESS # 5: ERIC HANSEN

Q. Please introduce yourself to the Council.

A. Eric Hansen

Q. What is the subject of your testimony?

A. My testimony will address three topics:

First, my background and experience.

Second, the air emissions associated with the proposed facility.

Third, the sound emissions associated with the proposed facility.

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Background

Q. What is your occupation and title?

A. I am a senior consulting scientist at MFG, Inc, which is a environmental and engineering consulting firm with 200 employees in offices across the country. I work out of the MFG office in Lynnwood, Washington, where we focus primarily upon air quality and environmental noise issues.

Q. Please describe your background.

A. I began my career in air quality consulting in 1978. In 1980, I received private instruction in environmental noise from a University of Washington professor. Over the last 20 years, I have evaluated a very broad range of transportation and industrial air quality and noise issues, primarily in the Pacific Northwest.

Evaluating the air quality and noise implications of combustion turbine-based electrical generating facilities has been a major focus of mine during the last ten years. For example, I prepared the air quality and noise assessments for the SEPA process for the 127 MW cogeneration unit now operating in Sumas, and I prepared the air quality assessments used in connection with the EFSEC application for the Chehalis Generating Facility. I have been also been involved in a number of other combined cycle-based projects in the Pacific Northwest.

I have a Bachelors of Arts degree in Physical Oceanography and a Masters degree in Civil Engineering, both from the University of Washington. A copy of my resume is provided as Exhibit ___ (EH-1) to this testimony.

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Q. Have you testified as an expert before EFSEC before?

A. Yes. I provided expert testimony regarding air quality in the proceedings regarding the Chehalis Generating Facility in 1995.

Q. What is your role in connection with the Sumas Energy 2 Generation Facility (S2GF) project?

A. I am the project manager for MFG's role in the project, which includes evaluation of air quality and environmental noise issues. To date, our office has spent more than 2,000 hours evaluating the air quality and noise implications of the project, and responding to questions about those issues.

Q. Who else is part of the MFG team working on the S2GF project?

A. Several others were part of the MFG team. Ken Richmond and Kevin Warner performed air quality modeling, Kirk Winges assisted in analyzing air quality issues, and Marc Wolman assisted with the Best Available Control Technology (BACT) analysis. Kris Hansen and Kristen Wallace have assisted in the measurement and modeling of noise emissions. Copies of their resumes are provided as Exhibit ___ (EH-2) .

Air Emissions

Q. Please provide a general explanation of the regulatory framework that governs air emissions from a facility such as the S2GF generating facility.

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A. Emissions from S2GF would be governed by the federal New Source Performance Standards (NSPS) that address combustion turbines (Subpart GG) and heat recovery steam generators (Subpart Da), and by both state and federal requirements to meet Best Available Control Technology (BACT). In practice, the requirement to apply BACT results in much more stringent controls for combustion turbines than the NSPS.

Because the project would have the potential to emit more than 100 tons of a regulated pollutant per year, it will be subject to the federal Prevention of Significant Deterioration (PSD) permitting process. That process duplicates the state requirement for BACT, and requires that an applicant conduct an ambient air quality assessment. Once operational, the S2GF will need also to submit an operating permit application pursuant to Title V of the Federal Clean Air Act.

Q. Can you describe in general terms the work MFG has performed to determine whether this project will comply with those regulatory requirements?

A. To my knowledge, MFG has conducted the most thorough air quality assessment that has ever been conducted in the Pacific Northwest for an individual project. We first conducted a standard modeling assessment based on Gaussian plume models (e.g., ISCST3). That effort relied on five years of hourly meteorological data from Abbotsford Airport and considered the worst case emissions from plant. Concentrations of criteria and toxic air pollutants emitted during base load operation, base load with duct burners, and oil firing were calculated at more than 500 locations. The modeling indicated the plant would comply with ambient air quality standards and PSD increments by a wide margin. However, the use of ISCST3 provides a very

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conservative assessment of Class I area impacts, and federal land managers were concerned enough about the predicted impacts to "air quality related values" such as visibility and deposition to request more detailed modeling

At EFSEC's direction, MFG conducted a detailed evaluation using the Calmet/Calpuff models. That assessment was a collaborative effort by scientists from the University of Washington, the Department of Ecology, and MFG. This assessment evaluated more than 4000 receptors in a modeling domain stretching from (approximately) Olympia to Mount Whistler (north of Vancouver, B.C.) and from the Pacific Ocean to east of the Cascades. Meteorological data from more than 90 weather stations were used to refine a wind field that covered 32 vertical layers in 4 kilometer grid cells. This was a very high-level modeling study, and MFG's Ken Richmond has been complimented by Canadian and Washington regulatory staff and even by the Forest Service reviewer. The more detailed Calmet/Calpuff modeling agreed well with ISCST calculations for locations in the vicinity of the plant, and demonstrated that the plant would meet all requirements for an air quality permit. Calmet/Calpuff model predictions of potential impacts to more distant receptors in PSD Class I areas were much lower than those with ISCST. S2GF was found to comply with very low significance criteria recommended by Ecology at the beginning of the study, with the possible exception of visibility impacts under very specific circumstances.

In response to issues raised by Canadian air quality staff, MFG performed additional Calmet/Calpuff modeling to evaluate the S2GF's effect on Fraser Valley air quality. This more detailed modeling confirmed that emissions from the project would result in

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concentrations that would be only a fraction of the applicable Canadian standards, and furthermore, that ambient air quality standards would not be threatened even with the addition of background concentrations.

Q. What are the primary emissions of concern with respect to this project?

A. Oxides of nitrogen (NOx) are usually the pollutants of primary concern for power plants. In the presence of volatile organic compounds and sunlight, NOx is a precursor to ozone. In the presence of ammonia, NOx can be converted to ammonium nitrate, a particle with implications for regional haze. Other regulated pollutants emitted by the project include sulfur dioxide (SO2), carbon monoxide (CO), particulate matter (PM10), and some toxic air pollutants. Finally, although not regulated under federal or state law, there will also be greenhouse gas emissions associated with burning fossil fuels. All of these issues are addressed in the Application for Site Certification.

Q. What criteria did you use to evaluate the ambient air quality impacts of those emissions?

A. We compared calculated concentrations attributable to emissions from S2GF with the ambient air quality standards established to protect human health. We made two comparisons. First, we compared the highest calculated concentration of each pollutant (for each averaging time for which there was a standard) that occurred over a five-year period with the ambient standard. Second, we identified a conservative background concentration (the concentration that would be expected without the project) by averaging the highest concentration measured at a monitoring station in

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Abbotsford for each year from 1996 to 1998, added this background concentration to the highest concentration from S2GF. This is generally considered a conservative approach because the meteorological conditions that generate the maximum concentrations from S2GF are not necessarily the conditions that generated the highest concentrations at the Abbotsford monitoring station.

We also compared concentrations attributable to S2GF with PSD increments. By definition, the PSD increments are the criterion for determining whether there is a significant deterioration of air quality. As noted below, emissions from S2GF would

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generate ambient concentrations that are only a small fraction of the incremental increases that represent significant deterioration of air quality.

I should point out that virtually all the maximum concentrations are predicted during oil firing, which could occur up to 15 days per year. The probability of these maximum concentrations actually occurring is reduced by two factors. First, gas diversions that lead to oil firing have historically occurred only rarely. Second, the adverse meteorological conditions that lead to the maximum concentrations would have to occur when S2GF is firing oil, which would be at most 17% of winter days.

Q. Could you to address each of the pollutants you mentioned in turn. First, what did you conclude about NOx emissions?

A. S2GF proposes to employ selective catalytic reduction (SCR) to limit NOx emissions to ~~3~~ 2 ppm when fired by natural gas and ~~12~~ 6 ppm when fired by diesel. This is much less than the NSPS requirement, and is ~~equivalent to~~ lower than the most stringent limit yet imposed in Washington.

Our air quality modeling, which was based on SE2's original proposal to limit emissions to 3 ppm during gas firing and 12 ppm during diesel firing, indicates that ambient concentrations of NOx attributable to S2GF would be less than 1 percent of the ambient air quality standard that protects human health. Assuming a background concentration determined by averaging the

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annual concentrations observed in Abbotsford from 1996 through 1998, the total concentration of NOx would be 34 percent of the 100 ug/m3 ambient air quality standard.

In our Calmet/Calpuff modeling assessment of the Fraser Valley, the maximum predicted NOx concentrations attributable to S2GF were found to be 13, 5, and 1 percent of the Canadian 1-hour, 24-hour, and annual average air quality objectives. With the assumed background concentrations (determined by averaging the highest data from each year from 1996 to 1998), the cumulative concentrations would be 42, 36, and 55 percent of the Canadian objectives.

The maximum calculated NOx concentration was 2 percent of the PSD increment for Class II areas and about 1 percent of the PSD increment for Class I areas.

Q. What did you conclude about sulfur dioxide emissions?

A. S2GF proposes to rely on natural gas or very low sulfur diesel to limit SO_2 emissions to 1 ppm when fired by natural gas and 10 ppm when fired by diesel. Reliance on natural gas as a primary fuel and low sulfur oil as a backup fuel has been identified as BACT for SO2 in a number of recently permitted combined cycle projects in Washington. The sulfur content of natural gas is almost negligible, so actual SO2 concentrations would typically be much lower than the maximum values (which result from firing oil) reported here and in the Application of Site Certification.

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Our air quality modeling indicates that ambient concentrations of SO_2 attributable to S2GF would be 7 percent or less of the U.S. ambient air quality standards that protect human health. Assuming a background concentration determined by averaging the maximum concentrations observed in Abbotsford from 1996 through 1998, the total concentration of SO_2 would be 10 percent or less of the ambient air quality standards.

In our Fraser Valley Calmet/Calpuff modeling assessment of the Fraser Valley, the maximum predicted SO_2 concentrations attributable to S2GF were found to be 13 percent or less of the Canadian 1-hour, 3-hour, 24-hour, and annual average air quality objectives. With the assumed background concentrations (determined by averaging the highest data from each year from 1996 to 1998), the cumulative concentrations would be 21 percent or less of the Canadian objectives.

The maximum calculated SO_2 concentration was 10 percent of the PSD increment for Class II areas and about 10 percent of the PSD increment for Class I areas.

Q. What did you conclude about carbon monoxide emissions?

A. S2GF proposes to employ catalytic oxidation to limit CO emissions to 2 ppm when fired by natural gas and 12 ppm when fired by diesel. This control technology and

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emission rate has been determined to be BACT in other recently permitted combined cycle projects in Washington.

Our air quality modeling indicates that ambient concentrations of CO attributable to S2GF would be less than 1 percent of the ambient air quality standard that protects human health. Assuming a background concentration determined by averaging the annual concentrations observed in Abbotsford from 1996 through 1998, the total concentration of CO would be 34 percent or less of the ambient air quality standards.

In our Calmet/Calpuff modeling assessment of the Fraser Valley, the maximum predicted CO concentrations attributable to S2GF were found to be 0.2 percent of the Canadian air quality objectives. With the assumed background concentrations (determined by averaging the highest data from each year from 1996 to 1998), the cumulative concentrations would be 62 percent of the Canadian objectives.

There are no PSD increments for CO, but the incremental increase in ambient concentrations attributable to the project would be less than 1 percent of the standards.

Q. What did you conclude about particulate matter emissions?

A. S2GF proposes to employ natural gas fuel and proper combustion to limit PM-10 emissions to 24 lb/hr when fired by natural gas and 64 lb/hr when fired by diesel.

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Our air quality modeling indicates that ambient concentrations of PM-10 attributable to S2GF would be less than 7 percent of the U.S. ambient air quality standard that protects human health. Assuming a background concentration determined by averaging the maximum concentrations observed in Abbotsford from 1996 through 1998, the total concentration of PM-10 would be 44 percent of the 150 ug/m3 ambient air quality standard.

In our Calmet/Calpuff modeling assessment, the maximum predicted PM-10 concentrations attributable to S2GF was found to be 1 percent of the Canadian annual air quality objective. With the assumed background concentrations (determined by averaging the annual average concentrations from 1996 to 1998, the cumulative annual concentration would be 53 percent of the Canadian objective of 30 ug/m3.

The maximum 24-hour average PM10 concentrations in the Fraser Valley already exceed the GVRD's 50 ug/m3 objective. However, we don't believe the maximum concentration attributable to S2GF (7 ug/m3) would aggravate that situation because the maximum S2GF concentrations occur with stable atmospheric conditions with light winds while the maximum measured concentrations appear to be generated by high wind events and windblown dust. We further evaluated this issue with the Calmet/Calpuff modeling by adding actual measured PM10 concentrations to predicted PM10 concentrations for the specific days considered in the Calmet/Calpuff evaluation (April 1998 through March 1999). When comparing the maximum concentration attributable to S2GF (for each season) with the actual measured

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concentration for that same day, the maximum cumulative concentration was 33 ug/m3, or 66 percent of the 24-hour PM10 objective of 50 ug/m3.

The maximum calculated PM-10 concentration was 34 percent of the PSD increment for Class II areas and about 7 percent of the PSD increment for Class I areas.

Q. What about ozone?

A. Ozone is not emitted directly by the project, but Canadian citizens raised concerns about the potential effects on ozone episodes attributable to S2GF's emissions of NOx and volatile organic compounds (VOCs). As part of Canadian efforts to understand troposphere ozone, Environment Canada has conducted detailed photochemical model evaluations of ozone precursors for specific adverse episodes. In response to a request from the Lower Fraser Valley Air Quality Coordinating Committee and the S2GF proponents, Environment Canada agreed to add proposed emissions from S2GF to its emission inventory and to evaluate the project's impact on ozone concentrations in the Lower Fraser Valley. Based on that modeling effort, Environment Canada determined that S2GF emissions would have a slight effect on ozone episode intensity and no effect on ozone episode duration. A copy of the report from Environment Canada is provided as Exhibit ___ (EH-3).

Q. After investigating all of the emissions that would be associated with the proposed project, do you believe there will be any adverse health impact associated with the plant's operation?

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A. Based on the comparison of model predictions with state and federal air quality standards, I do not believe S2GF will have an adverse health impact.

Q. The Draft Environmental Impact Statement published by EFSEC's consultant Jones and Stokes concluded that "[a]lthough the proposed project would result in an increase in air emissions, no significant adverse air quality impacts would occur." (DEIS at 3.1-21.) Do you agree with that conclusion?

A. Yes

Q. What did you conclude about visibility impacts?

A. One of the primary purposes of the Calmet/Calpuff modeling was to examine the increases in particulate matter concentrations in Class I areas and the resulting effect on visibility. MFG followed the *IWAQM Phase 2 Recommendations* for assessing regional visibility, and considered both direct fine particle emissions and secondary aerosols formed from the gases emitted by S2GF. Twenty-four hour average extinction coefficients are used as a measure of regional haze. Increased extinction causes reduced visual range. A 5% change in extinction is generally used to indicate a "just perceptible" change to a landscape.

With gas firing, predicted extinction coefficients are less than the 5% criterion, which indicates changes to visual conditions in the Class I areas would not be perceptible when the S2GF turbines are gas-fired. However, the CALPUFF modeling predicted that oil-fired emissions combined with unfavorable meteorological conditions may result in perceptible regional haze in Olympic National Park and North Cascades

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National Park. These meteorological conditions occurred three days during December 1998 through February 1999. In fact, however, daily average temperatures in Abbotsford for these particular days ranged from 36°F to 40°F. This is close to the seasonal average winter temperature of 38°F. The events did not occur when temperatures are unseasonably cold and it is unlikely gas would be curtailed due to the region's needs – and, in fact, Westcoast Pipeline confirmed that there had been no gas curtailment on those days. Thus, the meteorological conditions that resulted in predicted visibility impacts to the Olympic or North Cascades National Parks are not the same as those that would trigger oil firing. Because the probability of a gas shortage is low when temperatures are not extreme, it is unlikely the adverse visibility impacts would actually occur.

Q. What did you conclude about greenhouse gas emissions?

A. Although greenhouse gas emissions are not regulated under state or federal law, we considered those emissions. The primary greenhouse gas emitted by the project will be carbon dioxide (CO2). The project would emit approximately 2.4 million tons per year of carbon dioxide if it operates every hour of the year and fires oil a full 15 days a year. It is important to understand that the combustion of natural gas results in much lower emissions of CO2 than the combustion of other fossil fuels, such as coal or oil. Furthermore, because the combined cycle technology used by the S2GF is the most efficient means available for converting the energy in fossil fuels into electrical power, the same amount of electricity can be produced with lower greenhouse gas emissions than coal or oil plants. Exhibit ____ (EH-4) compares the CO2 emissions per kilowatt hour of electricity produced at various power plants in the region.

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Q. What is S2GF doing to mitigate for the greenhouse gas emissions?

A. The gradual replacement of coal-fired and oil-fired plants with highly efficient natural gas fired gas turbine-based electrical generating stations is one of the national strategies to reduce greenhouse gas emissions. To the extent that this plant will displace plants that emit greater amounts of carbon dioxide per megawatt of power, it is a step in the right direction for reducing greenhouse gases globally.

SE2 has also voluntarily committed to additional greenhouse gas mitigation measures. The Greenhouse Gas Offset Strategic Plan found in Appendix B of the Application outlines a proposal to invest $100,000 per year for ten years. The money would fund research, offset plans and/or management programs. The plan identifies a menu of potential GHG offset and management opportunities, and SE2 has also offered to work with the Energy Division of the Department of Community Trade and Economic Development to identify appropriate mitigation projects.

Sound Emissions

Q. Please explain what regulations apply to sound emissions from a facility such as the S2GF.

A. Sound emissions are regulated at both the state and local level. In this case, the City of Sumas has adopted an environmental noise ordinance that applies essentially the same criteria as the Washington State regulation. These regulations establish limits on the levels and duration of noise crossing property boundaries. Allowable maximum sound levels depend on the zoning of the source of the noise and the zoning of the

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receiving property. Except for short-term exceedances prescribed in State and local law, the project may not generate sound levels greater than 70 dBA at adjacent industrial properties. At the nearest residential properties, the project may not generate sound levels greater than 60 dBA during the day and 50 dBA at night (10 p.m. to 7 a.m.). The same limits apply to properties in Whatcom County outside the City limits.

Q. Can you explain what work MFG did to determine the extent of sound emissions that would be associated with the project?

A. We considered all the dominant noise sources from the facility – all those that would be expected to contribute significantly to the noise generation of the plant, and we obtained sound level emission date from equipment suppliers (e.g. the gas turbine manufacturer, and the supplier of the cooling tower and air-cooling condenser). These noise data were evaluated with the Environmental Noise Model (ENM), which calculates sound levels at off-site locations. Our work focused on the nearest receiving properties, which are all zoned for industrial uses, and on the nearest residentially zoned properties, which lie 1,400 feet north of the site. Our first assessments indicated that sound levels attributable to S2GF would exceed the 50 dBA night noise limit at the residential properties. We then identified a series of noise reduction measures, and the proponent agreed to include them in the proposal. With those measures, the project would meet the night noise limits – even under stable (i.e., inversion) atmospheric conditions.

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Q. What sorts of sound attenuation measures has SE2 incorporated in the project design?

A. The site layout was designed to minimize noise impacts to the nearest residential property. For example, the cooling tower and air-cooled condenser were placed south of the steam turbine and gas turbine buildings to increase the distance to residential areas to the north and to enhance the barrier effect of the gas turbine and steam turbine buildings. In addition to site layout, the following measures that go beyond standard equipment designs have been incorporated into the proposal:

- The gas turbines and generators have been enclosed in an insulated building.
- A quieted air filter house package has been specified.
- The steam turbine and generator has been enclosed in an insulated building.
- The thickness of the steel walls of the heat recovery steam generator (HRSG) sections has been increased.
- The thickness of the stack walls has been increased.
- A sound baffle has been installed in the HRSG to reduce noise from the stack tips.
- Acoustical splitters have been specified for each cell of the air-cooled condenser.
- Noise walls have been designed for the steam turbine and gas turbine generator transformers.

Although the ENM modeling does not indicate it will be necessary, additional noise walls and other forms of mitigation could be employed if necessary to further reduce noise levels at off-site locations.

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SE2 is also committed to including noise performance specifications in its purchase agreements. Noise levels will be measured at startup, and equipment suppliers will be required to retrofit equipment if necessary to meet the performance specification. Final payment to equipment suppliers will not be made until noise specifications are met. This is a common practice in the power industry.

Q. What are your conclusions about the amount of sound emissions?

A. Our calculations indicate that S2GF will meet the City of Sumas's night noise limit of 50 dBA at residentially zoned properties and the 70 dBA noise limit for industrial zones.

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END OF TESTIMONY

I declare under penalty of perjury that the above testimony is true and correct to the best of my knowledge.

DATED: April _____, 2000.

By _____
Eric Hansen

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