3.0 DESCRIPTION OF ALTERNATIVES INCLUDING THE PROPOSED ACTION

The proposed action is for the United States Department of Energy (DOE) to provide, through a cooperative agreement with Northwest Fuel Development, Inc. of Oswego, OR, cost-shared financial support for the design, construction, and operation of an integrated power generation system that uses coal mine waste methane. The proposed system would be located at the Eastern Associated Coal Corporation's (EACC's) Federal Number 2 Mine near the unincorporated town of Crossroads in rural western Monongalia County, WV (Figure 3.1). The cooperative agreement would result in a 3-year project. The project would demonstrate the collection, processing, and utilization of coal mine methane.

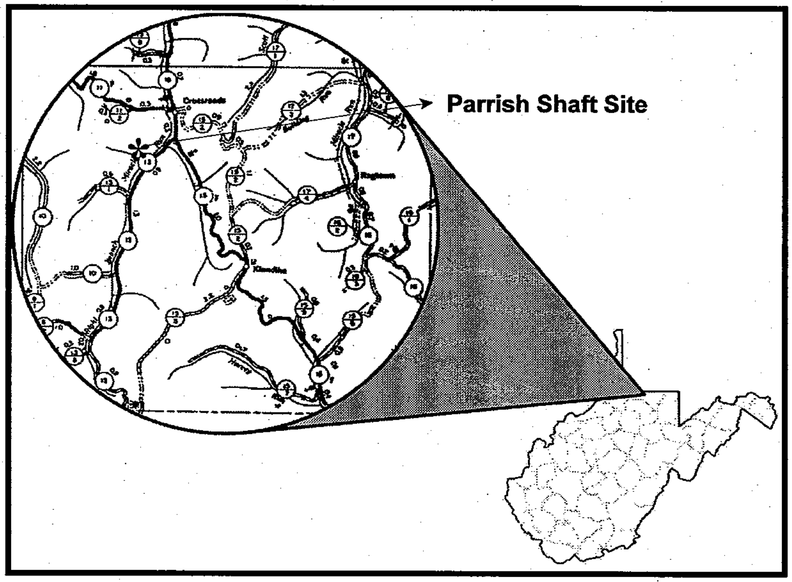

Figure 3.1 Location of Proposed Project

Under the proposed action, DOE would provide $600,000 (approximately 35%) of the total cost for the proposed project. The cooperative agreement would result in a project to test the commercial viability of capturing low quality coal mine methane and processing the gas on-site into two gas streams - a pipeline quality gas for sale and a lower quality gas stream for combustion in a series of modular reciprocating internal combustion engines to generate electricity for use by the mine.

3.1 Background

The site for the proposed project would be the Parrish Shaft of EACC's Federal Number 2 Mine in western Monongalia County, West Virginia. The Federal No. 2 Mine employs longwall mining techniques. As mining progresses through the coal seam, the area behind the longwall miner collapses, and the area fills with rock debris from the overlying and adjacent rock layers. This gob contains a mixture of methane and ventilation air. Currently, waste methane gas from the mine is vented to the atmosphere by vertical boreholes drilled in advance of mining.

The Parrish Shaft site is located along an access road off of County Route 13 approximately 0.4 miles from County Route 15. The proposed site is located approximately 2.25 miles southeast of Wadestown, WV. The site was previously the location of a fan for the Federal No. 2 Mine. Approximately three years ago EACC removed the fan, and the site was converted to an emergency hoisting facility. The site is located in the Dunkard Creek watershed and is adjacent to the Right Branch of Miracle Run, a tributary of Dunkard Creek.

3.2 Description of the Proposed Action

The proposed project would combine two technologies - gas processing and power generation - in an integrated system on a small field site. Northwest Fuel would construct and demonstrate an integrated gas processing/power generation system capable of producing approximately 500,000 standard cubic feet per day (scfd) of pipeline quality gas and approximately 1.2 megawatts of electricity. The gas processing system would use continuous pressure swing adsorption to separate pipeline-quality methane, which would be sold, from the high-nitrogen coal mine methane. Electricity would be generated using modular units of approximately 75 kilowatts each. In each unit, combustion engines would use the high nitrogen content methane gas rejected from processing operations and additional high-nitrogen methane from the mine. Overall, the system would use about 1,000,000 scfd of coal mine methane that would otherwise be vented to the atmosphere.

Equipment for the proposed project would be located on the Parrish Shaft site. Currently, the site comprises a fenced area of 150 ft by 300 ft and houses an emergency hoisting facility for the mine. The gensets, gas upgrading equipment, and vacuum blower for the gathering lines would be located within the fenced area on previously disturbed land immediately west of the hoisting facility and adjacent to the EACC electrical substation. Gathering lines would be installed to bring the waste methane from two existing ventilation boreholes (i.e., gob vents 29 and 30) to the project site. The ventilation boreholes are located across a small unnamed ridge southeast of the site and across County Route 13. A vacuum system would be used to extract the waste methane from the ventilation boreholes. The vacuum system would eliminate the need for a compressor station at the ventilation boreholes making operation and maintenance easier. Additionally, operating the gathering system under vacuum (rather than compression) would reduce the amount of water condensing in the gathering lines.

Site preparation would consist of installation of a supply pipeline from the two boreholes. The pipeline would be constructed of polyethylene plastic and buried to a depth of 3 feet to avoid frosting. The pipeline would cross over the Right Branch of Miracle Run adjacent to the Parrish Shaft site. Overall, the length of the supply pipeline would be approximately 7,000 feet. This pipeline would follow an existing, EACC-owned right-of-way for approximately 2,000 feet. The remainder of the pipeline would be installed along the route of an existing jeep trail through woodland and a pasture (Figure 3.2).

Figure 3.2 Expected Route of Pipeline Along Existing Trail

The supply pipeline would cross two streams, the Right Branch of Miracle Run and an unnamed tributary to that stream. The pipeline would be installed in a shallow trench, which would be filled and reseeded. The pipeline would pass under County Route 13 and would pass over the Right Branch of miracle Run on an overhead pipe rack. The pipe rack would be installed over the Right Branch of Miracle Run immediately adjacent to the Parrish Shaft site. It is anticipated that the pipeline crossing the unnamed tributary would be underground. Figure 3.3 shows the route of the proposed pipeline - including the line running from the proposed project to the gas distribution pipeline.

A short pipeline would also be installed to transport high quality product gas from the project site to an existing, commercial natural gas distribution pipeline. An Equitrans natural gas distribution pipeline traverses EACC property and is less than 0.5 miles from the Parrish Shaft. The required pipeline would generally follow an existing roadway and EACC's power line right-of-way to the natural gas distribution

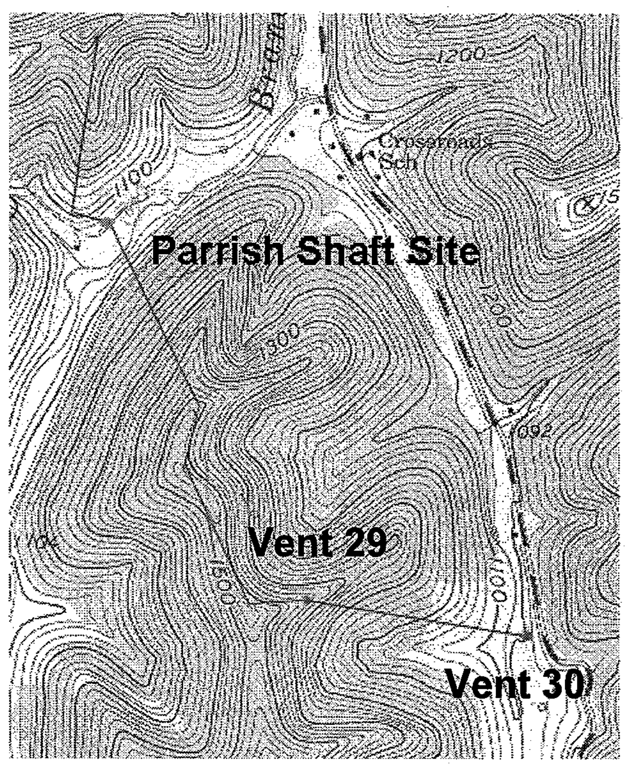

Figure 3.3 Proposed Pipeline Route

pipeline, about 2,500 ft from the project site.

Land required for the pipeline segments is owned by EACC and several local residents. Temporary disturbances to the land caused by installation of the supply and product pipelines and the gas processing/power generation equipment would be mitigated by appropriate construction and re-seeding. Right-of-way agreements would be needed for installation of the pipeline.

The coal mine waste gas, which is currently vented to the atmosphere from a sealed portion of the mine, would be supplied to a Nitrogen Rejection Unit (NRU). Feed capacity of the unit would be 1 million scfd. The NRU would receive 500,000 scfd of higher quality gas (containing approximately 89% methane) from the two gob vents and 650,000 scfd of lower quality gas (approximately 45% methane) from the Parrish Shaft. The NRU would preferentially remove excess nitrogen (using the Continuous Pressure Swing Adsorption process) and would produce two gas streams. One stream (approximately 285,900 scfd) of pipeline quality natural gas (95% methane) would be delivered to the natural gas pipeline located near the Parrish Shaft property. A second gas stream (approximately 819,500 scfd) of "waste" byproduct gas (containing approximately 55% methane) would be piped directly to a power generation unit capable of using the lower quality gas. A process diagram showing the waste methane utilization is shown is Figure 3.4.

The gas processing system would also include units to remove carbon dioxide and water. These systems would include either an amine scrubbing system or pressure swing adsorption to remove excess carbon dioxide and either a tri-ethylene glycol (TEG) system or salt system to remove excess water. A TEG system, which is a common dehydration method currently used by the oil and gas industry, uses tri-ethylene glycol to

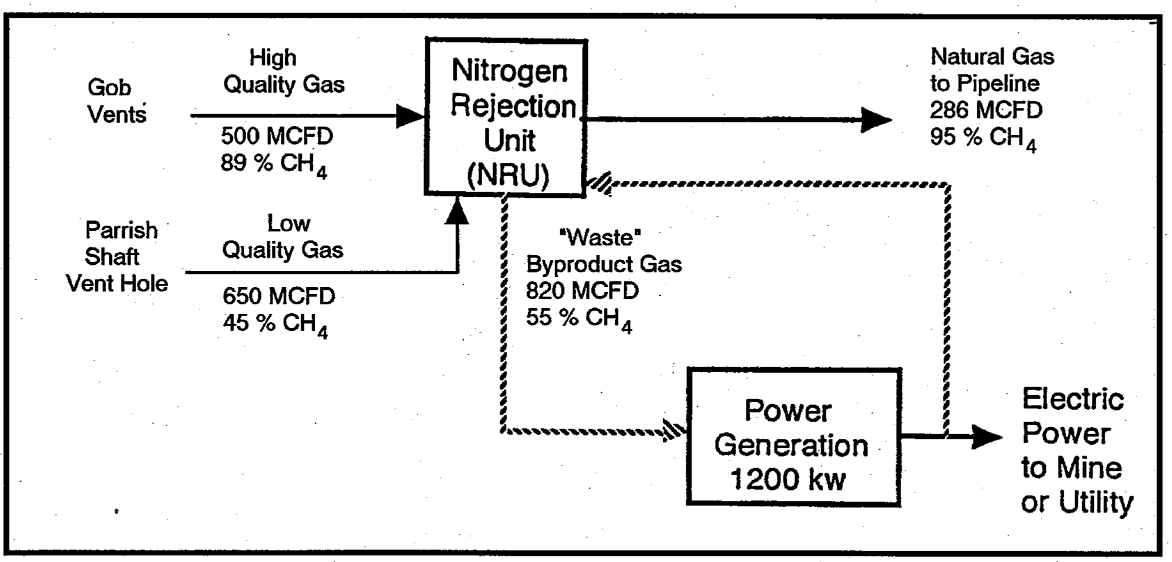

Figure 3.4 General Process Diagram Showing Methane Utilization

strip away the unwanted water. The tri-ethylene glycol is then heated to eliminate the water and the TEG is recirculated and continuously reused.

The power generation subsystem would consist of 18 skid-mounted reciprocating internal combustion engines driving electric generators, each rated at 75 kilowatts. The internal combustion engines would be conventional Chevy 454 (cubic inch) light truck engines, and each engine would be limited to a maximum design heat input of 1.4 million Btu/hr. The 18 engine/generator modules (gensets) would be installed in two rows of 9 engines exhausted though common manifolds to a 90 ft tall stack to be located at the proposed site (Figure 3.5). Exhaust to the stack would be assisted by a fan. The gensets and associated manifolds and control panels would occupy an area measuring approximately 60 ft by 120 ft. The anticipated general site layout is depicted in Figure 3.6.

Electricity from the proposed project would be sold directly to the mine. The proposed project would provide more than 10% of the electricity used by the Federal

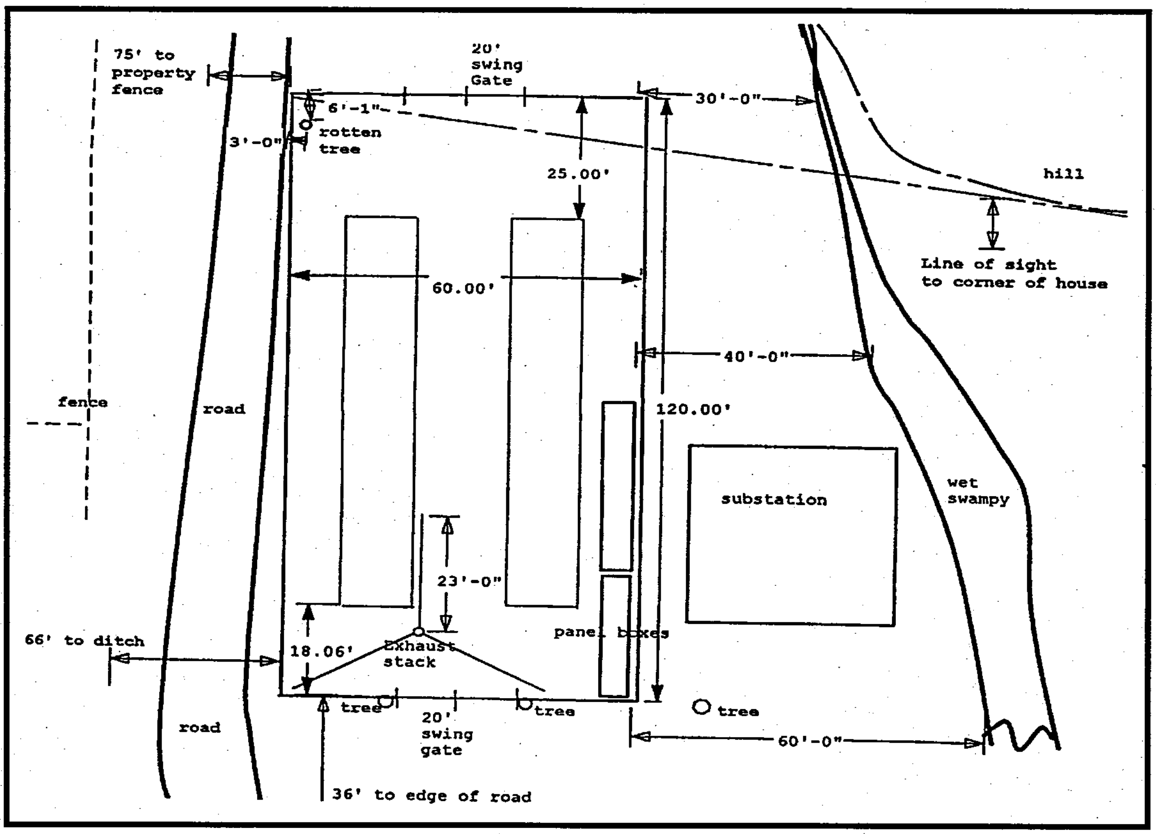

Figure 3.5 General Site Layout

Number 2 Mine. Electric utility companies in the vicinity of the proposed project generate over 90% of their electricity from coal-fired plants. The electricity generated from combusting gas produced by the proposed project would effectively offset current emissions produced from combusting coal at a utility plant to supply the equivalent amount of electricity to the mine. Generators for the proposed project would be connected to an existing electrical substation owned by EACC and located at the Parrish Shaft site. No electrical transmission lines would be constructed offsite under the proposed action.

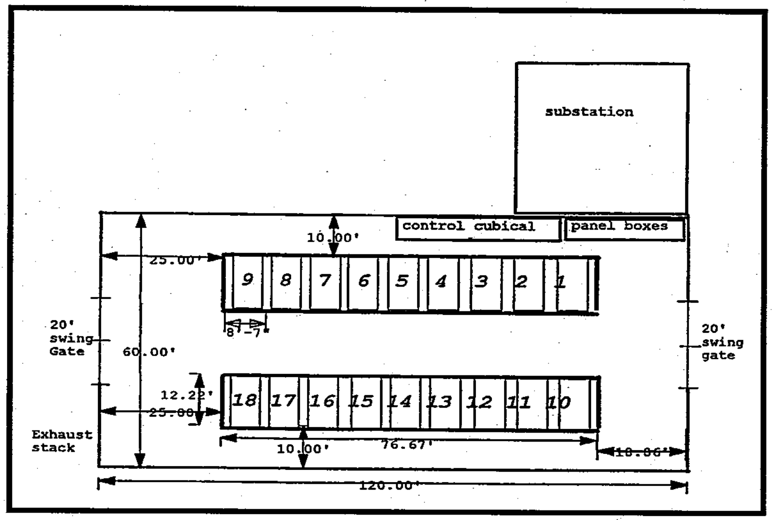

Figure 3.6 Arrangement of Gensets

3.3 Project Schedule

The proposed project is expected to last for approximately 36 months including final engineering design work and the environmental review, which includes the preparation of this EA. The demonstration phase of the project, which would include full operation of the project as described earlier in this section, is expected to last 12 to 24 months. Site preparation would involve standard work practices such as trenching and laying continuous pipeline and minor leveling of the site. The gensets are modular units, and are readily available for delivery and hookup. Because of the minimal site work required and the use of modular gensets, DOE anticipates that the project could begin operations within 60 days of a decision to proceed.

DOE anticipates that the demonstration phase of the project would begin in the spring or summer of 2002. Following completion of the demonstration phase of the project, the project would either be discontinued or converted to commercial operations by the Industrial Participant. If discontinued, the Industrial Participant would submit a site restoration plan to DOE for approval, and the project would be dismantled. The modular gensets would be removed and either reused - in whole or in part - at another location operated by the Industrial Participant or sold for salvage value. The site would be turned back over to the owner, EACC. It is expected that the underground portion of the gas pipelines would be abandoned in place to avoid the additional damage of re-opening the trench for removal of the lines. DOE anticipates that site restoration work would be completed within 30 days of approval of the site restoration plan.

In lieu of discontinuing the project at the end of the demonstration phase, based on successful operation during the demonstration phase and favorable economic conditions at the end of the demonstration phase, the Industrial Participant could decide to continue operating the project on a commercial basis. Both the Industrial Participant and the site owner are aware of the possibility of future commercial operations, and are supportive of the concept. DOE's involvement is limited to the demonstration phase of the project, and DOE would provide no funding for commercial operations should they occur. While commercial operation at the conclusion of the demonstration phase - and DOE's involvement - is possible, the occurrence of such would depend on activities (for example, future mining operations and the price of natural gas and electricity) outside of DOE's control. DOE has no information on either the likelihood of commercial operation occurring or the duration of commercial operations should they occur.

3.4 Alternatives to the Proposed Project

The solicitation (DE-PS26-00NT 40767) which resulted in the selection of the proposed project for consideration for partial funding by DOE was restricted to five firms which had participated in Phase I (feasibility study) and Phase II (conceptual design and analysis) efforts conducted under previous Government contracts. The solicitation called for responding firms to use data results obtained from their respective Phase I and Phase II efforts to propose a pilot-scale project demonstrating the technology and design of their earlier efforts. The objective of the solicitation and projects selected was to reduce methane emissions associated with underground mining operations by conducting a pilot-scale field demonstration of existing technologies for capturing, recovering, and utilizing coal mine methane from mine operations. As part of the evaluation criteria used in selecting the successful proposal, offerors were required to demonstrate a commitment from a coal mine owner for utilization or recovery of the coal mine methane.

DOE's participation in the proposed project is limited to partial funding of the project proposed by private industry. Because of DOE's limited funding role in the proposed project (financial assistance for 35% of the estimated cost of the Integrated Power Generation System project), and due to the absence of a decision-making role other than a decision to act on a proposal from private industry for a defined project at a specific location, alternatives to be considered in the EA are limited to the No Action alternative and minor design consideration alternatives.

3.4.1 No Action

Under the No Action alternative, DOE would not provide partial funding for the installation and operation of the Integrated Power Generation System at EACC's Parrish Shaft site. In the absence of DOE funding, Northwest Fuel or a successor could continue with its plans to construct and operate the project subject to all applicable regulations and permits. Under this case, the environmental changes resulting from the project would be expected to be the same as those identified and analyzed in Section 4 of this EA. It is more likely, however, that the action in the absence of DOE's funding is that the plans for the Integrated Power Generation System would be discontinued and the mine would continue to vent waste methane to the atmosphere.

Should the Industrial Participant decide to proceed with the project in the absence of DOE funding, noise arising from the project could be greater than with DOE's participation, as DOE has determined to require noise abatement measures to mitigate property line noise. As neither West Virginia nor Monongalia County have enacted noise control ordinances, in the absence of DOE's participation, noise abatement measures would be at the discretion of the Industrial Participant or the site owner unless or until public concern or the threat of legal action necessitated noise abatement.

3.4.2 Gas Turbine for Full or Partial Power Generation

In its initial proposal, Northwest Fuel proposed to install the gensets in two stages. During the first stage, nine reciprocating internal combustion engines with generators would be installed and operated while the methane productivity of the two vent holes was evaluated. Additional generating capacity would then be added in a second stage after methane quality and quantity was verified as sufficient to support the additional generating capacity. Northwest Fuel identified two options for the additional generating capacity: an additional bank of nine reciprocating internal combustion engines or a single gas turbine.

A gas turbine (also referred to as a "combustion turbine") is an internal combustion engine that operates with a rotary (as opposed to a reciprocating) motion. Gas turbines consist of three essential components: a compressor, a combustor, and a power turbine. The compressor draws in and compresses ambient air and directs the compressed air to the combustor. In the combustor, fuel (in this case, waste coal mine methane) is introduced, mixed with the compressed air, ignited, and burned. Hot gases from the combustion process are directed to the power turbine where energy from the hot, expanding exhaust gases is utilized to drive a rotating shaft. Over half of the shaft horsepower is utilized to drive the compressor; the remaining horsepower generated is available to drive an external load (in this case, an electric power generator).

The combustion process in a gas turbine can be classified as either diffusion flame combustion or lean-burn, premix staged combustion. In diffusion flame combustion, mixing of the fuel and air occurs simultaneously with combustion in the primary combustion zone. This process produces regions in the combustion chamber with fuel/air mixtures near the stoichiometric ratio, the exact proportion of air necessary for the complete combustion of the fuel gas. Combustion at the stoichiometric ratio produces comparatively high temperatures, which would favor the production of oxides of nitrogen (NO_x), a generally unfavorable scenario. In a lean-burn, premix staged combustor, fuel and air are completely mixed in an initial stage. This process results in a uniform, lean, unburned fuel/air mixture. This mixture is directed to a second stage where the combustion actually occurs. The majority of gas turbines manufactured today use lean-burn, premix staged combustors.

Because gas turbines burn natural gas, the same products of combustion associated with burning natural gas are produced in gas turbines as in reciprocating, internal combustion engines. EPA has calculated emission factors which can be used to estimate the amount and types of products emitted from gas turbines. These emission factors are based on the heat intake of the combustion turbine, and are tabulated in pounds per million British Thermal Units (MMBTUs) in Chapter 3.1 of the AP-42 Handbook of Emission Factors (EPA, 2000).

The proposed project would use 820 thousands standard cubic feet (scf) of mine gas per day (MCFD) with an average methane content of 55% for the generation of electricity. Assuming half of this amount (410 MCFD) would be used in the gas turbine (the other 410 MCFD being combusted in the initial bank of 9 reciprocating internal combustion engines), the heat input to the gas turbine would be 8.7 MMBTU/hour. Using this heat input, a lean-burn premix staged combustion gas turbine would produce 0.86 lbs/hour of oxides of nitrogen (NO_x) and 0.13 lbs/hour of carbon monoxide (CO). Emissions of volatile organic compounds (VOC), a precursor to the formation of ozone, would be expected to be 0.02 lbs/hour. A second bank of 9 reciprocating internal combustion engines as currently proposed would produce 35.4 lbs/hr of NO_x and 2.8 lbs/hour of CO. VOC emissions would be expected to be 1.0 lbs/hour. Emissions of lead (Pb) and particulate matter (PM) for both types of engines would be negligible. The comparative air emissions for criteria air pollutants are tabulated in Table 3.1.

Source noise levels for a single gas turbine sized to produce 675 kW (the power output of nine reciprocating internal combustion engines) was estimated at 105.2 dBA using the tables and methodology published by the American Gas Association (Miller, 1969). Applying the AGA methodology and tables for reciprocating engines fired on natural gas, nine engines would be expected to produce 94.7 dBA. As the decibel scale used to describe noise is logarithmic, the noise level expected from the gas turbine would be more than twice the noise level of the second bank of nine reciprocating internal combustion engines. When added to the base level of nine reciprocating internal combustion engines (the power generation to be initially installed) following the rules for adding comparable noise levels, the net increase in noise from the gas turbine alternative would be 7.5 dBA, which would be a noticeable difference for most people.

Air emissions from the proposed action (18 reciprocating internal combustion engines) as limited by the State air permit would not result in an exceedance of applicable ambient air quality standards. Therefore, the lower emissions expected from the gas turbine - while desirable - would have little incremental benefit over the proposed action. Noise, on the other hand, was identified as a potential concern for the nearest

Pollutant	Gas Turbine Alternative	Second Bank of Nine Reciprocating Engines
Oxides of Nitrogen	0.86 lbs/hr	35.4 lbs/hr
Carbon Monoxide	0.13 lbs/hr	2.8 lbs/hr
Volatile Organic Compounds	0.02 lbs/hr	1.0 lbs/hr
Data from AP-42 Handbook of Emission Factors (EPA, 2000)		

Table 3.1 Comparison of Expected Air Emissions for Alternatives Considered

residents to the proposed site. As the selection of the proposed action would be expected to have lower noise impacts than the gas turbine alternative, the proposed action would be preferred when considering the consequences of community noise.

3.4.3 Selection of Alternate Vent Holes

The proposed project would utilize coal mine methane gathered from two vent holes (# 29 and # 30) located approximately 4,500 feet and 6,000 feet, respectively, from the Parrish Shaft site. The pipeline to connect these vents to the proposed project would generally follow an existing power line right-of-way and existing jeep trail. The vent holes were selected because of their productivity, which is anticipated to be sufficient for the proposed power generation, their proximity to the Parrish Shaft site, their availability, and their accessibility for purposed of constructing the pipeline. Additionally, the pipeline would be operated under vacuum to reduce the cost of the project and to minimize the collection of water in the line. Under vacuum operation, it is necessary to minimize the number of low-lying sections of pipeline where water from the mine gas would collect. The proposed vent holes selected to supply the project may allow for the pipeline to be routed with few dips while still following the general route of the existing right-of-way and jeep trail.

The selection of alternate vent holes for the methane supply would depend on the expected productivity of the individual vent holes and their availability to the project. For purposes of considering reasonable alternatives, two nearby vent holes (# 28 and #26) were considered as representing the potential impacts of using other alternate vent holes. Vent #28 is located approximately 1900 feet northwest of vent hole #30. Vent hole #26 is located on the west facing hillside across County Route 15.

Vent # 28 is located approximately the same distance from the Parrish Shaft site as vent hole #29. However, access to vent hole #28 is via an access road off of County

Route 15. To connect the pipeline to this vent hole would require disturbing approximately 1200 feet of woodlands to reach the existing jeep trail before following the proposed pipeline route along the ridgeline. Vent #26 is slightly further from the Parrish Shaft site than Vent #30, and would require the pipeline to be located along a small valley. The location of Vent #26 is also approximately 50 feet higher in elevation than Vent #30. However, to connect this vent to the Parrish Shaft site, the pipeline would have to cross under County Route 15 and continue down to the nearby valley before heading up the hillside to the existing power line right-of-way and jeep trail. This drop of approximately 80 feet in vertical elevation would increase the likelihood of water from the mine gas plugging the pipeline. Under vacuum conditions, it would not be possible to drive the water plug out of the line. Consequently, it would be necessary to either establish a permanent cleanout in the pipeline to drain the collected water or install a gas dryer at the vent hole to dry the mine gas before introducing it into the pipeline. Either option would be expected to increase the surface disturbance to the land around the pipeline or the vent hole.

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