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AZ CORP COMMISSION
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December 30, 1999

Ms. Deborah Scott
Director, Utilities Division
Arizona Corporation Commission
1200 West Washington Street
Phoenix, AZ 85007

DOCKET NO. L-00000P-99-0098

RE: Application for a Certificate of Environmental Compatibility for the Arlington Valley Energy Project

Dear Ms. Scott:

ENSR, acting on behalf of the Duke Energy Maricopa LLC (Duke), is pleased to provide 25 copies of the attached Application for a Certificate of Environmental Compatibility (CEC). This CEC Application is for the Arlington Valley Energy Project proposed to be located near Arlington in Maricopa County, Arizona.

We also have enclosed a check for $10,000 as per A.R.S. § 40-360.09.

Duke requests that the public hearing before the Power Plant and Transmission Line Siting Committee for this Application be set at the first available date. We will provide a form of notice to the Power Plant and Transmission Line Siting Committee for its convenience.

If we can be of assistance to the Power Plant and Transmission Line Siting Committee on this Application please contact me at (978) 635-9500.

Sincerely,

Patricia D. Fleischauer

Patricia D. Fleischauer
Project Manager

PF/

Ref: 2355-022

Enc. 25 copes of the CEC Application
Check for $10,000
Docket Cover Sheet

0265712-2355-022

NEW APPLICATION
RECEIVED

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AZ CORP COMMISSION
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DOCKET NO. L-00000P 99-0098

APPLICATION FOR A CERTIFICATE OF ENVIRONMENTAL COMPATIBILITY

ARLINGTON VALLEY ENERGY PROJECT

Prepared for

STATE OF ARIZONA POWER PLANT AND TRANSMISSION LINE SITING COMMITTEE

Prepared by

DUKE ENERGY MARICOPA, LLC

Date: _____
Case No. _____

ENSR

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Acton, MA 01720
(978) 635-9500
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NEW APPLICATION
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0265712-2355-022

BEFORE THE
POWER PLANT AND TRANSMISSION LINE SITING COMMITTEE

In the Matter of the Application of Duke Energy Maricopa, LLC in conformance with the requirements of Arizona Revised Statutes 40-360.01 et seq., for a Certificate of Environmental Compatibility authorizing construction of a natural gas-fired, combined-cycle generating facility and associated transmission line near Arlington in Maricopa County, Arizona	)))))))))	Case No. _____

APPLICATION FOR
CERTIFICATE OF ENVIRONMENTAL COMPATIBILITY

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INTRODUCTION

Duke Energy Maricopa, LLC (Duke) is requesting a Certificate of Environmental Compatibility (CEC) from the Arizona Power Plant and Transmission Line Siting Committee (Siting Committee) for construction of the Arlington Valley Energy Project. The proposed project will include the construction and operation of a 580-megawatt (MW) (nominal) gas turbine/steam turbine combined-cycle merchant power plant and approximately 2.4 miles of new 525-kilovolt (kV) transmission line in Maricopa County, Arizona. The key elements of the proposed project include:

- Two combustion turbine generators (CTGs) with inlet chilling fueled by pipeline-quality natural gas;
- Two natural gas supplementary-fired Heat Recovery Steam Generators (HRSG);
- One steam turbine generator (STG) set;
- One gas-fired (intermittent) auxiliary boiler;
- One surface condenser;
- Two mechanical draft cooling towers; and
- 525-kV transmission line.

Construction will begin in February 2001, with commercial operation scheduled to begin in June 2002. The plant will generate 580 MW, enough electricity to serve approximately 150,000 homes during peak summer demand. The project is designed to use the latest combined cycle generating technology to produce reliable and low-cost electrical power, and minimize environmental impacts.

The project will be located approximately 50 miles west of Phoenix, in unincorporated Maricopa County near Arlington, Arizona, which is about 8 miles south of Interstate 10 (Figure 1). The project site was selected for the following reasons:

- A natural gas pipeline, water sources, roads, and railroad access needed for construction and operation of the project are already in place at or near the proposed plant site. Electrical transmission lines are available near the project site to provide interconnections with the existing power grid through the proposed Palo Verde South switchyard located east of the proposed plant site.

- The area presently supports energy production and transmission facilities. The new generation units will be compatible with existing land uses in the vicinity of the project site, and will not conflict with any future development plans.

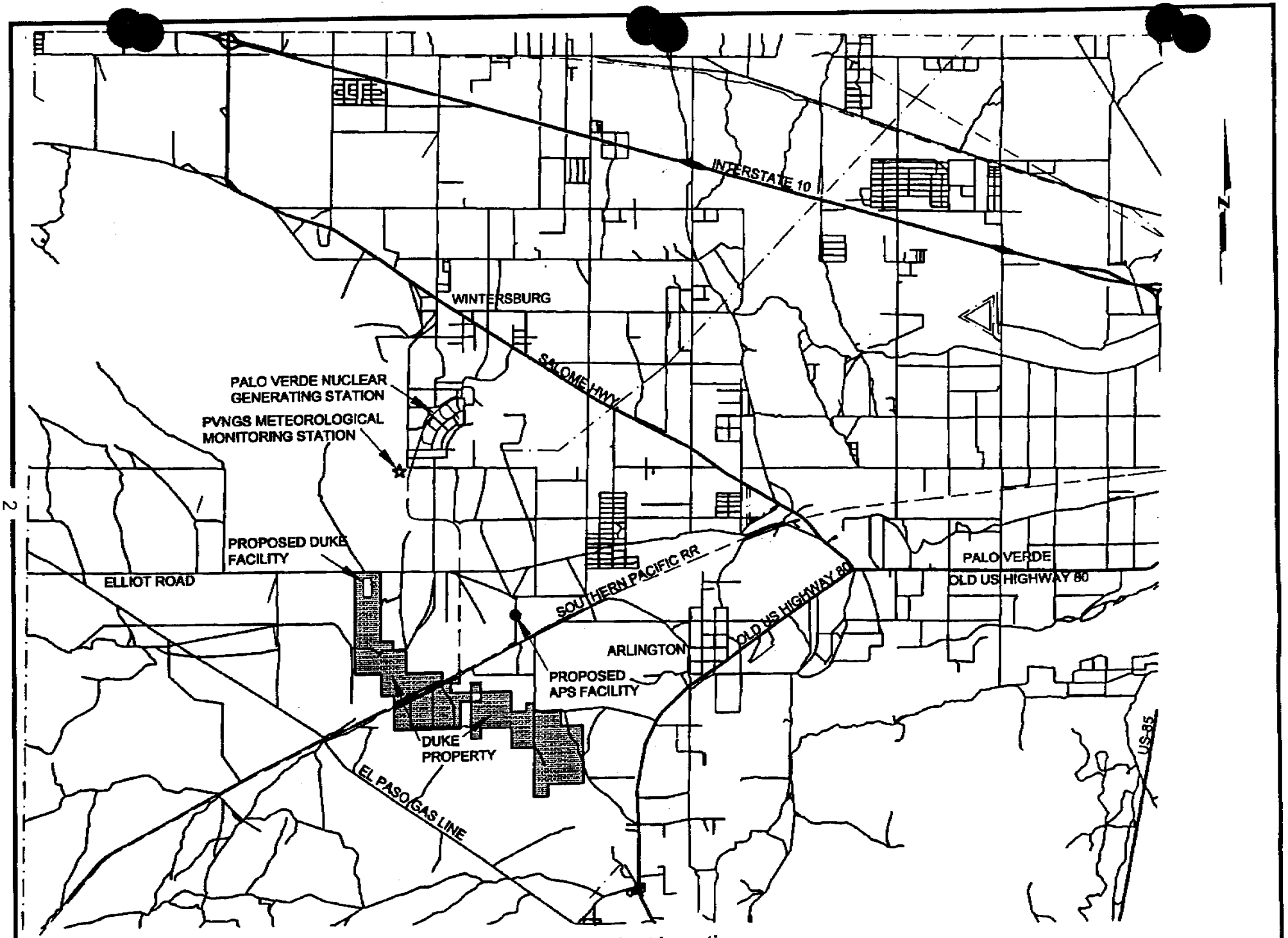

Figure 1. Project Location

SCALE: 1"=4 KM

- A large number of local residents currently work at Palo Verde Nuclear Generating Station (PVNGS) or in related occupations, and local community services are available to support the additional workforce required for this project. The project location is within commuting distance of the Phoenix metropolitan area, which would be expected to supply the majority of the facility's work force and thereby cause no changes in the area population.

- Based on extensive investigation and analyses, Duke has concluded that the selected project is consistent with surrounding land uses and environmentally compatible.

This application includes the environmental evaluation and documentation relevant to the proposed project as specified by Arizona Administrative Code Rule R14-3-219. Environmental controls will be provided to ensure that the project complies with all applicable environmental regulations. In summary, impacts will be avoided and minimized as follows:

- Groundwater will be used as the source of water for the project, pumped on site from the existing wells, or replacements of those wells. The water will be used for steam generation and cooling and will be used in accordance with the Arizona Department of Water Resources (ADWR) water conservation requirements. Potential re-use options for water discharged from the system are being actively investigated as alternatives to disposing of the wastewater in evaporation ponds.

- Groundwater supplies for the project will be developed through retirement of irrigated farm lands and associated irrigation rights. This will result in a reduction in potential groundwater withdrawals in the project area. Duke has purchased, or optioned, over 2,000 acres of irrigated farmland in the vicinity of its proposed power plant in order to secure enough groundwater for the operation of its plant. The proposed water use by Duke is less than half of the historic withdrawals for agricultural irrigation. Studies conducted as part of this investigation indicate that sufficient water is available to supply the project needs and that the proposed withdrawal of this water will have minimal impact on the aquifer. (Refer to Exhibit B-2, Groundwater Assessment Report.)

- The plant site is located on land previously used for agriculture; the transmission line will cross creosote bush flats and a riparian area associated with Winters Wash.

- Based on discussions with agencies, database review, and field evaluations, impacts to sensitive plants or wildlife populations/habitat are not anticipated.

- No documented archaeological or historic resources are located at the proposed plant site and along the transmission line route. A cultural resources pedestrian survey will be conducted in early 2000 to ensure that impacts to cultural resources will be avoided or mitigated.

- Noise from the new generating facilities is expected to have minimal impacts to residences in the vicinity of the plant (see Exhibit I for results of noise surveys conducted in November 1999).

- The proposed natural gas-fired combustion turbines operating in combined cycle mode utilize the lowest emitting fossil fuel fired technology available, on a per-unit generating capacity basis, and produce the least amount of waste per unit of electricity. The project is located in an attainment area for all air quality criteria pollutants.

The total project cost is estimated to be about $250 million. The new generating units will provide social and economic benefits to the community in the following ways:

- Annual property tax revenues from the project will be about $4.5 million, increasing funds available to any one of a number of public services (see Exhibit J-4, Economic and Fiscal Impact Report).

- Approximately 300 jobs, including many technical and skilled craft positions, will be created during the 12- to 14-month construction period. Up to 25 moderate- to high-wage permanent jobs also will be generated for commercial operations. In addition, a comparable number of secondary employment opportunities (services, vendors, and suppliers) will be made available during the construction and operational phases of the proposed project (see Exhibit J-4, Economic and Fiscal Impact Report).

- The project will increase the regional electrical energy supply capacity and help moderate large swings in wholesale electricity prices during periods of high consumer demand, such as during the hottest summer months.

A public involvement program has been carried out by Duke to provide information to the community, and identify potential issues and concerns. The program has included discussions with individuals and community leaders, presentations for government agencies and organizations, and community meetings held in the project area. This proactive approach has been successful in identifying potential environmental issues and providing the community with useful information about the project. The program will continue as the project proceeds. Additional information about the public involvement program is included in Exhibit J of this application.

After evaluating the factors to be considered by the Siting Committee (as defined in ARS §40-360.06), Duke has concluded that the project is environmentally compatible with the surrounding area.

APPLICATION

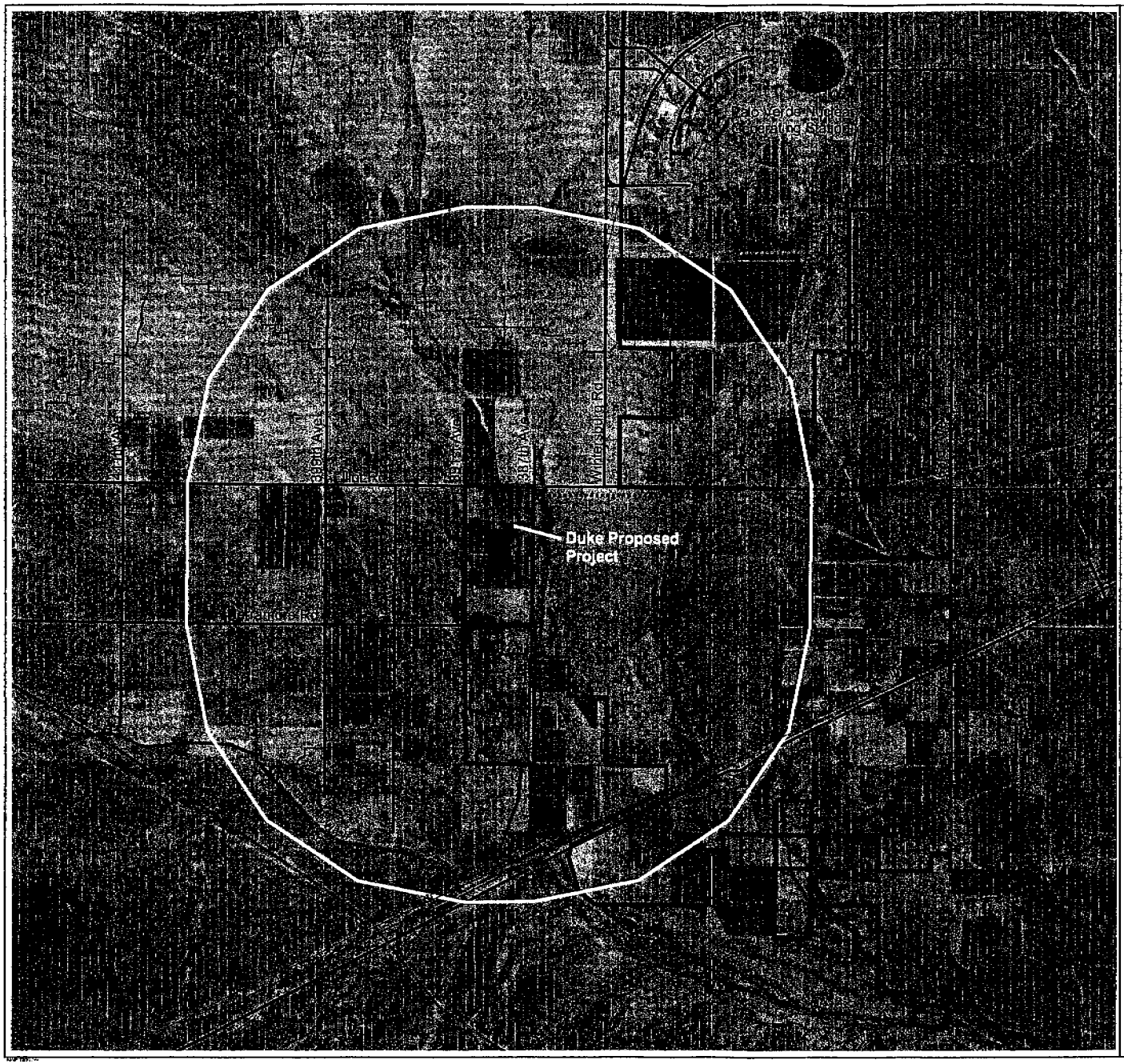

Exhibit A-2:

Proposed Project and Adjacent Area within 2 Miles of Project

Legend

- Duke Proposed Project
- Duke Properties
- Proposed Electric Power Transmission Lines
- Electric Power Transmission Lines
- Natural Gas Line
- Rivers and washes
- Streets
- Area within 2 Miles of Project
- Elevation Contours

Land Use

- Palo Verde Nuclear Generating Station
- Large Lot Residential

Land use for the remainder of the area is Rural.

0 0.5 1
Miles

Duke Energy

APPLICATION

1. *Name and address of the applicant:*

Duke Energy Maricopa, LLC
5400 Westheimer Court
Houston, Texas 77056-5310

2. *Name, address, and telephone number of a representative of the application who has access to technical knowledge and background information concerning this application, and who will be available to answer questions or furnish additional information:*

Mr. Max Shilstone, Manager
Duke Energy North America
5400 Westheimer Court
Houston, Texas 77056-5310
(713) 627-6572

3. *State each date on which applicant has filed a 10-year plan in compliance with ARS §40-360.02,and designate each such filing in which the facilities for which this application is made were described. If they have not been previously described in a 10-year plan, state the reasons therefore.*

Recent legislation (H.B. 2663) has eliminated the need to file a 10-year plan for the contemplated construction of generation facilities. A 10-year plan for the transmission line will be filed on January 3, 2000.

4. *Description of the proposed facilities, including:*

4.a. *With respect to an electric generating plant:*

4.a.i *Type of Generating Facilities.*

The proposed Arlington Valley Energy Project will utilize two, 170-MW GE 7FA natural gas-fired combustion turbines operating in combined-cycle mode with two supplementary fired, three-pressure HRSGs and a common, reheat condensing steam turbine. Steam generation in the HRSGs will be augmented with supplementary natural gas-firing using duct burners. Each HRSG will produce high pressure steam at approximately 1,800 pounds per square inch gauge (psig) for

introduction into the steam turbine. The steam turbine will drive an additional generator to increase the total plant output to about 510 MW without duct firing or 580 MW with duct firing and inlet air chilling.

The production of electricity using a combustion turbine engine coupled with a shaft driven generator is referred to as the Brayton Cycle. This also is referred to as a "simple-cycle" and has been traditionally utilized for electricity peaking generation since the unit and its output can be brought on line very quickly. The Rankine Cycle represents the traditional method of generating power from utility steam electric power plants. In this cycle, boilers are used to produce high pressure steam which expands in a steam turbine to drive an electric generator.

The proposed project will combine the Brayton and Rankine cycles to maximize thermal efficiency. Natural gas will be combusted in two Brayton Cycle turbines that will generate most of the electrical output. Instead of being discarded to the environment, the exhaust heat will be recovered in a Rankine Cycle HRSG/steam turbine, and the heat will be extracted until the exhaust temperature is about 200°F before being discharged through the stacks. This will result in an overall thermal efficiency for the proposed project of over 55 percent. The project, therefore, will consume only about two thirds of the fuel that would be consumed in a conventional utility power plant to produce the same amount of electricity. This state-of-the-art, high-efficiency technology combined with the exclusive use of the cleanest fossil fuel (natural gas) and the application of Best Available Control Technology, will yield a small fraction of the air emissions of a similarly sized conventional power plant.

4.a.ii Number and size of proposed units.

The proposed 580-MW merchant power plant will include the following components:

- Two CTGs with inlet chilling fueled by pipeline-quality natural gas;
- Two natural gas supplementary-fired HRSG;
- One STG set;
- One gas-fired (intermittent) auxiliary boiler;

- One surface condenser;
- Two mechanical draft cooling towers (one for the condenser and one for the chiller);
- Cooling tower water treatment system;
- Plant sumps, sump pumps, and oily water separator;
- Feed water treatment systems including demineralizer regeneration and neutralization tanks;
- Plant and instrument air compressors and auxiliary equipment;
- Sanitary lift station;
- Steam and water sampling systems;
- Deaerator vent; and
- Several buildings for warehouse/maintenance administration and operational activities.

4.a.iii *The source and type of fuel to be utilized, including a proximate analysis of fossil fuels.*

The combustion turbines will be fueled entirely by natural gas supplied by El Paso Natural Gas Company. A proximate analysis of the natural gas is provided in Table 1. Pipeline quality natural gas will be delivered to the facility at a pressure sufficient for use in the CTGs without additional fuel compression. The gas will be heated to approximately 365°F using steam from the HRSGs.

Natural gas will first be sent through a knockout drum for removal of any liquid which may have been carried through from the pipeline. The gas will then pass through a filter/separator to remove particulate matter and entrained liquid. The gas will flow through the filter/separator's first chamber, the filtration section, where entrained liquid will coalesce on the filter cartridges, drop to the bottom of the chamber and either vaporize and return to the main gas stream or drain to the sump below. The gas will then flow through the coalescing filters that will remove

particulate matter. The gas will then pass to the second chamber, the separation section, where any entrained liquid remaining in the stream will be returned to the gas stream. The gas will be preheated and split into two streams, one for each CTG. Finally, the gas will be delivered to the CTGs and combusted as part of the power generation operation.

Table 1
Natural Gas Analysis

Component	Normalized Percent
Carbon Dioxide	0.78
Nitrogen	1.33
Methane	96.08
Ethane	1.49
Propane	0.21
Iso. Butane	0.03
Normal Butane	0.03
Iso. Pentane	0.01
Normal Pentane	0.01
Hexane and Heavier	0.03
Gallons Per Minute	0.776
BTU (standard cubic feet)	1,020
Specific Gravity	0.587

Source: Casa Grande Compressor Station Gravitometer Analysis I.D. 05227; El Paso Natural Gas, June 1998 to June 1999 (annual average).

One emergency diesel engine, nominally 400 horsepower (hp), will be located on-site and operated as an emergency fire-water pump driver. The facility operations plan calls for this unit to be operated less than 500 hours per year. The engine will be equipped with a 150-gallon fuel storage tank.

4.a.iv Amount of fuel to be utilized daily, monthly, and yearly.

Maximum natural gas usage for the proposed project will be approximately 100 million standard cubic feet (MMscf) per day; 3,000 MMscf per month; and 37,000 MMscf per year. This projected gas usage is based on lower heating value (LHV). The fuel use will vary based on the actual number of hours of operation of the combustion turbines, duct burner, and auxiliary boiler, and start-up/shut-down

conditions. In the unlikely event of a fire, diesel fuel will be used for fire water pump operations.

4.a.v Type of cooling to be utilized and the source of any water to be utilized.

4.a.v.1 Type of cooling:

A ten cell cooling tower will be integral to operation of the facility. The majority of the cooling water will be used in the surface condenser to absorb the heat rejected from the steam turbine. Water from the cooling tower is commonly referred to as "main" cooling water. A dedicated set of cooling water pumps will be provided for this service. Additional cooling water will be required for auxiliary plant cooling. Cooling tower water will not be used for direct cooling of plant auxiliaries; a closed loop auxiliary cooling system consisting of pumps, expansion tank, and heat exchangers will be provided for this purpose. Cooling tower water circulated through a set of plate and frame heat exchangers will cool a closed loop coolant, usually a glycol/water mixture; this is commonly referred to as "auxiliary" cooling water. The cooling tower itself is a device designed to evaporate clean water, which provides cooling. Some small water droplets (referred to as drift) will escape from the top of the tower, and may liberate dissolved solids as they evaporate in the atmosphere.

The turbines will employ inlet chillers during hot ambient conditions to recover power output that would normally be lost due to lower air density at higher ambient temperatures. The process of cooling takes place at the cooling coils where inlet air is cooled before entering the CTG compressor. At lower temperature, the air becomes more dense and therefore more mass flows through the CTGs. The net increase in mass flow will result in higher output for each of the CTGs by up to 22 MW. In addition to the output enhancement from the CTGs, the additional mass flow also will increase output of the STG by approximately 12 MW.

The inlet chilling system is a mechanical system using R-717 (ammonia) for cooling. A second, smaller (7 celled) cooling tower will reject heat for the chillers. This tower will be similar to the process cooling tower, except that it will only operate when the chillers are on (high ambient temperatures).

4.a.v.2 Water Source:

Groundwater will be used as the source of water for the project, pumped on site from the existing wells, or replacements of the existing wells. The water will be used for steam generation and cooling and will be used in accordance with the Arizona Department of Water Resources (ADWR) water conservation requirements.

Groundwater supplies for the project will be developed through retirement of irrigated farm lands and associated irrigation rights. Groundwater has been withdrawn in the project area since the 1950s. In order to secure a groundwater supply for the operation of its power plant, Duke has purchased, or has under option, over 2,000 acres of farmland with Irrigation Grandfathered Rights in the vicinity of the project. These parcels of farmland have a water duty of approximately 11,200 acre-feet/year for 1999 as assigned by ADWR. Duke will convert these Irrigation Grandfathered Rights, in accordance with ADWR procedures, into approximately 6,800 acre-feet/year of Type I Non-irrigation Grandfathered Rights (Type I Rights). Pumpage on the parcels in recent years under the Irrigation Grandfathered Rights has averaged approximately 3,300 acre-feet/year.

An evaluation of the physical availability of a water supply over the lifetime of the project and the potential impact of groundwater pumping on groundwater levels in the area has been conducted and is attached as Exhibit B-2. The evaluation of the hydrogeology of the project area indicates that sufficient water is physically available to supply the project water demands for the 30-year lifetime of the project and that the proposed withdrawals by Duke will have only minimal impact on the aquifer.

The evaluation of the potential impact of groundwater pumping on groundwater levels was conducted using two approaches. The first approach compared projected pumpage for this proposed project to historic pumpage to provide insight into potential future impacts. The proposed water use is less than half of the historic withdrawals for irrigation on the parcels being acquired by Duke, and about a quarter of the historic pumpage in the project area. The potential impacts are therefore expected to be considerably less than what would be expected if irrigated agriculture were not retired.

The second approach simulated the potential effects of the proposed groundwater pumping on the aquifer. Groundwater modeling over the expected life of the power plant was conducted. After 30 years of pumping, minimal water level changes (up to 10 feet) are projected within 2 miles of the plant production wells, and smaller level changes at greater distances. These projections are considered conservative as they do not consider the retirement of current irrigation pumpage or the natural recovery of water levels that has occurred in recent years.

The evaluation concludes that sufficient water is available to supply the plant needs and that the proposed withdrawal of this water will have minimal impact on the aquifer.

Duke is presently studying the use of alternative disposal strategies for the project in an effort to conserve water and promote its reuse. Duke is engaged in discussions with ADWR regarding the potential for use of alternative conservation requirements to facilitate wastewater reuse as a disposal alternative. Conventional water conservation approaches lead to the production of high concentration wastewater that requires elaborate storage and long-term care to isolate the brines and salts from the environment. Lower levels of concentration can allow for reuse of the wastewater without impacting water quality.

The disposal alternatives being evaluated range from the conventional approach of disposal of wastewater in evaporation ponds to the potential beneficial reuse of wastewater for project landscaping and revegetation of retired farm lands to the return of the wastewater to the aquifer via recharge.

In the unlikely event that none of the proposed disposal alternatives are functionally or economically feasible, Duke will utilize lined evaporation ponds, to be permitted by ADEQ, for disposal of its effluent.

4.a.vi Proposed height of stacks and number of stacks, if any:

A total of 5 stacks will be constructed at the plant site. Both CTG and HRSG units will include stacks 185 feet above ground surface. The auxiliary boiler will require a

37-foot high stack, the main cooling tower and the inlet chilling system tower will be approximately 47 feet above grade.

4.a.vii Dates for scheduled start-up and firm operation of each unit and date construction must commence in order to meet schedules:

A primary contractor (Duke-Flour Daniel) will design and construct the facility. Duke has firm contracts for the delivery of essential turbine equipment items to meet its construction schedule. Construction activities will be initiated in February 2001 and are expected to extend over a period of 12 to 14 months into 2002. During this period, the construction work force will include up to 300 people. An area at the site will be used temporarily for construction parking, work trailers, storage, and laydown areas. Water and electrical power facilities will be made available at the site for use during construction. The primary access during construction to the project site will be from the existing access road that enters the site from the north off of Elliot Road. Commercial operations are scheduled to begin in June 2002.

4.a.viii To the extent available, the estimated costs of the proposed facilities and site, stated separately.

Estimated construction costs for the power plant, associated natural gas and water pipelines, and related facilities (excluding transmission lines and switchyard) are $250 million. Land acquisition costs associated with the project site and adjacent parcels are estimated at $5 million.

4.a.ix Legal description of the proposed site.

The proposed 40-acre project site is located approximately 50 miles west-southwest of Phoenix, in Maricopa County Arizona. The project site is situated approximately 1.5 miles southwest of the PVNGS property and 5 miles west of the town of Arlington. The site is located on the south side of Elliot Road between 387th Avenue and 391st Avenue. The site is located at 112° 53' 28" longitude and 33° 20"25" latitude. The plant site will be located in Section 17, Township 1 South, Range 6 West, Gila and Salt River Base and Meridian.

4.b With respect to a proposed transmission line:

4.b.i Nominal voltage for which the line is designed; description of the proposed structures and switchyards or substations associated therewith; and purpose for constructing said transmission line.

A new 2.4-mile, 525-kV transmission line with a 2,000-MW capacity will be constructed to connect the power plant to the proposed Palo Verde South switchyard located approximately 2 miles east of the plant site, immediately south of Elliot Road. The switchyard will be flanked by the existing Kyrene and North Gila 500-kV transmission lines. Preliminary plans indicate that the switchyard will serve as a satellite facility for new and existing powerlines and an alternative to connecting directly into the existing PVNGS switchyard.

Construction of the 525-kV transmission line will include the installation of several 117-foot lattice steel towers with an average span distance of 1,300 feet. Span distances will vary depending on the final alignment of the transmission line. A 200- to 400-foot-wide right-of-way will be sought along the entire transmission route.

4.b.ii Description of geographical points between which the transmission line will run, the straight-line distance between such points, and the length of the transmission line for each alternative route for which application is made.

The transmission line will proceed north from the proposed plant site (E1/2, Section17, Township 1 South, Range 6 West) for approximately 0.5 mile, then run east for approximately 1.9 miles. The route will span Winters Wash and continue eastward on the south side of Elliott Road to the site of the proposed Palo Verde South switchyard (N1/2, Section 15, Township 1 South, Range 6 West). The straight-line distance between the two points is approximately 1.9 miles.

4.b.iii Nominal width of right-of-way required, nominal length of spans, maximum height of supporting structures, and minimum height of conductor above ground.

The nominal right-of-way width required is 200 feet; nominal span length will be 1,300 feet. The maximum height of the supporting structures will be approximately 117 feet, and the minimum height of conductor above the ground will be 45 feet.

4.b.iv To the extent available, the estimated costs of proposed transmission line and route, stated separately.

The estimated total cost for the transmission line construction is $672,000 per mile, or approximately $1,613,000 for 2.4 miles, excluding right-of-way acquisition costs which are currently being negotiated.

4.b.v *Description of proposed route and switchyard locations.*

The proposed route and switchyard locations are as described in response to Section 4.b.ii.

4.b.vi *For each alternative route for which application is made, list the ownership percentages of land traversed by the entire route (Federal, State, Indian, private, etc.).*

The current land ownership of the proposed transmission line route is as follows: Duke (27.8 percent), Arizona State Trust Lands (41.7 percent), and private land (30.5 percent).

5. *List the areas of jurisdiction (as defined in ARS §40-360) affected by each alternative site or route and designate those proposed sites or routes, if any, which are contrary to the zoning ordinances or master plans of any of such areas of jurisdiction.*

All components of the project will be located entirely within an unincorporated area of Maricopa County. The plant site, access road, and water pipeline will be located on private lands currently owned or controlled by Duke. The proposed transmission line crosses private lands and State Trust Lands. The natural gas pipeline is expected to be routed across private land and/or shared right-of-way on lands located south and west of the power plant site.

The proposed project is located within the Rural-190 Zoning District as designated by Maricopa County and shown on the Maricopa County Comprehensive Plan. Duke is in the process of applying for (a) a Special Use Permit from Maricopa County based on the current zoning classification (see Exhibit B-4) and (b) a comprehensive Plan Amendment. In addition, Duke will obtain a ROW grant for State Trust Lands crossed by the proposed transmission line.

6. *Describe any environmental studies applicant has performed or caused to be performed in connection with this application or intends to perform or cause to be performed in such connection, including the contemplated date of completion.*

Duke has engaged several experienced consultants who have conducted studies and impact evaluations of the project. The results of these studies are included in Exhibits B through I. For the proposed plant site and transmission line corridor, evaluations of the existing environment were completed for land use, air quality, water resources, visual resources, biological resources, cultural resources, and noise effects. In addition, cultural resources pedestrian surveys will be conducted in early 2000 in order to ensure that impacts to cultural resources will be avoided or mitigated.

Environmental studies of the project area began with the collection of existing environmental data, including literature, maps, and other agency data. Interviews were conducted with appropriate agencies and organizations. Resource specialists conducted field studies of the project area.

Potential environmental effects of the proposed project were assessed for the disciplines addressed above. Where appropriate, mitigation measures were identified to minimize or eliminate impacts. Duke will implement identified mitigation measures as integral elements of the project. These include state-of-the-art combustion technology and continuous air emissions monitoring.

Duke therefore affirms, upon thorough, expert scientific environmental investigation and analyses, that the proposed project is environmentally compatible, and respectfully requests the Committee to issue its Certificate of Environmental Compatibility for the proposed project.

DUKE ENERGY MARICOPA, LLC

By: _____

Authorized Officer

ORIGINAL and 25 copies of the foregoing hand delivered and filed With the Director of Utilities, Arizona Corporation Commission, this 30th day of December, 1999.

EXHIBIT A
LOCATION AND LAND USE MAPS

EXHIBIT A
LOCATION AND LAND USE MAPS

As stated in Arizona Corporation Commission Rules of Practice R-14-3-219:

"Where commercially available, a topographic map, 1:250,000 scale, showing the proposed plant site and the adjacent area within twenty (20) miles thereof. If application is made for alternative plant sites, all sites may be shown on the same map, if practicable, designated by applicant's order of preference."

"Where commercially available, a topographic map, 1:62,500 scale, of each proposed plant site, showing the area within two (2) miles thereof. The general land use plan within this area shall be shown on the map, which shall also show the areas of jurisdiction affected and any boundaries between such areas of jurisdiction. If the general land use plan is uniform throughout the area depicted, it may be described in the legend in lieu of an overlay."

The following maps are included as exhibits:

- Exhibit A-1 – Project Location
- Exhibit A-2 – Ownership

More detailed discussion regarding land ownership and existing and future land use conditions and potential impacts on such resources within the vicinity of the proposed project are provided in Exhibit B-3.

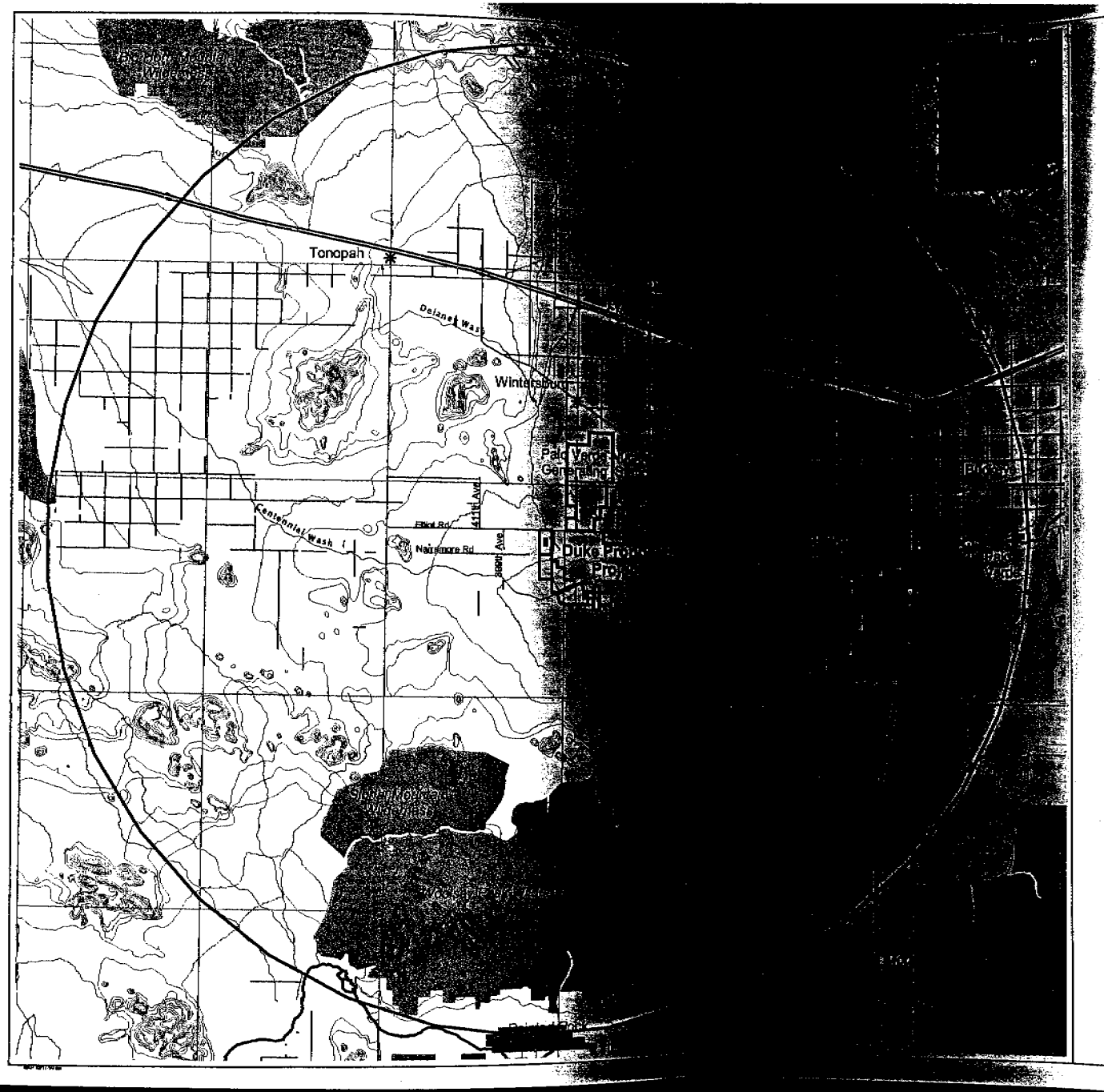

Exhibit A-1:

Proposed Project and Adjacent Area within 20-mile Radius

Legend

- Duke Proposed Project
- Duke Properties
- Palo Verde Nuclear Generating Station
- Elevation Contours
- Rivers and Washes
- Cities and Towns
- 20-mile Radius
- USGS 7.5' Quadrangles
- Streets
- BLM Wilderness Areas
- Parks and Recreation
- Game and Fish
- Painted Rock Wildlife Area

0 1 2 3 4 5
Miles

Duke Energy

EXHIBIT B
ENVIRONMENTAL REPORTS

EXHIBIT B
ENVIRONMENTAL REPORTS

As stated in Arizona Corporation Commission Rules of Practice R-14-3-219:

"Attached any environmental studies which applicant has made or obtained in connection with the proposed site(s) or route(s). If an environmental report has been prepared for any federal agency or if a federal agency has prepared an environmental statement pursuant to Section 102 of the National Environmental Policy Act, a copy shall be included as part of this exhibit."

Duke retained the services of consultants to complete the environmental studies for the proposed project. The environmental studies completed for this project are described in this exhibit and include the following:

- Exhibit B-1 – Air Quality (PSD/Title V) Permit Application
- Exhibit B-2 - Groundwater Assessment
- Exhibit B-3 – Land Use Study

Descriptions of other resource studies including biology, cultural, visual, and noise are discussed in Exhibits C, D, E, G, and I.

EXHIBIT B-1

AIR QUALITY PERMIT APPLICATION

ENSR

Consulting • Engineering • Remediation

1220 Avenida Acaso
Camarillo, CA 93012

(805) 388-3775
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http://www.ensr.com

October 22, 1999

Ms. Elena Gorelik
Maricopa County Environmental Services Department
1001 N. Central Avenue Suite 201
Phoenix, AZ 85004-1942

Subject: Duke Energy Maricopa, LLC PSD/Title V Permit Application for Arlington Valley Energy

Dear Ms. Gorelik:

ENSR is submitting the enclosed PSD/Title V permit application for Arlington Valley Energy on behalf of Duke Energy Maricopa, LLC. As discussed with Dale Lieb, no further application fees are required at this time since a fee to initiate the expedited permit processing was previously submitted. As requested by you, we are submitting copies of this application to the following distribution:

1. Ms. Elena Gorelik, Maricopa County Environmental Services Department
   1001 N. Central Avenue Suite 201, Phoenix, AZ 85004-1942 (2 copies)

2. Mr. Matt Haber, U.S. Envirnomental Protection Agency, Region IX
   75 Hawthorne Street, San Francisco, CA 94105-3901 (2 copies)

3. Mr. Peter Lahm, U.S. Forest Service, c/o Arizona Dept. of Env. Quality
   3033 N. Central Avenue, Phoenix, AZ 85012 (1 copy)

4. Mr. Russ Erbes, Kleinfelder
   3249 East Harbor Drive, Phoenix, AZ 85034 (2 copies)

We have only included a compact disc of the air quality modeling files with the copies sent to you, the EPA, and Kleinfelder. Please let me know if you or others require additional copies of the electronic files.

We look forward to meeting with you on November 4, 1999 to discuss this application. Should you have any questions in the meantime, please feel free to call myself or Mr. Max Shilstone of Duke at 713-627-6572.

Sincerely,

Sara J. Head
Manager, Air Permitting & Compliance

PSD/Title V Permit Application
Arlington Valley Energy Project
Maricopa County, Arizona

ENSR Document No. 2355-022-250
October 1999

Prepared for

Duke Energy Maricopa, LLC

Submitted to

Maricopa County Environmental Services Department
Phoenix, Arizona

ENSR
1220 Avenida Acaso
Camarillo, California 93012

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1.0 INTRODUCTION

Duke Energy Maricopa, LLC is proposing to construct and operate a 580 MW (nominal) gas turbine/steam turbine combined-cycle merchant power plant in Maricopa County, Arizona. The project, to be known as Arlington Valley Energy, will be located on a 40 acre site near Arlington. The key elements of the proposed project include:

- Two combustion turbine generators (CTGs) with inlet chilling fueled by pipeline-quality natural gas;
- Two natural gas supplementary-fired Heat Recovery Steam Generators (HRSG);
- One steam turbine generator (STG) set;
- One gas-fired (intermittent) auxiliary boiler;
- One surface condenser; and
- Two mechanical draft cooling towers (one for the condenser and one for the chiller).

Duke Energy Maricopa, LLC is applying to the Maricopa County Environmental Services Department (MCESD) for an air quality pre-construction permit as required by Maricopa County Air Pollution Control Regulation (MCAPCR) II, "Permits and Fees". Since the proposed facility will be a "major source", both the Prevention of Significant Deterioration (PSD) Permit and Title V Operating Permit requirements are addressed in this application.

MCESD standard application forms and tables are located in Appendix A. A Certification of truth, accuracy and completeness of this application is also contained in Appendix A. Thirdly, a completed administrative checklist, which shows where each of the required items are addressed in this application, is also provided in Appendix A.

1.1 Applicant Information

To facilitate the MCESD's review of this document, individuals familiar with both the facility and the preparation of this application are identified below. The MCESD should contact these individuals if additional information or clarification is required during the review process. These contacts include contractors/consultants who have assisted with the preparation of this application under Duke's direction.

Duke Corporate Offices	Max Shilstone, Manager Duke Energy North America 5400 Westheimer Ct., 4TH Floor Houston, TX 77056-5310 Telephone (713) 627-6572 Fax (713) 627-6588
Environmental Manager	Kenneth S. Johnson 400 South Tryon Street Suite 1800 Charlotte, NC 28202 Telephone (704) 382-8692 Fax (704) 382-9325
Permitting Consultant	Sara J. Head ENSR 1220 Avenida Acaso Camarillo, CA 93012 Telephone (805) 388-3775 Fax (805) 388-3577

1.2 Project Location

Arlington Valley Energy will be located approximately 50 miles west-southwest of Phoenix, in Maricopa County Arizona. The location of the plant on a regional perspective can be seen in Figure 1-1. The project site is situated approximately 3.5 miles south of the Palo Verde Nuclear Generating Station and 5 miles west of the town of Arlington. Benchmark Universal Transverse Mercator (UTM) coordinates for the plant (NAD 27), corresponding to the northwest corner of the site, and site elevation are as follows:

Zone Number	12
UTM E:	323857.591
UTM N:	3691306.961
Site Elevation	881 Feet

The site is located at 112° 53' 28" longitude and 33° 20' 25" latitude. The plant site sill be in Section 17, Township 1 South, Range 6 West, Gila and Salt River Base and Meridian.

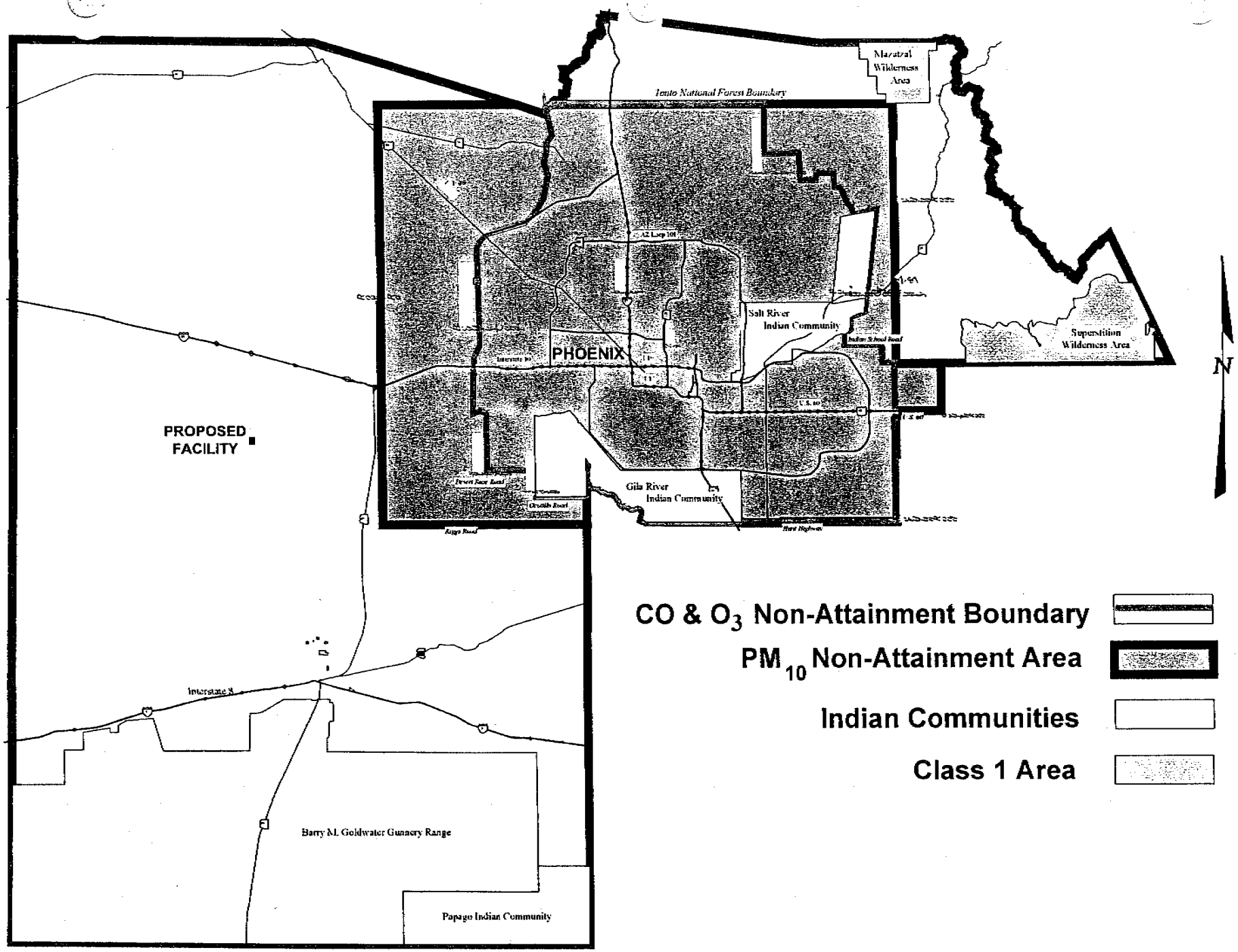


Figure 1-1 Regional Location Map

Arlington Valley Energy will be developed on approximately 40 acres of currently undeveloped property. The approximate project property boundary and local road network is shown on Figure 1-2. Figure 1-2 also shows the land use within the 15-mile region surrounding the proposed site. Within this area are:

- the Palo Verde Nuclear Generating Station;
- the residential communities of Arlington and Palo Verde to the east and Wintersburg to the north;
- widely scattered businesses and/or residences; and
- roadways including Interstate 10 and US Route 85.

1.3 Standard Industrial Classification (SIC) Code

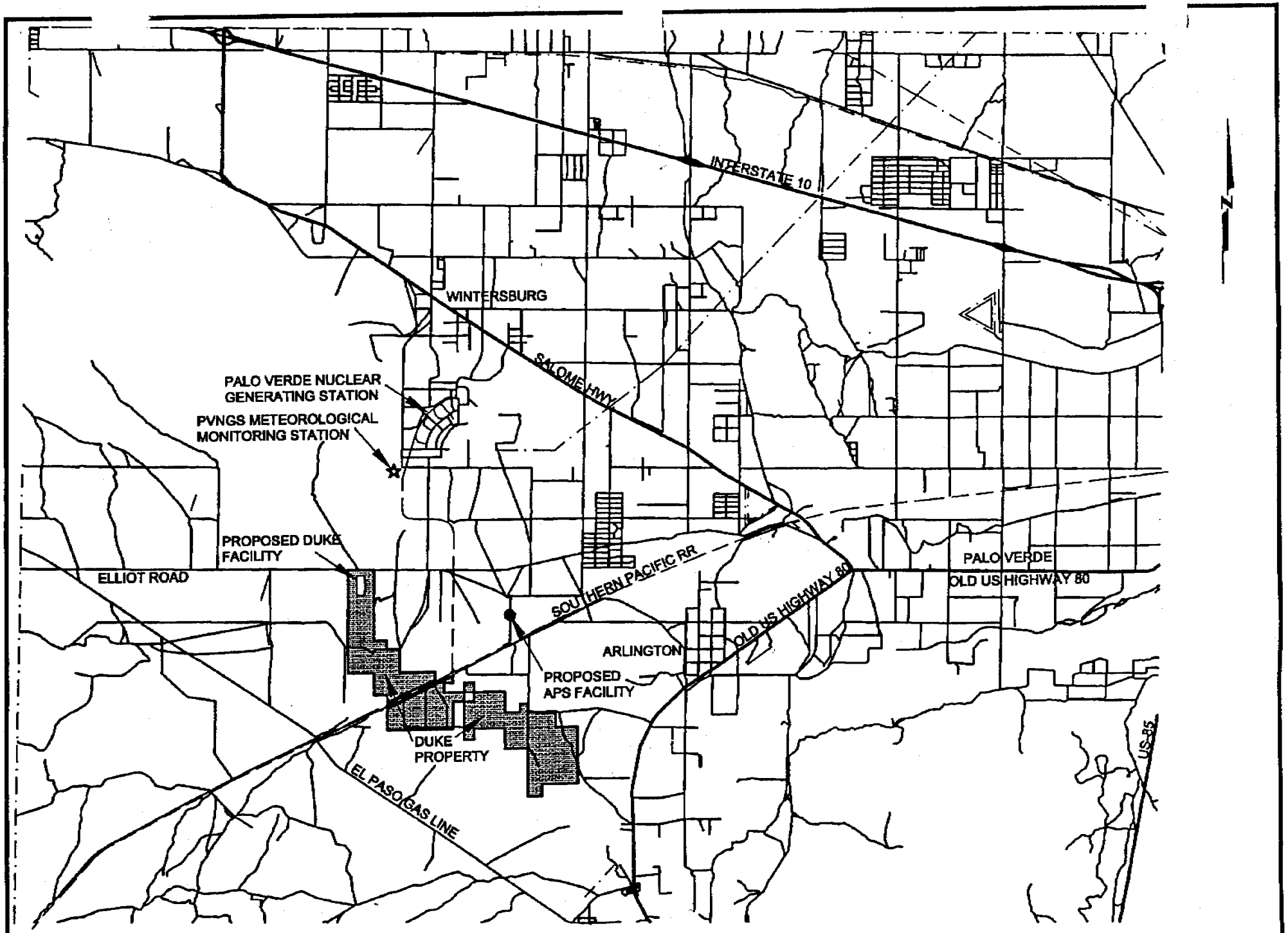
The United States government has devised a method for grouping all business activities according to their participation in the national commerce system. The system is based on classifying activities into "major groups" defined by the general character of a business operation. For example, electric, gas, and sanitary services, which include power production, are defined as a major group. Each major group is given a unique two digit number for identification. Power production activities have been assigned a major group code "49". To provide more detailed identification of a particular operation, an additional two digit code is appended to the major group code. In the case of power generation facilities the two digit code is "11" in order to define the type of production involved. Thus, Arlington Valley Energy is classified under the SIC code system as 4911: Electric Services.

The SIC Code system will eventually be replaced by North American Industrial Classification System (NAICS). This system's organization is similar to the SIC codes. Under this system, this facility would be classified under 221112, Fossil Fuel Electric Power Generation.

1.4 Air Quality Source Designation

New and existing stationary sources are classified as either major or minor based on their potential-to-emit (PTE) regulated air contaminants. This classification is also affected in part by whether the area in which the source is located has attained the National Ambient Air Quality Standards (NAAQS)[1]. An area is classified as attainment if the ambient air quality concentration for a specific pollutant as measured by a monitor is below the standard concentration level for a

[1] Criteria pollutants are those for which EPA has established NAAQS and consist of particulate matter with a nominal aerodynamic diameter of 10 microns or less (PM_{10}), carbon monoxide (CO), oxides of nitrogen (NO_x), sulfur dioxide (SO_2), lead and ozone, which is formed through the photochemical reaction of volatile organic compounds (VOC) and NO_x in the atmosphere. These pollutants are also known as "conventional air pollutants" under state law.



SCALE: 1"=4 KM

Figure 1-2. Project Location

set averaging period. As shown in Figure 1-1, the area in which the project is proposed to be located is designated as attainment for all the NAAQS.

This application satisfies the requirements for two permit programs applicable to major sources under the federal Clean Air Act (CAA): Prevention of Significant Deterioration (PSD) and Title V. Maricopa County's PSD and Title V programs, set forth in MCAPCR 240 and 220, respectively, have been approved by EPA.

PSD applied to the construction or major modification of a major source in an attainment area. If a facility is one of 28 "categorical sources," the major source threshold is 100 tons per year of a regulated air pollutant; otherwise the threshold is 250 tons per year. The proposed facility will be one of the 28 categorical sources (fossil-fuel-fired steam electric plants of more than 250 million BTU per hour heat input). It will also have a PTE of more than 100 tpy for three regulated pollutants: Oxides of Nitrogen (NO_X), particulates (PM_{10}), and Carbon Monoxide (CO).

Major sources are also required to obtain an operating permit under Title V of the CAA. Maricopa County's approved program defines a Title V major source (in part) as a source with the potential to emit 100 tons per year as a regulated air pollutant. Again, the facility is a major source under this definition and will require a Title V as well as a PSD permit.

1.5 Past Permitted Activities

The proposed project will be a grass roots (greenfield) development. There are currently no permitted activities on the project site.

1.6 Document Organization

The balance of this document is divided into sections, which address each component of the air quality review. The outline below provides an overview of the contents of each of the remaining sections.

Section 2.0 - Process Description provides a general description of the combined-cycle process by which power will be produced at this site.

Section 3.0 - Emissions Summary presents a detailed review of the emissions that will occur at the project site subsequent to the completion of project development.

Section 4.0 - Control Technology Evaluation is a substantial requirement of the PSD application. Since the proposed project will have the potential to emit "significant" amounts of certain pollutants (as defined under PSD regulations), this application includes

a detailed evaluation of control technologies demonstrating that the best available control technology (BACT) will be applied for those pollutants. Emissions are expected to be significant for CO, VOC, PM_{10} and NO_x. "Top down" BACT analyses for these pollutant therefore have been provided.

Section 5.0 – Applicable Requirements is a substantial requirement of the Title V program. This section presents a discussion of applicable State and/or Federal regulatory programs. The focus of this section will be on establishing which regulations are directly applicable to the proposed project and for which compliance must be demonstrated.

Section 6.0 – Methodology for Air Dispersion Modeling summarizes the dispersion modeling methodology and the manner in which the predicted impacts will be compared to the applicable standards. Specifically, this section discusses the modeling input data and the various modeling scenarios evaluated.

Section 7.0 – Results of Air Quality Modeling Analysis presents the results of the air dispersion analyses performed for the project. This section compares the predicted impacts to the applicable standards to demonstrate that the project will operate in compliance. This section also discusses the potential for impacts to soils and vegetation, and visibility on sensitive areas. This section also compares the modeling results to certain informal guidelines referred to by MCESD.

Section 8.0 - References includes a list of the documents relied upon during the preparation of this document.

Appendices - Permit application forms are provided in Appendix A. A site plan and elevation drawing for the proposed project can be found in Appendix B. Emission calculations are presented in Appendix C and supporting information for the control technology review is presented in Appendix D. Input/output files for the air dispersion modeling can be found in Appendix E. Meteorological analyses in support of the visibility modeling are contained in Appendix F. The acid deposition screening analysis can be found in Appendix G.

2.0 PROCESS DESCRIPTION

The following section provides an overview of the proposed Arlington Valley Energy project described in this permit application. The proposed project is a natural gas-fired combined-cycle power plant to be located in Maricopa County, Arizona. The plant will operate commercially as a merchant power plant. A merchant power plant is a power generation facility designed to produce electricity for the emerging deregulated electricity market without pre-arranged long-term utility power purchase agreements. As a merchant plant in a deregulated electricity market, Arlington Valley Energy is being designed to convert clean natural gas to useful power at high efficiency and low cost. Arlington Valley Energy is designed to have a nominal generating capacity of 580 MW. Commercial operation is scheduled to commence in the year 2002.

A facility plot plan is shown in Figure 2-1 and a process flow diagram is shown in Figure 2-2. In addition, a site plan and an elevation diagram are included in Appendix B.

The proposed generation facility will employ BACT for NO_x, CO, SO_2, VOC and PM_{10} to minimize air emissions. The project will not produce significant emissions of lead and will not be a major source of hazardous air pollutants (HAP).

2.1 Power Generation Facility

Arlington Valley Energy will include two 170 MW General Electric 7FA natural gas-fired combustion turbines operating in combined-cycle mode with two supplementary fired, three-pressure Heat Recovery Steam Generators (HRSGs) and a common, reheat condensing steam turbine. Steam generation in the HRSGs is augmented with supplementary natural gas-firing using duct burners. Each HRSG will produce high pressure steam at approximately 1,800 pounds per square inch gauge (psig) for introduction into the steam turbine. The steam turbine will drive an additional generator to increase the total plant output to about 510 MW without duct firing or 580 MW with duct firing and inlet air chilling.

Arlington Valley Energy will use combined-cycle power generation technology to maximize generation efficiency and minimize fuel use. Efficient natural gas combustion in state-of-the-art dry low-NO_X combustors will minimize air pollutant emissions. This technology is nearly 30 percent more thermally efficient than vintage steam-electric central utility power plants. Since combined-cycle units burn less fossil fuel to generate an equivalent amount of power, they also emit substantially less air pollutants, including CO_2 (a greenhouse gas), and will play an important role in meeting potential National CO_2 emissions targets in the future.

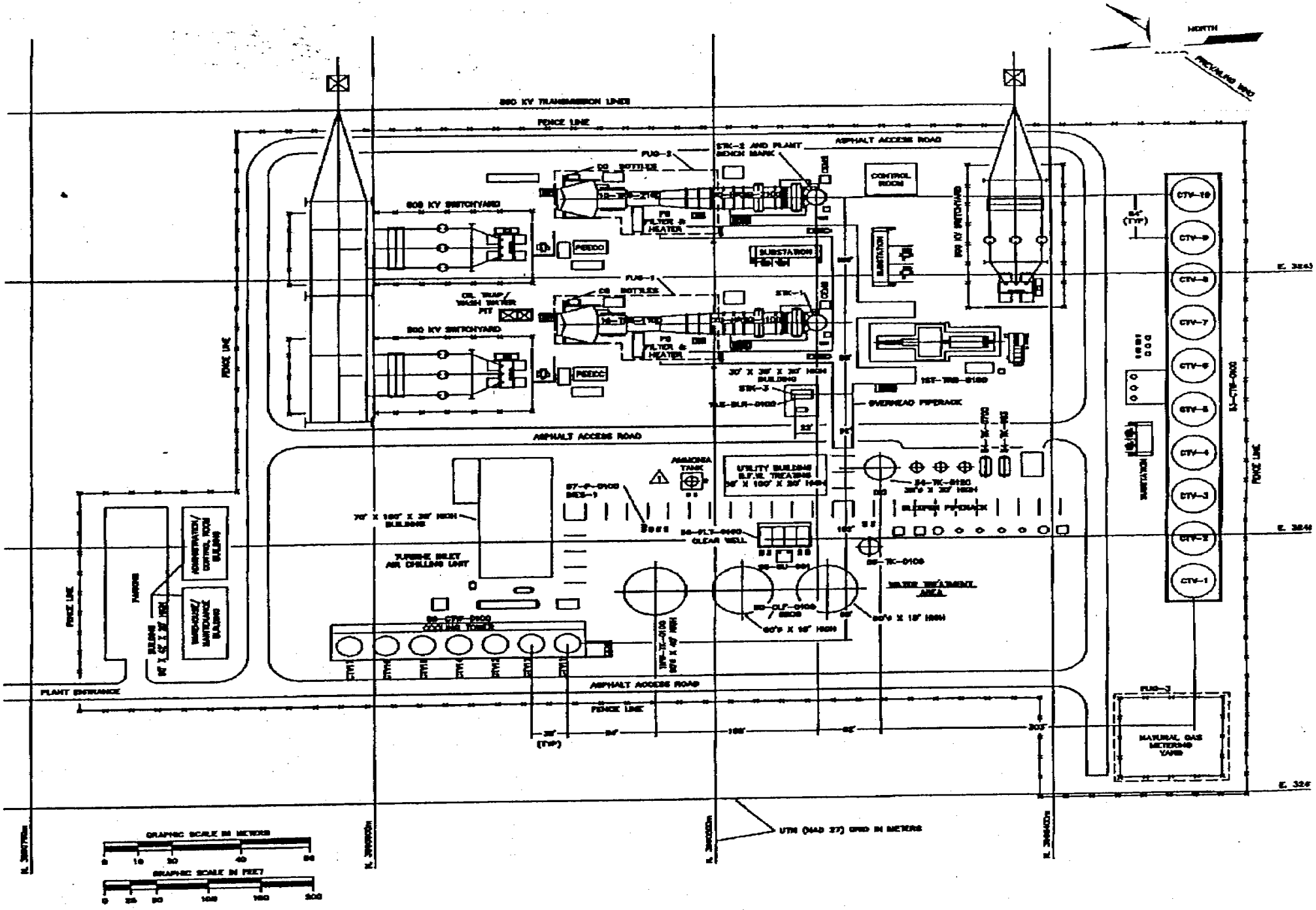


Figure 2-1 Facility Plot Plan

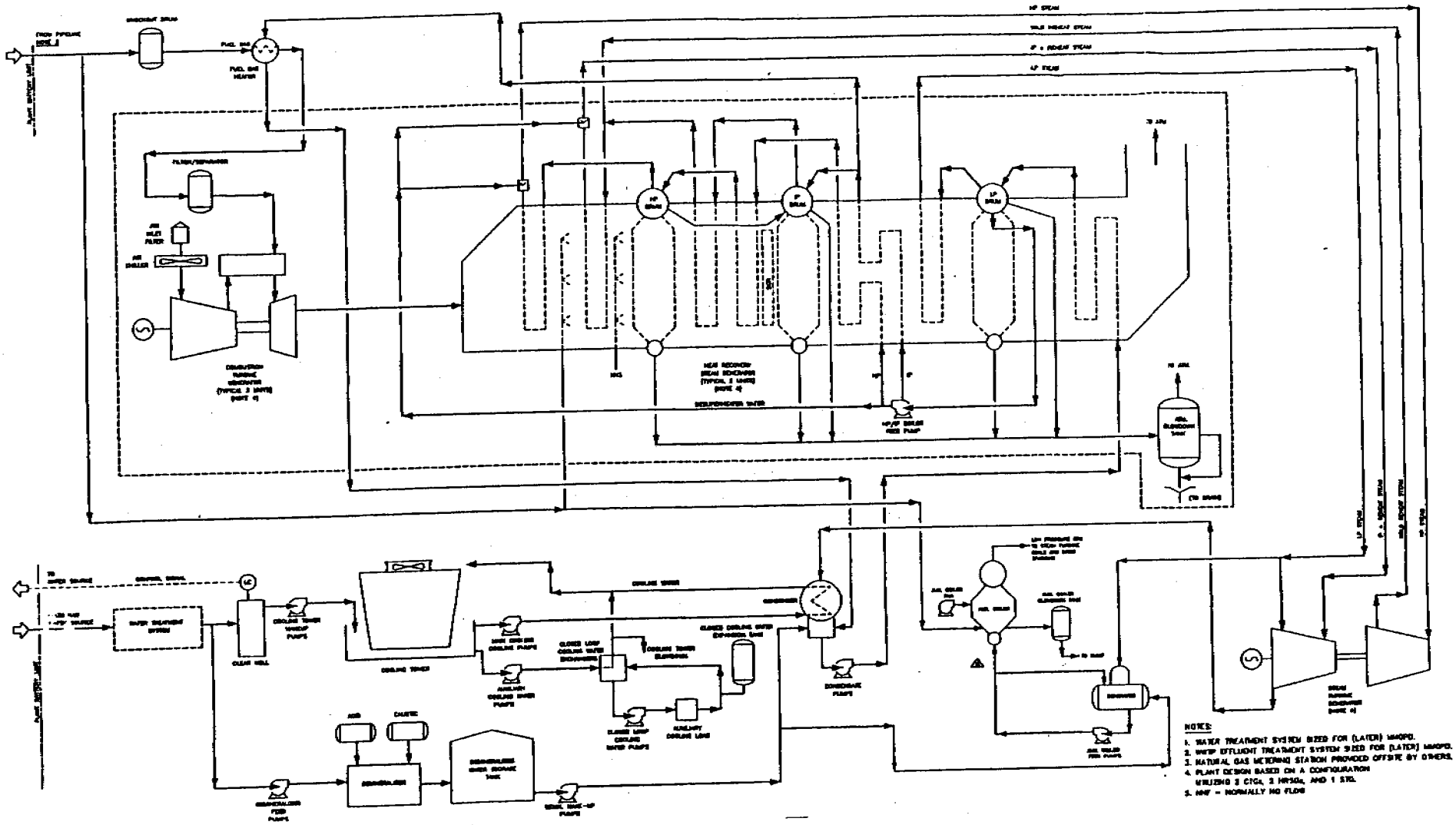


Figure 2-2 Process Flow Diagram

2.2 Combined Cycle Power Generation

The production of electricity using a combustion turbine engine coupled with a shaft driven generator is referred to as the Brayton Cycle. This power generation cycle has a thermal efficiency which generally approaches 40 percent. This is also referred to as "simple-cycle" and has been traditionally utilized for electricity peaking generation since the unit and its output can be brought on line very quickly. The largest energy loss from this cycle is from the turbine exhaust in which heat is discarded to the atmosphere at about 1,100°F.

The Rankine Cycle represents the traditional method of generating power from utility steam electric power plants. In this cycle, boilers are used to produce high pressure steam which is expanded in a steam turbine to drive an electric generator. Rankine cycle plants have a typical thermal efficiency of less than 35 percent. The largest energy losses from this cycle are from the boiler stack that exhausts at about 350°F and from heat rejected in the steam turbine condenser. Due to their low thermal efficiency, these plants were traditionally designed to burn inexpensive, low-grade fuels such as coal or residual fuel oil. Relatively high stack temperatures are necessary with these fuels in order to prevent stack corrosion. The need to reject large quantities of heat from the steam turbine is the reason many utility power plants were sited next to a large source of cooling water.

Arlington Valley Energy will combine the Brayton and Rankine cycles to maximize thermal efficiency. Natural gas will be combusted in two Brayton Cycle turbines that will generate most of the electrical output. Instead of being discarded to the environment, the exhaust heat will be recovered in a Rankine Cycle HRSG/steam turbine, and the heat will be extracted until the exhaust temperature is about 200°F before being discharged through the stacks. This will result in an overall thermal efficiency for the proposed project of over 55 percent. In other words, the project will consume only about two thirds of the fuel that would be consumed in a conventional utility power plant to produce the same amount of electricity. This state-of-the-art, high-efficiency technology combined with the exclusive use of the cleanest fossil fuel (natural gas) and the application of Best Available Control Technology, will yield a small fraction of the air emissions of a similarly sized conventional power plant.

2.3 Major Facility Components

The primary sources of criteria pollutants associated with Arlington Valley Energy are two gas-fired combustion turbines with two HRSGs and supplementary duct burners that will exhaust through two independent stacks and a gas-fired auxiliary boiler. Other potential sources of criteria pollutants associated with this facility include two cooling towers, the fuel system and a small diesel fire-water pump. There will be a minor amount of emissions associated with ancillary facilities, including a small diesel storage tank for the fire-water pump, small acid storage tank(s)

used in the treatment of process water, and an ammonia tank used to store the aqueous ammonia solution that will be used with the Selective Catalytic Reduction (SCR) system used to control NO_x emissions. Brief descriptions of the major components of the facility are provided in the following sections.

2.3.1 Gas Turbines

Arlington Valley Energy proposes to install two advanced firing, GE 7FA gas turbines in combined-cycle mode with duct-fired HRSGs and a common steam turbine generator (total 580 MW). The fuel will be exclusively pipeline quality natural gas. Arlington Valley Energy has been designed to operate without backup fuel oil capability to help minimize air pollutant emissions to the atmosphere. Each gas turbine power block will include an air compressor section, gas combustion system (utilizing advanced dry low-NO_x combustors), power turbine, and a 60-hertz (Hz), 18 kilovolt (kV) generator. Each gas turbine generator is designed to produce approximately 170 MW of net electrical power.

The gas turbine is the heart of a combined-cycle power system. First, air is filtered, cooled, and compressed in a multiple-stage axial flow compressor. Compressed air and natural gas are mixed and combusted in the turbine combustion chamber. Lean pre-mix dry low-NO_x combustors minimize NO_x formation during combustion. Exhaust gas from the combustion chamber is expanded through a multi-stage power turbine that drives both the air compressor and electric power generator.

Exhaust gas exiting the power turbine at approximately 1,100°F is ducted to a waste heat boiler commonly known as a Heat Recovery Steam Generator where steam is produced to generate additional electricity in a steam turbine generator. Gas fired duct burners located within the HRSG's are used for supplementary firing to increase steam output.

The combustion turbines are designed to operate in the dry low-NO_X (lean pre-mix) mode at loads from about 60 percent up to base load rating and will normally be taken out of service only for scheduled maintenance, or as dictated by economic or electrical demand conditions.

2.3.2 Heat Recovery Steam Generators (HRSG)

A horizontal, natural circulation, three-pressure HRSG system will extract heat from the exhaust of each gas turbine. Exhaust gas entering the HRSG at approximately 1,100°F will be cooled to approximately 200°F by the time it leaves the HRSG exhaust stack. Steam production in the HRSGs will be augmented using "low-NOx" duct burners that will be natural gas-fired. The steam produced is used in the combined-cycle plant for additional power and natural gas/feedwater heating. Each HRSG will include a high-pressure superheater, high-pressure evaporator, high-pressure economizer, reheat section (to reheat partially expanded steam), intermediate-pressure superheater, intermediate-pressure evaporator, intermediate-pressure

economizer, low-pressure superheater, low-pressure evaporator, and condensate/feedwater preheater.

2.3.3 Steam Turbine

Arlington Valley Energy will include one reheat, condensing steam turbine. The high-pressure portion of the steam turbine receives high-pressure superheated steam from the HRSGs, and exhausts to the reheat section of the HRSGs. The steam from the reheat section of the HRSGs is supplied to the intermediate-pressure section of the turbine, which expands to the low-pressure section. The low-pressure turbine also receives excess low-pressure superheated steam from the HRSGs and exhausts to the surface condenser. The steam turbine set is designed to produce approximately 180 MW of electrical power without additional fuel consumption, and up to 240 MW including duct firing.

2.3.4 Auxiliary Boiler

One package boiler, rated at about 600 horsepower, will be located on-site to supply heating steam for steam turbine seals and for sparging of the HRSG steam drums during down periods. The boiler will be a fire-tube type and combust natural gas only. Make-up water will be received from the demineralizer system that feeds the auxiliary boiler deaerator.

The primary use of the auxiliary boiler will be to maintain steam flow and operating temperatures within the HRSGs and steam turbine while the combustion turbines are off line. By maintaining steam temperatures within the turbine seals, piping, and HRSGs, the CTG's will be able to minimize the amount of startup time required to come back on line after a shut down. The steam from the auxiliary boiler will not be used to augment the power generation of the CTG's or the Steam Turbine. It is expected that the auxiliary boiler will be operated less than 1,000 hours per year.

2.3.5 Process Cooling

A ten cell cooling tower will be integral to operation of the facility. The majority of the cooling water will be used in the surface condenser to absorb the heat rejected from the steam turbine. Water from the cooling tower is commonly referred to as "main" cooling water. A dedicated set of cooling water pumps is provided for this service. Additional cooling water will be required for auxiliary plant cooling. Cooling tower water is not used for direct cooling of plant auxiliaries; a closed loop auxiliary cooling system consisting of pumps, expansion tank, and heat exchangers is provided for this purpose. Cooling tower water circulated through a set of plate and frame heat exchangers cools a closed loop coolant, usually a glycol/water mixture; this is commonly referred to as "auxiliary" cooling water. The cooling tower itself is a device designed to evaporate clean water which provides cooling. Some small water droplets (referred to as drift) escape from the top of the tower, and may liberate dissolved solids as they evaporate in the atmosphere.

2.3.6 Inlet Chilling System

The turbines will employ inlet chillers during hot ambient conditions to recover power output that would normally be lost due to lower air density at higher ambient temperatures. The process of cooling takes place at the cooling coils where inlet air is cooled before entering the CTG compressor. At lower temperature, the air becomes denser and therefore more mass flows through the CTGs. The net increase in mass flow results in higher output for each of the CTGs by up to 22 MW. In addition to the output enhancement from the CTGs, the additional mass flow also increases output of the STG by approximately 12 MW.

The inlet chilling system is a mechanical system using R-717 (ammonia) for cooling. A second, smaller (7 celled) cooling tower will reject heat for the chillers. This tower will be similar to the process cooling tower, except that it will only be run when the chillers are on (high ambient temperatures).

2.3.7 Fuel Gas System

Pipeline quality natural gas will be delivered to the plant boundary at a pressure sufficient for use in the combustion turbine generators (CTGs) without additional fuel compression. The gas will be heated to approximately 365°F using steam from the HRSGs.

Natural gas will first be sent through a knockout drum for removal of any liquid which may have been carried through from the pipeline. The gas then passes through a filter/separator to remove particulate matter and entrained liquid. The gas flows through the filter/separator's first chamber, the filtration section, where entrained liquid is coalesced on the filter cartridges, drops to the bottom of the chamber and either vaporizes and returns to the main gas stream or drains to the sump below. The gas then flows through the coalescing filters that remove particulate matter. The gas then passes to the second chamber, the separation section, where any entrained liquid remaining in the stream is further separated by impingement on a net or labyrinth and drains to the bottom sump. Two filter/separators are included: one in service and one spare. Hydrocarbon liquids in the sump are returned to the gas stream. The gas is preheated and split into two streams, one for each CTG. Finally, the gas is delivered to the CTGs and combusted as part of the power generation operation.

2.3.8 On-Site Diesel Engine

One small emergency diesel engine, nominally 400 horsepower (hp), will be located on-site and operated as an emergency fire-water pump driver. The facility operations plan calls for this unit to be operated less than five-hundred hours per year. The engine will be equipped with a 150 gallon fuel storage tank (horizontal tank, 6.5 feet long x 2.0 feet diameter).

2.3.9 Ancillary Facilities

Other systems supporting plant operations include:

- Cooling tower water treatment system;
- Plant sumps, sump pumps, and oily water separator;
- Feed water treatment systems including:
  - One-6,000 Gallon Demineralizer Regeneration Tank, expected to be of a horizontal fixed roof design, typically storing sulfuric acid or equivalent
  - One-50,000 Gallon Neutralization Tank, expected to be of a vertical fixed roof design, storing a water/sodium sulfate or similar solution
  - One-6,000 Gallon Demineralizer Regeneration Tank, of horizontal fixed roof design to store material such as sodium hydroxide solution or equivalent
- Plant and instrument air compressors and auxiliary equipment;
- Sanitary lift station;
- Steam and water sampling systems; and
- Deaerator vent.

Additional on site chemical storage may become necessary for the water treatment system, typical of any high pressure boiler installation. The kinds and amounts of chemicals to be stored will be known after the water treatment system design has been completed. Any additional tankage required will be permitted as required by MCESD regulations.

2.3.10 Buildings

Following are the dimensions of the buildings that will be onsite.

- A 90' x 42' x 20' warehouse/maintenance building at the park entrance;
- A 90' x 42' x 20' administration/main control room building to house the DCS and plant operations personnel;
- A 150' x 70' x 30' substation metal pre-fabricated "Butler-type" building to house inlet chilling facilities;
- A 100' x 50' x 20' boiler feed water treating building;
- A 50' x 50' x 20' second control room; and
- A 35' x 30' x 20' auxiliary boiler pre-fabricated "Butler-type" building.

2.4 Emissions Control

As discussed in Section 4, an SCR system has been determined to be BACT for the control of NO_x emissions from the CTGs and duct burners. The SCR system will consist of a modular foil catalyst bed and support structure located within the Heat Recovery Steam Generator (HRSG) at the point where the flue gas temperature is optimized for SCR conversion of NO_x, and an ammonia (NH_3) injection grid located within the HRSG upstream of the catalyst.

Support facilities for the SCR system will include aqueous ammonia (ammonium hydroxide) delivery and a storage tank. The aqueous ammonia (20-25% solution) will be stored in a 20,000 gallon tank (26 feet tall x 12 feet diameter).

2.5 Emissions Monitoring

A continuous emissions monitoring system (CEMS) will be provided for the combustion turbines. The CEMS will be designed to sample NO_x, CO and O_2 in accordance with New Source Performance Standards (40 CFR 60 Subpart GG) and Title IV Acid Rain Program (40 CFR 75) requirements. The CEMS will be located next to each of the combustion turbines as shown in the Site Plan (Figure B-1).

2.6 Fuel Use

The combustion turbines are fueled entirely by pipeline natural gas supplied by El Paso Natural Gas Company. No fuel will be used for process heat. The higher heating value of the fuel is 1,000 Btu per cubic foot – dry. The maximum sulfur content of the natural gas will be 0.75 gr/100 dscf. Table 2-1 summarizes the fuel usage information.

Table 2-1
Fuel Usage Information

Equipment	Fuel Type	Maximum Hourly [scf/hr]	Maximum Annual [MMscf/yr]
Combustion Turbines (2x)	Gas	3,500,000	30,660
Duct Burner	Gas	630,000	5,519
Auxiliary Boiler	Gas	29,000	29
Fire Water Pump	Diesel	2	0.001
Natural gas usage based on lower heating value (LHV).			

2.7 Raw Materials Used

Other than natural gas usage as described in Section 2.5, water is the only other significant raw material that will be used. Well water will be treated by reverse osmosis/demineralization for use in the HRSGs. Water will also be used in the cooling towers.

2.8 Operating Schedule and Limitations

Table 2-2 summarizes the anticipated CTG operating schedule. Operations limitations will be due to regular maintenance outages. Other than regular maintenance, no additional limitations on source operations that might affect emissions are anticipated.

Table 2-2
Anticipated and Maximum Operating Schedules

Normal Operations	Anticipated	Maximum Potential
Percent of Annual by Season:		
Winter	25%	25%
Spring	25%	25%
Summer	25%	25%
Fall	25%	25%
Total	100%	100%
Days of the Week	7	7
Hours of the Day	24	24
Days per Year	365	365
Hours of Year	8,760	8,760

As discussed elsewhere, the auxiliary boiler will be limited to 1000 hours of operation per year, the emergency fire-water pump will be limited to 500 hours of operation per year, and the CTGs will have no more than 600 hours per year in start-up mode.

3.0 EMISSIONS SUMMARY

This section discusses the basis and method used to calculate the emission rates used for Arlington Valley Energy. The section is organized by emission source groups. Within each section the basis for the emissions and any adjustments which are required appear first, followed by a summary of the emissions resulting from the specific operation or activity. Finally, the section provides a listing of the operational emissions totals for criteria and non-criteria air contaminants.

The emission rates used to support the development of this application rely on process information developed and provided by Duke Energy Maricopa, LLC, Duke/Fluor-Daniel, manufacturers' data, and/or emission factors such as those contained in the U.S. Environmental Protection Agency's (EPA) "Compilation of Air Pollutant Emission Factors, AP-42". Unit design parameters and operational practices have been incorporated in the analysis to make the emission estimates realistic and representative of on-site conditions. The summary presented below has been prepared for each air pollutant emission component of the proposed project, which includes the following:

- Combustion Turbines (2 Units);
- Duct Burners (each HRSG);
- Auxiliary Boiler;
- Cooling Tower;
- Fire-Water Pump Engine;
- Oil/ Water Separator; and
- On-Site Fuel/Chemical Storage Tanks.

Detailed emission calculations for the turbines, auxiliary boiler, cooling tower, fire-water pump engine and oil/water separator are presented in Appendix C. Emission rates for the combustion turbines, duct burners and auxiliary boiler were provided by the respective equipment vendors and are presented in this section.

3.1 Combustion Turbines

As outlined in Section 2.0, the primary emission sources will be the two combustion turbines. Emissions were estimated for normal operations and also during start-up/shut-down conditions.

3.1.1 Normal Operations

The manufacturer (General Electric) provided hourly emission rates for CO, NO_x, and VOC from the combustion turbines. Stack concentrations that result from these emission rates when combined with duct burning were determined by Duke/Fluor-Daniel with input from GE and the HRSG manufacturer. The NO_x emissions were adjusted to account for the control rate guaranteed for the SCR system.

SO_2 emissions were calculated by Duke/Fluor-Daniel using the expected combustion turbine operational data and the maximum sulfur content (0.75 gr/100 scf) of pipeline quality natural gas to be provided by the gas supplier.

Based on General Electric (GE) data for the turbines, including additional particulate due to duct firing and operation of SCR, a PM_{10} limit (front-half plus condensables) of 32 lbs/hr per turbine is achievable over the range of operating conditions (EPA Reference Method 5/202). Since a primary source of solid particulate is fuel burned in the unit, an effective natural gas solids loading (equivalent to a 32 lbs/hr) emission rate was determined for the highest fuel consuming case. This rate was then applied to all operating conditions.

Maximum hourly emission rates for each pollutant were established after reviewing the provided vendor data over the range of potential ambient temperatures and proposed operating loads. The minimum (13°F), maximum (121°F) and annual average (66.3°F) temperature for this area were determined from climatological data. Table 3-1 presents a summary of the hourly emissions for the combustion turbines and more detailed information is provided in Appendix C.

3.1.2 Start-up/Shutdown Emissions

Emissions of NO_x, CO and VOC may be significantly higher during transient conditions, such as start-up and shutdown, than during normal operations. During start-up, the turbine will be unstable and will not operate in lean pre-mix mode. The SCR system for NO_x control will not become completely effective until it reaches a minimum temperature, e.g., 550 to 600°F. As discussed in Section 4, the SCR system represents the best available control technology. A merchant power plant has the potential to start and stop on a frequent basis as the demand for power varies. Therefore, turbine emissions during start-up and shutdown modes were also assessed for the proposed project.

Start-ups are classified as cold, warm, and hot depending on the length of time the unit has been off-line prior to start-up. For a cold-start, the turbine is assumed to have not been operating for at least forty-eight hours prior to the start. A hot-start occurs when the turbine has been shutdown for less than eight hours. A warm-start is between eight and forty-eight hours after shutdown. A maximum of 200 start-ups or 600 hours in start-up mode per year has been assumed for this project. NO_x and CO emissions are expected to vary significantly during start-up from operating

levels. The maximum hourly emission rate during start-up mode provided by the turbine manufacturer (GE) is 102.5 lbs/hr of NO_x and 594 lbs/hr of CO per turbine.

Table 3-1
Calculated Hourly Emissions Rate Summary (lbs/hr) for Two Combustion Turbines

Pollutant	Load (%)	Temperature (°F)		
		13	66.3	121
NO_x (3 ppm)	100 (Duct Firing ON)	48	45	44
	100 (Duct Firing OFF)	40	38	37
	75	33	30	26
	50	13	NA	NA
CO	100 (Duct Firing ON)	134.2	125.9	123.0
	100 (Duct Firing OFF)	101.4	95.1	92.9
	75	80.9	75.1	65.9
	50	33.1	NA	NA
VOC	100 (Duct Firing ON)	19.45	18.27	17.97
	100 (Duct Firing OFF)	5.85	5.53	5.43
	75	4.67	4.36	3.94
	50	1.91	NA	NA
SO_2	100 (Duct Firing ON)	9.3	8.8	8.6
	100 (Duct Firing OFF)	7.9	7.4	7.3
	75	6.3	5.8	5.0
	50	8.1	NA	NA
PM_{10}	100 (Duct Firing ON)	64	64	64
	100 (Duct Firing OFF)	56	56	56
	75	56	56	56
	50	28	NA	NA

NA = Not Applicable

The maximum annual emissions by pollutant for the combustion turbines are shown in Table 3-2. This table assumes a maximum of 8,760 hours of operating time as a worst case for SO_2 and PM_{10}. Due to the additional emissions during start-up, a different worst-case annual emissions scenario was developed for NO_x and CO. Although emissions will be higher during a cold start than a warm or hot start, there is also a minimum of 48 hours of down time prior to a cold start. Therefore, the maximum annual emission scenario consists of all hot starts since no intervening

down time needs to be assumed. Assuming the hot start will typically last about 85 minutes until 60% load is reached, 200 starts per year would last about 283 hours. The maximum hourly rate for NO_x and CO shown above (i.e., 102.5 lbs/hr and 594 lbs/hr, respectively, per turbine) was assumed during this time and the maximum hourly rate from Table 3-1 was assumed for the other 8,477 hours (shut-down was assumed to be similar to emissions during normal operations, since the SCR will still be functioning properly). VOC emissions information was not available from GE for the turbines during start-up. Therefore, the annual VOC emissions for the turbines shown in Table 3-2 are based on maximum normal operation emission rates only. Even without start-up, the total potential emissions of VOC are greater than the PSD significance level of 40 tpy.

Assuming that the turbines are operating all hours of the year in either start-up or 100% operating mode, that the start-up emissions are at the maximum hourly start-up rate, and that the duct burners are on at all times are very conservative assumptions.

Table 3-2
Calculated Potential Annual Emission Rates of Criteria Pollutants from Two Combustion Turbine Generators and Duct Burners

Pollutant	Annual Emission Rate[1] (Tons Per Year)
NO_x	220[2]
CO	702
PM_{10}	280
SO_2	39
VOC	80
Lead	0.01

(1) Potential annual emission rates are based on unlimited operation of both combustion turbines, the hourly emission rate (i.e., 100% load) at an annual average temperature of 66.3° F as shown in Table 3-1, and 283 hours at the maximum start-up emissions rate for NO_x and CO.
(2) Proposed NO_x emissions after application of BACT, 3ppm.

3.1.3 Malfunctions

The BACT levels discussed in Section 4 are only achievable during stable operation. Dry low-NO_x combustors normally operate in lean pre-mix mode such that fuel and air are premixed before entering the burner. By controlling the mixture to be fuel-lean, the temperature of the resulting flame can be reduced, thereby reducing NO_x. Unfortunately, the lean pre-mix flame tends to be

unstable and subject to "Flame Out" or vibration at lower loads. Due to potential flame instability and resulting equipment and safety concerns, the turbine defaults to diffusion mode under these abnormal operating conditions. In diffusion mode, natural gas and air are fed to the burner separately. The fuel and air diffuse into one another creating a near stoichometric mixture which burns rapidly and yields a high flame temperature. The diffusion flame is stable, but produces high levels of NO_x due to the high temperature. Lean pre-mix mode is reinitiated once all operating parameters achieve normal conditions and ranges. Because periods (other than start-up) when the combustors switch from lean pre-mix mode to diffusion mode are sudden and unavoidable, they are considered malfunctions.

Emissions during these malfunction periods will be similar to emissions during start-ups. During both start-ups and malfunctions, the turbines are not operating in pre-mix mode and the ideal flame temperature for low-NO_x combustion has not been achieved.

3.2 Duct Burners

The 286 MMBtu/hr duct burners will contribute emissions of CO, NO_x, VOC, SO_2, and PM_{10}. Duct burner emissions for NO_x and CO were provided by Duke/Fluor Daniel; emissions of VOC and PM_{10} were taken from EPA AP-42, and SO_2 emissions were estimated using the pipeline quality natural gas sulfur content used to calculate SO_2 from the turbines. The duct burners specified are to be of "low-NO_x" design. Emissions for duct firing (maximum) were included in Tables 3-1 and 3-2, and Tables C-1 and C-2.

3.3 Auxiliary Boiler

The project will utilize a 22 MMBtu/hr (approximately 600 horsepower) gas-fired package auxiliary boiler to maintain minimal steam flow when the turbines are not in operation. Maximum emission rates for this unit were provided by the manufacturer as shown in Table 3-3 and emission rates for various loads are provided in Appendix C. The unit will be operated up to 1,000 hours per year. The annual emissions were estimated assuming all 1,000 hours were at the maximum hourly rate (i.e., 105% load).

Table 3-3
Summary of Auxiliary Boiler Maximum Emission Rates (105% Load)

Pollutant	Hourly Emissions (lbs/hr)	Annual Emissions(tpy)
NO_x	3.11	1.56
CO	3.95	1.98
VOC	0.42	0.21
SO_2	0.03	0.02
PM_{10}	0.26	0.13
Lead	0.00	0.00

3.4 Cooling Tower

The process cooling tower at Arlington Valley Energy represents an air emission source of PM_{10}. (Note: the larger unit will have drift emissions, while the smaller chiller tower is a closed system that has evaporation but no drift.) The level of emissions from the tower is dependent on the dissolved solids content of the circulating water and the amount of drift that leaves the unit. The method used to estimate particulate matter emissions is based on the approach presented by the EPA (AP-42, Section 13.4). Using the cooling tower's preliminary design characteristics (See Appendix C), the total particulate emissions from the large cooling tower has been estimated to be 10.9 lbs/hr and 47.8 tpy.

Each water droplet that leaves the cooling tower can be assumed to liberate solid particulate upon evaporation of the water in the droplet. Based on this assumption, the mass of solids (dissolved and suspended) in the droplet must equal the mass of solids in the final particle.

The following equation can be used to calculate the size of the particle from the size of the droplet:

$$^4/_3 * \pi * (D_p/2)^3 * P_p = \quad ^4/_3 * \pi * (D_d)^3 * P_d * (\text{Solids}/1{,}000{,}000) * C$$

where:

D_p = diameter of final particulate

P_p = density of the final particle

D_d = diameter of the droplet

P_d = density of the droplet

Solids = total solids (suspended and dissolved)

C = cycles of concentration

This equation simplifies to:

$$D_p = D_d \bullet [(P_d/P_p) \bullet (Solids * C) / 1{,}000{,}000]^{1/3}$$

The mass fraction of droplets, which will form particulates 10 microns (PM_{10}) and smaller can be estimated for a given droplet size distribution using the above approach. Specifically, the particle size (D_p) is calculated using the above equation for each droplet size for the given distribution. The mass fraction of droplets corresponding to 10 micron particles and smaller is then summed.

The analysis indicates that droplets 80 microns and smaller will produce PM_{10}. Although this analysis concludes that only about 2.5% of the droplets would form PM_{10}, a more conservative rate of 50% of the droplets was assumed to produce PM_{10} for this application.

3.5 Fire-Water Pump Engine

As noted in Section 2.0, the project design includes provisions for an emergency fire-water pump driven by a small diesel engine. While the engine is expected to operate less than 10-hours per week, emissions for this unit were calculated based on the design rating of the unit (400 hp), and an operations level of 500 hrs/year. EPA emission factors from AP-42 Section 3.3, Table 3.3-1 were used to estimate emissions.

Emissions calculations for the fire-water pump engine are presented in Appendix C and summarized in Table 3-4 below.

Table 3-4
Emergency Fire-Water Pump Emissions

Pollutant	Maximum Emissions	
	Hourly (lbs/hr)	Annual (tpy)
NO_x	12.40	3.1
CO	2.67	0.7
VOC	0.99	0.3
SO_2	0.82	0.2
PM_{10}	0.88	0.2

3.6 Oil/Water Separator

The facility will include a small oil/water separator. The maximum oil design flow for this unit is 10 gallons per minute. VOC emissions from this unit have been calculated using AP-42 (Section 5.1) for similar units at petroleum refineries. While this is likely to over-predict emissions, it maintains a conservative basis for the analysis.

Total annual VOC emissions from the unit are estimated to be 0.53 tons/yr. Calculations are presented in Appendix C.

3.7 Storage Tanks

Two of the storage tanks may also emit VOC; the 150 gallon diesel day tank for the fire-water pump and the 6,000 gallon acid storage tank for the water treatment system. While both tanks are small and contain low vapor pressure materials, emissions were estimated for these sources. Annual emissions from the two storage vessels were estimated to be less than 1 pound per year. Therefore, these sources are insignificant sources.

In addition to the two storage tanks reviewed above, other additional small storage tanks will be constructed at the site. Most of these tanks will be involved in water treatment, are not expected to store organic compounds or compounds with a significant vapor pressure. For this reason, no emissions have been estimated for these tanks.

3.8 Total Project Criteria Pollutants Emissions Summary

Tables 3-5 and 3-6 combine the emission rates summarized in this Section to establish the PTE for Arlington Valley Energy. As demonstrated in the table, the proposed project will be a major source of PM_{10}, CO, and NO_x, and have significant emissions of VOC. These pollutants will, therefore, be subject to full PSD review. SO_2 is below the PSD significant level, however, a BACT analysis is included for SO_2 in Section 4 per MCAPCR Rule 241. Lead emissions are nil and have not been included in the tables.

Table 3-5
Calculated Maximum Hourly Emissions Summary
Arlington Valley Energy

Source Name	NOx (1)	CO	VOC	SO_2	PM_{10}
Hourly Emission Rates (lbs/hr)					
Two combustion turbine generators with duct burners	48	134.2	19.45	9.3	64
Process cooling tower	-	-	-	-	10.9
Fire-water pump engine	12.40	2.67	0.99	0.82	0.88
Auxiliary Boiler	3.11	3.95	0.42	0.03	0.26
Oil/Water separator	--	-	0.12	-	-
Total	63.51	140.82	20.98	10.15	76.04

Note: This table presents the maximum emission rate over the potential operating range (50 to 100% load and 13 to 121°F)
(1) NO_x emissions from combustion turbines are based on exhaust gas concentration of 3 ppm with proposed SCR control technology

Table 3-6
Calculated Annual Emissions Summary
Arlington Valley Energy

Source Name	NOx (1)	CO	VOC	SO_2	PM_{10}
Annual Emission Rates (TPY)					
Two combustion turbine generators with duct burner	220	702	80	38.5	280
Cooling Tower	-	-	-	-	47.8
Fire-water pump engine	3.1	0.7	0.3	0.2	0.2
Auxiliary Boiler	1.6	2.0	0.2	0.02	0.1
Oil/Water separator	–	-	0.5	-	-
Total	224.7	704.7	81.0	38.7	328.1

Note: This table presents the maximum emission rate over the potential operating range (50 to 100% load and 13 to 121°F) and includes start-up NO_x and CO emissions.
(1) NO_x emissions from combustion turbines are based on exhaust gas concentration of 3 ppm with proposed SCR control technology

3.9 HAP Emissions Summary

Arlington Valley Energy will emit federally listed hazardous air pollutants as a result of combustion processes in the CTGs, duct burner and auxiliary boiler. The facility will also emit other substances that are not regulated but which MCESD has a practice of comparing to informal guidelines that have not been formally adopted. These are known at the Ambient Air Quality Guidelines (AAQG). The computed HAP and AAQG emissions for the two CTGs with duct burners and for the auxiliary boiler are shown in Table 3-7. Total HAP emissions are 14.7 tpy and no one HAP has a potential to emit more than 10 tpy. Therefore, the facility is not a major source of HAP.

Estimates of emissions of hazardous air pollutants for the CTGs and duct burners were obtained using emission factors contained in the California Air Resources Board (ARB) California Air Toxics Emission Factors (CATEF) database. The ARB has compiled this database based on source data collected for the Air Toxics Hot Spots Program (AB2588). Since much work has been done in California to develop HAP emission factors, the CATEF database was used for the turbines and duct burners.

The CATEF database (Version 1.2) contains approximately 2000 emission factors calculated from over 800 source tests for a wide range of devices. The CATEF emission factors provide estimates of emissions of organic products of combustion. AP-42 factors were used for metal and lead emission factors. AP-42 factors were also used to calculate emissions for the auxiliary boiler.

Table 3-7
Calculated Toxic Emissions Summary (2 CTGs & Auxiliary Boiler)

Pollutant	2 CTGs Emission[1] Rate (lbs/hr)	Aux. Boiler Emission[2] Rate (lbs/hr)	Pollutant on AAQG List	Pollutant HAP
1,3-Butadiene	5.52E-04	0.00E+00	YES	YES
3-Methylchloranthrene	0.00E+00	4.64E-08	YES	NO
Acetaldehyde	2.98E-01	0.00E+00	YES	YES
Acrolein	1.03E-01	0.00E+00	YES	YES
Arsenic	8.87E-04	5.16E-06	YES	YES
Barium	1.91E-02	1.14E-04	YES	NO
Benz(a)anthracene	9.83E-05	4.64E-08	YES	NO
Benzene	5.90E-02	5.42E-05	YES	YES
Benzo(a)anthracene	9.83E-05	4.64E-08	YES	NO
Benzo(a)pyrene	6.03E-05	3.10E-08	YES	NO
Beryllium	5.22E-05	3.10E-07	YES	YES
Cadmium	4.78E-03	2.84E-05	YES	YES

Table 3-7
Calculated Toxic Emissions Summary (2 CTGs & Auxiliary Boiler)

Pollutant	2 CTGs Emission[1] Rate (lbs/hr)	Aux. Boiler Emission[2] Rate (lbs/hr)	Pollutant on AAQG List	Pollutant HAP
Chromium	6.09E-03	3.61E-05	YES	YES
Cobalt	3.65E-04	2.17E-06	NO	YES
Copper	3.69E-03	2.19E-05	YES	NO
Dibenzo(a,h)anthracene	1.02E-04	3.10E-08	YES	NO
Ethylbenzene	7.79E-02	0.00E+00	YES	YES
Formaldehyde	4.78E-01	1.94E-03	YES	YES
Hexane	1.13E+00	4.64E-02	YES	YES
Manganese	1.65E-03	9.80E-06	YES	YES
Mercury	1.13E-03	6.71E-06	YES	YES
Naphthalene	7.22E-03	1.57E-05	YES	YES
Nickel	9.13E-03	5.42E-05	YES	YES
Propylene Oxide	2.08E-01	0.00E+00	YES	YES
Selenium	1.04E-04	6.19E-07	YES	YES
Toluene	3.09E-01	8.77E-05	YES	YES
Vanadium	1.00E-02	5.93E-05	YES	NO
Xylene (m)	2.13E-01	0.00E+00	YES	YES
Xylene (o)	1.04E-01	0.00E+00	YES	YES
Xylene (p)	2.13E-01	0.00E+00	YES	YES
Xylene (Total)	1.13E-01	0.00E+00	YES	YES
Arsenic	8.87E-04	5.16E-06	YES	YES
Barium	1.91E-02	1.14E-04	YES	NO
Beryllium	5.22E-05	3.10E-07	YES	YES
Cadmium	4.78E-03	2.84E-05	YES	YES
Chromium	6.09E-03	3.61E-05	YES	YES
Cobalt	3.65E-04	2.17E-06	NO	YES
Copper	3.69E-03	2.19E-05	YES	NO
Manganese	1.65E-03	9.80E-06	YES	YES
Mercury	1.13E-03	6.71E-06	YES	YES
Nickel	9.13E-03	5.42E-05	YES	YES
Selenium	1.04E-04	6.19E-07	YES	YES
Vanadium	1.00E-02	5.93E-05	YES	NO

1. Emissions based on total fuel usage of 4.347 MMscf/hr and operational hours 8,760 per year.
2. Emissions based on maximum gas usage of 26.361 MMBtu/hr and 1000 operational hours per year.

4.0 CONTROL TECHNOLOGY EVALUATION

4.1 Introduction

The PSD program specifies and MCESD requires the application of Best Available Control Technology (BACT) for the control of each regulated pollutant emitted in significant quantities from a new stationary source located in an attainment area. The main sources at the proposed project, i.e., gas turbines, duct burners, cooling tower, and auxiliary boiler, must demonstrate the application of BACT.

4.1.1 Top-Down BACT Approach

The BACT requirements are intended to ensure that a proposed facility will incorporate control systems that reflect the latest demonstrated practical techniques for the particular turbine or emission source. The BACT evaluation requires the documentation of performance levels achievable for each air pollution control technology applicable to the combined-cycle facility.

MCESD and EPA recommend that a "top-down" approach be taken when evaluating available air pollution control technologies. This approach to the BACT process involves determining the most stringent control technique available, or the lowest achievable emission rate (LAER), for a similar or identical emission source. Generally, LAER is required in a non-attainment area, but a less stringent control level (BACT) which accounts for other factors such as cost may be approved in an attainment area. Therefore, if it can be shown that the LAER is technically, environmentally, or economically impractical on a case-by-case basis for the particular source, then the next most stringent level of control is determined and similarly evaluated. The process continues until a control technology and associated emission level is determined which cannot be eliminated by any technical, environmental, or economic objections. The top-down BACT evaluation process is described in the EPA draft document "New Source Review Workshop Manual" (EPA, February 1996). The five steps involved in a top-down BACT evaluation are:

- Identify all available control options with practical potential for application to the specific emission unit for the regulated pollutant under evaluation;
- Eliminate technically infeasible or unavailable technology options;
- Rank remaining control technologies by control effectiveness;
- Evaluate most effective controls and document results; if top option is not selected as BACT, evaluate next most effective control option; and
- Select BACT, which will be the most effective practical option not rejected based on energy, environmental, and economic impacts.

The "top-down" approach was used in this analysis to evaluate available pollution controls for Arlington Valley Energy.

4.1.2 Cost Determination Methodology

Economic analyses of certain BACT alternatives were performed to compare capital and annual costs in terms of cost-effectiveness (i.e., dollars per ton of pollutant removed). Capital costs include the initial cost of components intrinsic to the complete control system (SCR, for example, includes catalyst, support frame, ammonia feed and distribution system, ammonia storage tanks, piping, rotating equipment, instrumentation, and monitoring equipment and installation costs). Annual operating costs consist of the financial requirements to operate the control system on an annual basis and include overhead, maintenance, outages, labor, raw materials, and utilities.

4.1.2.1 Capital Costs

The capital cost estimating technique used in this analysis is based on a factored method of determining direct and indirect installation costs. This technique is a modified version of the "Lang Method," whereby installation costs are expressed as a function of known equipment costs. This method is consistent with the latest EPA guidance manual (OAQPS Control Cost Manual) on estimating control technology costs (EPA, February 1996). The estimation factors used to calculate total capital costs are shown in Table 4-1.

Purchased equipment costs represent the delivered cost of the control equipment, auxiliary equipment, and instrumentation. Auxiliary equipment consists of all structural, mechanical, and electrical components required for efficient operation of the device. These include such items as reagent storage, supply piping, HRSG modifications and distributed controls. Auxiliary equipment costs are taken as a straight percentage of the basic equipment cost, the percentage being based on the average requirements of typical systems and their auxiliary equipment (EPA, January 1990). In this BACT evaluation, basic equipment costs were obtained directly from qualified vendors (see Appendix D). Instrumentation, usually not included in the basic equipment cost, is estimated at 10 percent of the basic equipment cost.

Direct installation costs consist of the direct expenditures for materials and labor for site preparation, foundations, structural steel, erection, piping, electrical, painting, and facilities. Indirect installation costs include engineering and supervision of contractors, construction and field expenses, construction fees, and contingencies. Direct installation costs are expressed as a function of the purchased equipment cost, based on average installation requirements of typical systems.

Table 4-1
Capital Cost Estimation Factors

Item	Basis
Direct Costs	
Purchased Equipment Cost	
Equipment cost + auxiliaries	A
Instrumentation	0.10 x A
Sales taxes	0.05 x A
Freight	0.05 x A
Total Purchased equipment cost, (PEC)	B = 1.22 x A
Direct installation costs	
Foundations and supports	0.08 x B
Handling and erection	0.14 x B
Electrical	0.04 x B
Piping	0.02 x B
Insulation for ductwork	0.01 x B
Painting	0.01 x B
Total direct installation cost	0.30 x B
Site Preparation	As Required
Buildings	As Required
Total Direct Cost, DC	1.30B + SP + Bldg.
Indirect Costs (installation)	
Engineering	0.10 x B
Construction and field expenses	0.05 x B
Contractor fees	0.10 x B
Start-up	0.02 x B
Performance test	0.01 x B
Contingencies	Variable
Simple Interest During Construction (IDC)	
i = interest rate; n = interest periods	DC x i x n
Total Indirect Cost, IC	0.28B + IDC
Total Capital Investment (TCI) = DC + IC	**1.58B+ SP + Bldg. + IDC + Contingency**

Indirect installation costs are designated as a percentage of the total direct cost (purchased equipment cost plus the direct installation cost) of the system. Other indirect costs include equipment startup and performance testing, working capital, and interest during construction.

4.1.2.2 Annualized Costs

Annualized costs are comprised of direct and indirect operating costs. Direct costs include labor, maintenance, replacement parts, raw materials, utilities, and waste disposal. Indirect operating costs include plant overhead, taxes, insurance, general administration, and capital charges. Annualized cost factors used to estimate total annualized cost are listed in Table 4-2. Annualized cost factors were obtained from the latest EPA guidance manual on estimating control technology costs (EPA, February 1996).

Direct operating labor costs vary according to the system operating mode and operating time. Labor supervision is estimated as 15 percent of operating labor. Replacement part costs, such as the cost to replace aged catalyst, have been included where required. Raw material and utility costs are based upon estimated annual consumption and the unit costs are summarized in Table 4-2. The presence of a catalyst bed would increase turbine back pressure resulting in efficiency losses to the system. This is reflected in the economic analysis as the value of lost power output based on turbine vendor estimates. With very low emission rates, the catalyst for a catalytic oxidation or reduction technology is assumed to require replacement every 3 years due to aging. The cost of replacement catalyst was provided by the catalyst vendors which was then annualized over 3 years.

With the exception of overhead, indirect operating costs are calculated as a percentage of the total capital cost. The indirect capital costs are based on the capital recovery factor (CRF), defined as:

$$CRF = \frac{i(1+i)^n}{(1+i)^n - 1}$$

where "i" is the pretax marginal rate of return and "n" is the equipment economic life (years). A control system's economic life is typically 10 to 20 years (EPA, February 1996). In this analysis, a 10-year equipment economic life (typical length of financing) was used. The project's actual average pretax marginal rate of return is estimated at 10% which reflects actual economic conditions in 1999. For this analysis, we have conservatively used EPA's recommended value of 7 percent (EPA, February 1996). CRF is therefore calculated to be 0.142.

Table 4-2
Annualized Cost Factors

Item	Cost Factor	Unit Cost
Direct Annual Costs, DC		
Operating labor		
Operator	0.5 hr/shift	$35.00/hr
Supervisor	15% Operating Labor	NA
Maintenance (SCR)		
SCR Labor Req.	1/2 hour per shift	$35.00/hr
Analyzer Labor Requirement	40 hr/yr	$35.00/hr
Catalyst Replacement Labor Req.	8 men for 40 hours every 3 yrs	$35.00/hr
Ammonia System Maintenance Labor Req.	40 hr/yr	$35.00/hr
Material	100% Maintenance Labor	NA
Supervisor	15% Labor	NA
Estimated Value of Lost Sales, Life of Project	3 days/catalyst replacement	6.5 cents per kW-hr Peak Power 3.5 cents per kW-hr Base Load
Ammonia	29% aqueous ammonia	$315 per ton
Process Air	350 scf/lb NH_3	$0.20 per thousand scf
Catalyst	100% replaced/3 years	
Utilities		
Natural Gas	Saved Cost during Outage	$0.01/kWh
Electricity	NA	
Steam	NA	$4.19/1000 lb
Cooling Water	NA	$0.35/1000 gal
Wastewater Discharge	NA	$0.60/1000 gal
Solvent Waste Disposal	NA	$150/drum
Solid Waste Disposal	NA	$40/ton
Indirect Annual Costs, IC		
Overhead	60% labor + materials	
Administrative Charges	2% TCI	
Property Taxes	1% TCI	
Insurance	1% TCI	
Operating Cost Contingency/or Cost to Obtain Annual Guarantees including Liquidation Damages	Applicable to first-of-a-kind Application Technology	
Capital Recovery	CRF x TCI	
Total Indirect ($/yr)		
Total Annual Cost (TAC) ($)		Sum of Annual Costs
Total Pollutant Controlled (ton/yr)		As Calculated
Cost Effectiveness ($/ton)		**TAC/tpy controlled**

The cost-effectiveness of an available control technology is based on the annualized cost of the available control technology and its annual pollutant emission reduction. Cost-effectiveness is calculated by dividing the annualized cost of the available control technology by the theoretical tons of pollutant removed by that control technology each year. The basis for determining the percent reduction of a given technology was based on information contained in EPA literature and from vendors of the control equipment.

4.2 Previous BACT/LAER Determinations for Gas Turbines

A list of previous BACT/LAER determinations for combined-cycle facilities is presented in Appendix D. These tables are compiled from EPA's RACT/BACT/LAER Clearinghouse. The RACT/BACT/LAER Clearinghouse keeps a listing of RACT/BACT/LAER determinations by governmental agencies for many types of air emission sources. The determinations are available in hard copy or through a computerized database. While the RACT/BACT/LAER Clearinghouse covers information from the past 10 to 12 years, only the more recent decisions (1994-present) have been included here. The last year has been exceedingly active for power plant projects due to utility deregulation. There has also been new control technology proposed, which has provided additional options to evaluate.

Since many agencies are slow to place information into the BACT Clearinghouse, several state agencies, including Arizona, Massachusetts, Oklahoma, California and Texas were contacted to determine BACT emissions rates in recently issued permits for similar facilities. Two permits for power generation facilities recently issued in attainment areas in Arizona are the most pertinent to this project - the Calpine Southpoint and the Griffith Energy project.

The Calpine Southpoint project will be located on the Fort Mohave Indian Reservation about 16 miles south of Bullhead City. The power plant will consist of two combined-cycle CTGs, with duct-fired HRSGs, to generate 500 MW of power. The plant will burn natural gas exclusively. A PSD permit was issued by EPA for this facility in early 1999. The relevant BACT determinations were:

- Use of SCR to control NO_x to 3 ppmdv at 15% O_2 per unit, based on a 3-hour rolling average; and
- CO limits of 10 ppmvd at 15% O_2 during normal base load operations, with adjustments up to 35 ppmvd at 15% O_2 during operations with duct firing and/or power augmentation, both based on a 3-hour rolling average.

The Griffith Energy project will be located about 9 miles southeast of Kingman. It will consist of two combined-cycle CTGs in conjunction with two HRSGs, including duct-firing. This facility will also burn only natural gas and will generate 650 MW of power. A Class I (PSD and Title V) Air

Quality Permit was issued by the Arizona Department of Environmental Quality for this facility in September 1999. The NO_x BACT determination for this plant was the same as for the Southpoint project. The CO limits were similar, but at 20 ppmvd during duct-firing instead of 35 ppmvd.

Since the BACT decisions for these two plants were very recent, and due to the similarities of the projects, they set a precedent for Arlington Valley Energy. However, BACT is a case-by-case evaluation; the BACT analyses specific to Arlington Valley Energy are presented below. Arlington Valley Energy is required by PSD rules to address BACT for NO_x, CO, VOC and PM_{10}. However, SO_2 BACT is also addressed per MCAPCR Rule 241.

4.3 BACT for Nitrogen Oxides (NO_x)

4.3.1 Formation

NO_x is primarily formed in combustion processes in two ways: 1) the combination of elemental nitrogen and oxygen in the combustion air within the high temperature environment of the combustor (thermal NO_x); and 2) the oxidation of nitrogen contained in the fuel (fuel NO_x). Although natural gas contains free nitrogen, it does not contain fuel bound nitrogen (EPA 1996); therefore, NO_x emissions from combustion turbines originate as thermal NO_x.

The rate of formation of thermal NO_x is a function of residence time and free oxygen, and is exponential with peak flame temperature. "Front-end" NO_x control techniques are aimed at controlling one or more of these variables. The primary front-end combustion controls for gas turbines include water or steam injection and dry low-NO_x combustors. The addition of an inert diluent such as water or steam into the high temperature region of the flame controls NO_x formation by quenching peak flame temperature. This technique can be operationally very hard on the turbine and combustors due to vibration and flame instability. Recent advances in the state-of-the-art have resulted in dry low-NO_x combustors which limit peak flame temperature and excess oxygen with lean, pre-mix flames that achieve equal or better NO_x control without the addition of water or steam. Catalytic combustion is an emerging front end technology which uses an oxidation catalyst within the combustor to produce a lower temperature flame and hence, low-NO_x. Other control methods, known as "back-end" controls, remove NO_x from the exhaust gas stream once NO_x has been formed. Selective Catalytic Reduction (SCR) using ammonia as a reagent represents the state-of-the-art for back end gas turbine NO_x removal. An emerging technology called $SCONO_x$™, which also uses a back-end catalyst but operates without ammonia, has shown promise during initial trials on a 23 MW turbine installation in California. These technologies are ranked and evaluated in the following sections.

4.3.2 Gas Turbines - Ranking of Available Control Techniques

A review of EPA's RACT/BACT/LAER Clearinghouse indicates general levels of NO_x control which are being permitted and/or achieved with various combinations of control technology.

Emission levels and control technologies for natural gas fired turbines have been identified and ranked as shown in Table 4-3.

Table 4-3
Ranking of NO_x Control Technologies for Gas Turbine at a Combined-Cycle Power Generation Plant

Control Technology	Typical Control Efficiency Range (% Removal)	Typical Emission Level[a] (ppm)	Technically Feasible on Combined-Cycle Gas Turbine
NATURAL GAS FIRING			
$SCONO_X$™	80-95	2-2.5	Yes[b]
SCR plus low-NO_x combustor	80-95	2-6	Yes
XONON™ flameless combustion	80-90	3-5	No
SCR plus water/steam injection or advanced low-NO_x combustor	80-95	6-9	Yes

(a) *Values represent long term values.*
(b) $SCONO_x$ has never been applied to a unit of this scale. The San Joaquin Valley Unified APCD recently issued a permit for PG&E Generating to construct and beta test the first full scale $SCONO_x$ system, which is direct evidence that it has not yet been demonstrated in practice for 120 MW units.

The most recent NO_x emission limits listed in EPA's BACT/LAER Clearinghouse are Champion International at 9 ppm and Santa Rosa Energy at 9.8 ppm using only dry low-NO_x combustors, TNP Techn, LLC at 15 ppm using water injection and SCR, PDC El Paso Milford LLC at 2 ppm (LAER), and Wyandotte Energy at 4.5 ppm using low-NO_x burners and SCR.

SCR technology represents the top level of NO_x control for projects listed in the Clearinghouse. In addition to PDC El Paso Milford, these include Portland General Electric and Hermiston Generating in Oregon, Pilgrim Energy and Sithe Energies in Islip and Oswego, NY, which all have emission limits of 4.5 ppm, and the Goal Line "Federal" facility project in California listed at 5 ppm with dry low-NO_x combustors and SCR. The Sumas Project in Washington and Kingsburg Project in California are listed at 6 ppm with SCR.

ENSR is aware of several other projects permitted or being permitted at lower NO_x emission levels which are not listed in the RACT/BACT/LAER Clearinghouse. For instance, a NO_x level of 2 ppm was recently permitted for the ANP combined-cycle project in Massachusetts and 2.5 ppm has been approved for the Calpine Sutter Power Project, the High Desert Power Project, and the La Paloma Project in California (note: these projects are all located in ozone non-attainment areas and subject to LAER). In addition to SCR, EPA has issued a finding that 2.5 ppm has been

demonstrated in practice on a small (23 MW) unit in California, using $SCONO_X$™. These alternatives are reviewed in the following sections.

4.3.2.1 $SCONO_X$™

$SCONO_X$™ is an emerging technology which offers the promise of reducing combined-cycle NO_x emissions to values less than 3 ppm. EPA issued a finding on July 2, 1997 that $SCONO_X$™ has been demonstrated in practice as LAER at the 23 MW Goal Line Federal facility in California and that emissions have been demonstrated at 2-2.5 ppm. $SCONO_X$™ is therefore reviewed as a BACT candidate for Arlington Valley Energy in this section.

Technical Analysis

According to literature provided by the maker of $SCONO_X$™ (see Appendix D) Goal Line Environmental Technologies LLC, the $SCONO_X$™ system uses an oxidation/absorption/ regeneration cycle across a catalyst bed to achieve back end reductions of NO_x. Unlike SCR, the system does not require ammonia as a reagent and involves parallel catalyst beds that are alternately taken off-line for regeneration through means of mechanical dampers.

According to Goal Line, the $SCONO_X$™ catalyst works by simultaneously oxidizing CO to CO_2, NO to NO_2, and then absorbing NO_2. The NO_2 is absorbed into a potassium carbonate catalyst coating as KNO_2 and KNO_3. When a catalyst module begins to become "loaded" with potassium nitrites and nitrates, it is taken off-line and isolated from the flue gas stream with mechanical dampers for regeneration.

Once the module has been isolated from the oxygen rich turbine exhaust, four percent hydrogen in an inert carrier gas of nitrogen or steam is introduced. An absence of oxygen is necessary to retain the reducing properties necessary for regeneration. It should be noted that four percent is about the lower flammability limit for hydrogen, so it is important that piping and air seals around dampers do not leak. Hydrogen reacts with potassium nitrites and nitrates during regeneration to form H_2O and N_2 which is emitted from the stack.

$SCONO_X$™ is an emerging and very new technology. According to Goal Line, the first generation system (mod 1) was based on a moving hood design that was used for proof of concept. This research led to the development of a second generation prototype (mod 2) which has operated for over a year on a 23 MW General Electric LM 2500 turbine at the Federal facility operated by Goal Line's parent, Sunlaw Energy. A June 1999 newsletter from Goal Line announced that on May 29, an authority to construct was issued to the PG&E Generating La Paloma Project. The La Paloma FDOC states "Currently, it is uncertain, due to commercial availability issues, if $SCONO_X$™ will be installed on the fourth gas turbine.... The availability of $SCONO_X$™ for this project is contingent on ABB's ability to scale up and test the $SCONO_X$™ system in a time period

consistent with La Paloma's schedule." This is an affirmative determination that $SCONO_X^{TM}$ is not yet ready for widespread application to 170 MW turbines.

$SCONO_X^{TM}$ catalyst is subject to the same fouling or masking degradation that is experienced by any catalyst operating in a turbine exhaust stream. Trace impurities either ingested from ambient air or internal sources gradually accumulate on the surface of the catalyst, eventually masking or poisoning active catalyst sites over time. This is why catalyst performance is known to degrade or "age" after years of operation. As one example, a catalyst system operating on a similar size cogeneration unit at MIT in Cambridge, MA experienced total catalyst failure after only several hundred hours of oil fired operation. It turned out that a trace element contained in an oil additive being supplied by the turbine manufacturer was discovered to be an aggressive catalyst poison. In any event, it is well demonstrated that all catalysts begin life at their highest level of reactivity, resulting in very low emissions when first installed. Goal Line reports that they have had to take periodic outages to wash the catalyst; apparently SO_2 present in natural gas is sufficient to mask the active catalyst sites. Goal Line proposes to install an SO_2 "guard bed" called $SCOSO_X$ on future systems such as La Paloma, but this component is as yet unproven. As stated previously, catalyst aging is also experienced with conventional SCR catalysts; however, with these systems the operating experience exists to confidently predict catalyst life and catalyst replacement cost.

Another area of concern is that the $SCONO_X^{TM}$ process is dependent on numerous hot side dampers and gas seals that must cycle every 10-15 minutes. According to Goal Line's literature, at the scale of the Federal facility, this involves approximately 8 mechanical dampers cycling about 4 times per hour, or 32 damper movements per hour. At ten times the scale, an equivalent system for Arlington Valley Energy would involve about one damper movement every ten seconds, 8,760 hours per year. While further research and development (R&D) may be done during scale up at La Paloma in an effort to reduce the number of moving parts, the $SCONO_X^{TM}$ system requires many mechanical linkages, activators, and damper seals which must operate reliably within a hostile flue gas environment. This, in combination with lack of long term demonstration and the specter of a 10:1 scale up results in associated concerns with long term availability. The La Paloma beta test will serve as a valuable R&D process to demonstrate that $SCONO_x$ can be scaled-up and eventually be guaranteed commercially for a project such as Arlington Valley Energy. It will also provide the CEM data to determine if a large scale $SCONO_X^{TM}$ application can meet 2-2.5 ppm NO_x on a continuous basis.

Commercial Availability

$SCONO_X^{TM}$ does not represent a commercially mature control technology for application to the Arlington Valley Energy project. In order for Arlington Valley Energy to obtain the financing needed to construct this project, Goal Line or its licensee would typically have to post performance bonds, and would have to provide meaningful financial guarantees for performance

and long term system availability, including remedies and liquidated damages. Goal Line's technology licensee, ABB Environmental, has not to date been willing to make such guarantees for a $35 million dollar 10:1 scale up of the "Mod 2" prototype demonstration plant. ABB has indicated that it will not be ready to offer $SCONO_X$ commercially until scale-up design and demonstration testing (such as at La Paloma, which has yet to be constructed) has been completed. Further, the unknowns associated with any pollution control system which is the first of its kind, and which has no long term company or operating history, represents a level of risk that would alter the ability to reasonably finance the project. In summary, the Arlington Valley Energy project could not practically be financed and built if $SCONO_X$™ were required for emissions control. This cannot, therefore, be considered an available control technology within the common sense meaning of the term and does not represent a candidate for BACT for Arlington Valley Energy.

Economic Evaluation

While $SCONO_X$™ does not represent a commercially available control technology for Arlington Valley Energy, it is also not a cost-effective technology. An economic analysis of the hypothetical installation of $SCONO_X$™ is presented in Table 4-4. Budget pricing for $SCONO_X$™ was provided by Goal Line (Appendix D), with an adjusted equipment cost including auxiliaries of $7.3 million per turbine (or $14.6 million total). Costs for a $SCOSO_x$ guard bed were not included, however an undemonstrated hydrogen generation system (both necessary to make $SCONO_X$™ work) was included in the estimate. For this evaluation, $SCOSO_x$ catalyst costs have not been included, rendering this analysis very conservative. Since a $SCONO_X$™ system of this scale has never been attempted to date, the direct installation contingency cost was increased from 3% to 10% to address the greater level of uncertainty of the installation cost estimate.

Based on EPA cost factors this represents a total capital investment of greater than $15.3 million per turbine, or $30.6 million total. This represents a tremendous capital investment, particularly for an unproven, first of a kind system. In terms of projected operating cost, $SCONO_X$™ avoids the cost of ammonia and associated costs, however it still incurs costs due to system pressure drop and periodic catalyst replacement. The largest potential cost to an around the clock merchant power plant is the tremendous financial losses that would result from periodic shutdowns to wash the catalyst or unscheduled outages due to NO_x control system masking or catastrophic failure. (The $SCONO_x$ system in Vernon, California has to be routinely washed, which requires the unit to be off-line.) Such risks have been conservatively included in this economic analysis by assuming a control system availability of 98 percent, which is considered to be high for a first-of-a-kind scale up application. Additionally, the value for operating contingency used in the spreadsheet was set at 10 percent of purchased equipment due to the unproven nature of the application. The estimated cost effectiveness for $SCONO_X$™ exceeds $23,800 per ton of NO_x removed, and would not be cost effective for application to Arlington Valley Energy.

This is a reasonable estimate for a new technology based on ranges of values in Perry's Chemical Engineering Handbook, 5th Edition. Similar costs could be incurred to extend the guarantee to continuous annual compliance, including liquidated damages.

Environmental Impacts

The $SCONO_x$™ catalyst requires frequent washing as part of the regeneration process. Other developers (e.g., ANP) have identified that this process will require additional water and could potentially generate a hazardous waste (since the catalyst likely contains metals and other trace elements). These considerations were not investigated in detail for this application since this technology is neither commercially available nor cost-effective.

Summary

$SCONO_x$™ has the potential to become a viable pollution control technology for large turbines if it can be successfully scaled-up and tested at La Paloma. The current lack of operating experience with features such as $SCOSO_x$ and in-situ hydrogen generation, the R&D status and technical challenge of a 10:1 scale up and ABB confirmation that the technology is not ready to be offered commercially and the reasonable doubt that such a large scale system could, in fact, continuously meet 2-2.5 ppm emission limits renders the technology unavailable and undemonstrated for Arlington Valley Energy. Finally, the technology cannot be considered cost effective for this project, even without considering potential financial losses due to unplanned outages or potential failure to meet long term performance guarantees. $SCONO_x$™ cannot, therefore, be considered to represent BACT for this application.

4.3.2.3 Selective Catalytic Reduction (SCR)

Technical Analysis

Selective catalytic reduction (SCR) is a process that involves post-combustion removal of NO_x from flue gas with a catalytic reactor. In the SCR process, ammonia injected into the turbine exhaust gas reacts with nitrogen oxides and oxygen to form nitrogen and water. SCR converts nitrogen oxides to nitrogen and water by the following reactions (Cho, 1994):

$$4NO + 4NH_3 + O_2 \rightarrow 4N_2 + 6H_2O \quad (1)$$
$$6NO + 4NH_3 \rightarrow 5N_2 + 6H_2O \quad (2)$$
$$2NO_2 + 4NH_3 + O_2 \rightarrow 3N_2 + 6H_2O \quad (3)$$
$$6NO_2 + 8NH_3 \rightarrow 7N_2 + 12H_2O \quad (4)$$
$$NO + NO_2 + 2NH_3 \rightarrow 2N_2 + 3H_2O \quad (5)$$

The reactions take place on the surface of a catalyst. The function of the catalyst is to effectively lower the activation energy of the NO_x decomposition reaction. Technical factors related to this technology include the catalyst reactor design, optimum operating temperature, sulfur content of the fuel, catalyst de-activation due to aging, ammonia slip emissions, and design of the NH_3 injection system.

Three types of catalyst bed configurations have been successfully applied to commercial sources: the moving bed reactor, the parallel flow reactor, and the fixed bed reactor. The fixed bed reactor is applicable to sources with little or no particulate present in the flue gas, such as would be the case for the proposed gas turbines. In this reactor design, the catalyst bed is oriented perpendicular to the flue gas flow within the HRSG and transport of the reactants to the active catalyst sites takes place through a combination of diffusion and convection.

Optimum operating temperature for a vanadium-titanium catalyst system has been shown to be in the range of 550° to 800°F (Rogers, 1992). In applications where heat recovery steam generation is used, SCR catalyst and ammonia injection grids are typically installed between tube bundles within the HRSG where the flue gas temperature remains within the required temperature range during base load operation. Operation at part load and potentially with or without duct burners during start-up and shut-down, yields a decreased NO_x conversion efficiency and a non-optimum SCR temperature. Since operation at less than design temperatures would neither effectively remove NO_x nor reduce ammonia, both would be emitted from the stack during off design catalyst temperatures. For this reason, automatic controls are used to cut back ammonia feed when the catalyst bed is below set point temperature.

Sulfur content of the fuel can be a concern for systems that employ SCR, however the pipeline quality natural gas maximum for this facility (0.75 grains per 100 dscf) should afford reasonable catalyst life. Catalyst systems promote partial oxidation of sulfur dioxide (from trace sulfur in gas and the mercaptans used as an odorant) to sulfur trioxide (SO_3), which combines with water to form sulfuric acid. At the temperatures of the HRSG, SO_3 and sulfuric acid may react with excess ammonia to form ammonium salts. These ammonium salts may condense as the flue gases are cooled in the HRSG, or may be emitted from the stack as increased emissions of PM_{10}. Sulfates and nitrates emitted from the stack are also precursors to atmospheric formation of PM_{10}. Under some circumstances, fouling may eventually lead to increased system pressure drop over time and decreased heat transfer efficiencies. Fortunately, ammonium salts may be removed by water washing, although this process requires an outage to allow cooling, washing and restart of the system.

The SCR process may also be subject to catalyst deactivation over time. Catalyst deactivation occurs through two primary mechanisms: physical deactivation and chemical poisoning. Physical deactivation is generally the result either of prolonged exposure to excessive temperatures or masking of the catalyst due to entrainment of particulate from ambient air or internal contaminants. Chemical poisoning is caused by the irreversible reaction of the catalyst with a contaminant in the gas stream and is a permanent condition. Catalyst suppliers typically only guarantee a 3-year lifetime to very low emission level, high performance catalyst systems.

SCR manufacturers typically estimate 10-20 ppm of unreacted ammonia emissions (ammonia slip) when making NO_x control guarantees at very low emissions levels. To achieve low NO_x limits, SCR vendors suggest a higher ammonia injection rate than stoichiometrically required, which necessarily results in ammonia slip. Thus an emissions trade-off between NO_x and ammonia may occur in high NO_x reduction applications.

Environmental Impacts

The potential environmental impacts associated with the use of SCR are summarized below:

- Some unreacted ammonia would be emitted to the atmosphere (ammonia slip); ammonia is a PM_{10} (and $PM_{2.5}$) precursor. Ammonia salts (PM_{10}/$PM_{2.5}$) may also be emitted; and
- There are safety issues associated with the transportation, handling, and storage of aqueous ammonia albeit manageable ones. The storage of aqueous ammonia (which is substantially lower risk than for anhydrous ammonia) is regulated under Occupational Safety and Health Act (OSHA) regulations and the Risk Management Planning (RMP) provisions of Clean Air Act Amendments Title III, Section 112(r).

The transport, handling, and storage of aqueous ammonia presents some limited environmental risks. However, the benefits from reduced NO_x emissions, including the reduction in NO_x precursor effects on ozone and visibility, should outweigh the potential environmental impacts from the storage and handling of aqueous ammonia at Arlington Valley Energy.

Summary

SCR has become a widely accepted control technology for application to combined-cycle turbines. While $SCONO_x$ may be capable of slightly lower emission rates (i.e., as low as 2 ppm vs. 3 ppm proposed with SCR) it has yet to be scaled up and applied to a project of this scale, and it is also not cost effective. While some recent permits in non-attainment areas have been written at 2 and 2.5 ppm with SCR (as LAER), these levels have yet to be demonstrated-in-practice for purposes of long-term compliance over the full range of the operating conditions. According to American Society of Mechanical Engineers (ASME), Reference Method CEMs may not even be able to differentiate between 2 and 3 ppm, given system accuracy that may be limited to ± 2ppm. Finally, the proposed duct burners will also contribute to emissions of NO_x which are included in the 3 ppm total.

SCR at 3 ppm on a 3-hour average basis therefore is concluded to represent BACT for NO_x from the Arlington Valley Energy project turbines and duct burners.

4.3.3 Duct Burners

As stated above, the use of low-NO_x burners followed by SCR also represents BACT (and LAER) for the proposed project duct burners.

4.3.4 Auxiliary Boiler

The proposed auxiliary boiler will incorporate a NO_X emission limit of 0.05 lb/MMBtu which will be achieved using low-NO_x burners and natural gas fuel. Given the limited operation (1,000 hours per year) and the small capacity of this boiler (25 MMBtu/hr) the installation of add on NO_x controls such as SCR, would not be cost effective. The use of low-NO_x burners using natural gas fuel represents BACT for the proposed auxiliary boiler.

4.3.5 Diesel Fire-Water Pump

EPA's Alternative Control Technology (ACT) document for reciprocating engines (EPA, 1996) lists back-end techniques such as SCR as well as combustion control techniques such as ignition retard for NO_x control from diesel engines. The ACT concludes that add-on controls are not cost effective for "emergency diesel engines which operate less than 500 hours/year". Therefore, neither back-end nor combustion controls represent NO_x BACT for the diesel fire-water pump.

4.4 BACT for Carbon Monoxide

4.4.1 Formation

Carbon monoxide (CO) is formed as a result of incomplete combustion of fuel. Control of CO is accomplished by providing adequate fuel residence time and high temperature in the combustion zone to ensure complete combustion. These control factors, however, also tend to result in increased emissions of NO_x. Conversely, a low NO_x emission rate achieved through flame temperature control (by water injection or dry lean pre-mix) can result in higher levels of CO emissions. Thus, a compromise is established whereby the flame temperature reduction is set to achieve the lowest NO_x emission rate possible while also optimizing CO emission rates.

4.4.2 Gas Turbines-Ranking of Available Control Techniques

CO emissions from gas turbines are a function of oxygen availability (excess air), flame temperature, residence time at flame temperature, combustion zone design, and turbulence. Alternative CO control methods include exhaust gas cleanup methods such as catalytic oxidation, and front-end methods such as combustion control wherein CO formation is suppressed within the combustors.

A review of EPA's RACT/BACT/LAER Clearinghouse (Appendix D) indicates several levels of CO control which may be achieved for natural gas fired gas turbines. Potential emission levels and control technologies have been identified and ranked as follows:

- 2 to 6 ppm: CO oxidation catalyst
- 10 to 25 ppm: Combustion control for natural gas firing; oxidation catalyst for distillate oil firing
- 25 to 50 ppm: Combustion controls for distillate oil firing

These levels of control are evaluated in terms of Best Available Control Technology in the following sections.

LAER: 2 to 6 ppm CO with Catalytic Oxidation

The most stringent CO control level available for gas turbines has been achieved with the use of an oxidation catalyst system, which can remove approximately 85 percent of CO in the flue gas stream. According to the list of turbines in the RACT/BACT/LAER Clearinghouse with limits on CO, the lowest emission level listed in the Clearinghouse is 3.0 ppm for the Wyandotte Energy facility in Michigan. A CO oxidation catalyst is therefore concluded to represent the top control technology for CO control from natural gas fired, combined-cycle turbines.

It should be noted that the makers of $SCONO_X$™ provide a conventional oxidation catalyst as part of their scope of supply. This is necessary to make the absorption catalyst work, but is not unique or different from the CO catalytic oxidation technology reviewed in this section.

Technical Analysis

As with SCR catalyst technology for NO_x control, oxidation catalyst systems seek to remove pollutants from the turbine exhaust gas rather than limiting pollutant formation at the source. Unlike an SCR catalyst system, which requires the use of ammonia as a reducing agent, oxidation catalyst technology does not require the introduction of additional chemicals for the reaction to proceed. Rather, the oxidation of CO to CO_2 utilizes the excess air present in the turbine exhaust; the activation energy required for the reaction to proceed is lowered in the presence of the catalyst. Technical factors relating to this technology include the catalyst reactor design, optimum operating temperature, back pressure loss to the system, catalyst life, and potential collateral increases in emissions of PM_{10}.

As with SCR, CO catalytic oxidation reactors operate in a relatively narrow temperature range. Optimum operating temperatures for base metal systems generally fall into the range of 700°F to 900°F. At lower temperatures, CO conversion efficiency falls off rapidly. Above 1,200°F, catalyst sintering may occur, thus causing permanent damage to the catalyst. For this reason, the CO catalyst is strategically placed within the HRSG for proper turbine exhaust lateral distribution (it is important to evenly distribute gas flow across the catalyst) and proper operating temperature at base load design conditions. Operation with duct burners on or off, at part load, or during start-up/shut-down can result in other than optimum temperatures and reduced control efficiency.

Typical pressure losses across an oxidation catalyst reactor (including pressure loss due to ammonium salt formation) are in the range of 1.5 to 3.0 inches of water (Engelhard, 1997). Pressure losses in this range correspond roughly to a 0.15 to 0.30 percent loss in power output and fuel efficiency (General Electric, 1997).

Catalyst systems are subject to loss of activity over time. Since the catalyst itself is the most costly part of the installation, the cost of catalyst replacement has been accounted for on an annualized basis. Depending on the actual installation, catalyst life may vary from the manufacturer's typical 3-year guarantee to a 5- to 6-year predicted life. Periodic testing of catalyst material is necessary to predict actual catalyst life for any given installation. The following economic analysis assumes that catalyst will be replaced every 3 years per vendor guarantee. This system would also be expected to control a small percent (5-20%) of hydrocarbon (VOC) emissions.

Environmental Analysis

A CO catalyst will also oxidize other species within the turbine exhaust. For example, sulfur in natural gas (fuel sulfur and mercaptans added as an odorant) is oxidized to gaseous SO_2 within the combustor, but is further oxidized to SO_3 across a CO catalyst (30 percent conversion is assumed). SO_3 will then be emitted and/or combined to form H_2SO_4 (sulfuric acid mist) from the exhaust stack. These sulfates condense in the gas stream or in the atmosphere as additional PM_{10} (and $PM_{2.5}$). Thus, an oxidation catalyst would reduce emissions of CO and to some extent VOC, but would increase emissions of PM_{10} and $PM_{2.5}$.

Economic Analysis

Capital and annual costs associated with installation of an oxidation catalyst system were obtained from Engelhard, a qualified vendor of catalyst control systems. The basic equipment cost plus auxiliaries for each unit is $1,288,522. Capital costs include the catalytic reactor, initial catalyst charge, freight, engineering and design, and installation. As shown in Table 4-5, the total purchased equipment cost is $1,546,222.

When adding direct installation costs and indirect costs, the total capital cost of this equipment is estimated at $2,010,100. Since the catalyst is assumed to be replaced periodically (every three years), it was deducted from the initial purchase cost for purposes of determining annualized capital recovery. Catalyst replacement is treated separately in this analysis under operating costs.

Annual operating costs, summarized in Table 4-5, include operating labor (1 hour/shift), routine inspection and maintenance, spent catalyst replacement, and lost cycle efficiency due to increased back pressure. Annualized catalyst replacement cost was calculated based on a 3-year life, for an annualized cost of about $533,090. Estimated annualized costs total $1,201,500. At an estimated control efficiency of 85 percent to reduce CO from a maximum of 20 ppm to 3 ppm during gas firing, the use of oxidation catalyst represents a maximum of 234.4 tons CO removed per year for each gas turbine at a cost of $5,100 per ton of CO controlled.

Summary

The use of an oxidation catalyst to control emissions of CO would result in collateral increases in PM_{10} (and $PM_{2.5}$) emissions, is not cost effective, and does not represent BACT for Arlington Valley Energy. The next best level of control, for the turbine generators with duct- firing is 10 ppm without duct burning and 20 ppm with duct burning (averaged on a 24-hour basis) using combustion control and is concluded to represent BACT for this facility. The resulting emission

Table 4-5
Oxidation Catalyst for CO Control

Control Efficiency (%)	85

Facility Input Data

Item	Value
Operating Schedule	
Shifts per day	3
Hours per day	24
Days per week	7
Hours per year	8,760
Source(s) Controlled	Power Block, ~ 290 MW @ Average Ambient Conditions
Power Output of Turbine (CTG Only) (kW)	170,405
Power Output CTG & Unfired HRSG (kW)	252,830
Power Output CTG & Fired HRSG (kW)	289,575
Estimated Total Flowrate (acfm)	885,525
Estimated Temperature (F)	187
Total Flowrate (scfm)	722,654
CO From Source(s) (lb/hr)	63.0
CO From Source(s) (tpy)	276
Site Specific Enclosure (Building) Cost	NA
Site Specific Electricity Value (Base Load) ($/kWh)	0.035
Site Specific Electricity Value (Peak Load) ($/kWh)	0.065
Site Specific Operating Cost ($/kWh)	0.010
Site Specific Operating Labor Cost ($/hr)	35
Site Specific Maint. Labor Cost ($/hr)	35

Capital Costs

	Value	Basis
Direct Costs		
1.) Purchased Equipment Cost		
a.) Equipment cost + auxiliaries	$1,288,522	Engelhard quote plus auxiliaries, A
b.) Instrumentation	$128,900	0.10 x A
c.) Sales taxes	$64,400	0.05 x A
d.) Freight	$64,400	0.05 x A
Total Purchased equipment cost, (PEC)	$1,546,222	B = 1.22 x A
2.) *Direct installation costs*		
a.) Foundations and supports	$123,700	0.08 x B
b.) Handling and erection	$216,500	0.14 x B
c.) Electrical	$61,800	0.04 x B
d.) Piping	$30,900	0.02 x B
e.) Insulation for ductwork	$15,500	0.01 x B
f.) Painting	$15,500	0.01 x B
Total direct installation cost	$463,900	0.30 x B
3.) Site preparation, SP	NA	NA

Table 4-5 (continued)
Oxidation Catalyst for CO Control

4.) Enclosure, Bldg.	NA	NA
Total Direct Cost, DC	$2,010,100	1.30B + SP + Bldg.
Indirect Costs (installation)		
5.) Engineering	$154,600	0.10 x B
6.) Construction and field expenses	$77,300	0.05 x B
7.) Contractor fees	$154,600	0.10 x B
8.) Start-up	$30,900	0.02 x B
9.) Performance test	$15,500	0.01 x B
10.) Contingencies	$46,400	0.03 x B
11.) Simple Interest During Construction	$54,117.79	PEC x 7% x 0.5 years
Total Indirect Cost, IC	$533,418	0.31B + Other
Total Capital Investment (TCI) = DC + IC	**$2,543,500**	**1.61B + Bldg. + Other**

Annual Costs

Item	Value	Basis	Source
1) Electricity			
Press. Drop (in. W.C.)	3.0	Pressure drop - catalyst bed with dilution air	Vendor, estimate
Power Output of Turbine (kW)	170,405		Vendor
Power Loss Due to Pressure Drop (%)	0.30%	0.1% for every 1" pressure drop	Vendor
Power Loss Due to Pressure Drop (kW)	511		
Unit Cost ($/kWh)	$0.035	Estimated Market Value	Estimate
Cost of Heat Rate Loss ($/yr)	$156,740		
Total Cost ($/yr)	$156,740		
2) Operating Labor			
CO Catalyst Requirement (hr/yr)	1095	8,760 operating hours per year	Estimate
Catalyst Cleaning (hr/yr)	80.0	2 workers x 40 hours per year	
Unit Cost ($/hr)	$35.00	Facility Data	Estimate
Cost ($/yr)	$41,125		
3) Supervisory Labor			
Cost ($/yr)	$6,170	15% Operating Labor	OAQPS
4) Maintenance			
CO Catalyst Labor Req. (hr/yr)	547.5	1/2 hour per shift	OAQPS
Catalyst Replacement Labor Req. (hr/yr)	106.7	8 workers for 40 hours every 3 yrs	Estimate
Unit Cost ($/hr)	$35.00	Facility Data	Estimate
Labor Cost ($/yr)	$22,896		
Material Cost ($/yr)	$22,900	100% of Maintenance Labor	OAQPS
Total Cost ($/yr)	$45,800		
5) Catalyst Replacement			
Catalyst Cost ($)	$710,373	Catalyst modules	Vendor
Catalyst Disposal Cost ($)	$50,000	Disposal of catalyst modules	Estimate
Sales Tax ($)	$38,019	5% Sales Tax	as of 1/1/99
Power Output of CTG & Unfired HRSG (kW)	252,830		
Power Output of Fired HRSG (Peak) (kW)	36,745		

Table 4-5
Oxidation Catalyst for CO Control

Base Load Power Loss During Replacement (kWh)	18,203,760	3 days shut down every three years	
Peak Load Power Loss During Replacement (kWh)	2,645,604		
Cost of Energy Loss During Catalyst Replacement ($)	$600,602		
Catalyst Life (yrs)	3	n	OAQPS
Interest Rate (%)	7	i	
CRF	0.38	Amortization of Catalyst	OAQPS
Annual Cost ($/yr)	$533,090	(Volume)(Unit Cost)(CRF)	
7) Indirect Annual Costs			
Overhead	$55,860	60% of O&M Costs	OAQPS
Administration	$50,870	2% of Total Capital Investment	OAQPS
Property Tax	$25,440	1% of Total Capital Investment	OAQPS
Insurance	$25,440	1% of Total Capital Investment	OAQPS
Capital Life (yrs)	10	n	
Interest Rate (%)	7	i	
CRF	0.14	Amortization of Capital Costs	
Capital Recovery	$261,000	(Capital Cost)(CRF)	OAQPS
Total Indirect ($/yr)	$418,610		
Total Annualized Cost ($/yr)	**$1,201,500**		
Total CO Controlled (tpy)	**234.4**		
Cost Effectiveness ($/ton)	**$5,100**		

level results in modeled impacts (presented elsewhere in this application) which are less than 5 percent of the 1- and 8-hr CO NAAQSs.

4.4.3 Duct Burners

Information received from the vendor is that duct burners may double the CO emissions. This level of emissions was used for the previous CO cost analysis. Since oxidation catalyst have already been shown to be not cost effective for application to the turbines, it could not be cost-effective to control the much smaller CO emission contribution of the duct burners. The proposed CO emission limit of 20 ppm in fact already includes duct burner emissions. Good combustion control, therefore represents BACT for CO from Arlington Valley Energy duct burners.

4.4.4 Auxiliary Boiler

The auxiliary boiler will employ good combustion control for CO which has been determined to represent BACT for this source type.

4.4.5 Diesel Fire-Water Pump

Add on controls for CO emissions have never been applied to emergency diesel engines that operate less than 500 hours/year. Combustion control is concluded to represent BACT for theArlington Valley Energy emergency fire-water pump.

4.5 BACT for Particulate Matter and Trace Metals

4.5.1 Formation

Particulate (PM_{10}) emissions from natural gas combustion sources consist of inert contaminants in natural gas, sulfates from fuel sulfur or mercaptans used as odorants, dust drawn in from the ambient air and particulate of carbon and hydrocarbons resulting from incomplete combustion. Therefore, units firing fuels with low ash content and high combustion efficiency exhibit correspondingly low particulate emissions. Trace metals which may be emitted from combustion of natural gas are discussed in this section because they form a fraction of the particulate to be emitted.

4.5.2 Gas Turbines, Duct Burners, Auxiliary Boiler and Diesel Fire-Water Pump

When the New Source Performance Standard for Stationary Gas Turbines (40 CFR 60 Subpart GG) was promulgated in 1979, the EPA recognized that "particulate emissions from stationary gas turbines are minimal," and noted that particulate control devices are not typically installed on gas turbines and that the cost of installing a particulate control device is prohibitive (EPA, September 1977). Performance standards for particulate control of stationary gas turbines were, therefore, not proposed or promulgated.

The most stringent particulate control method demonstrated for gas turbines, duct burners, small boilers or diesel engines is the use of low ash fuel (such as natural gas or low sulfur transportation diesel). No add-on control technologies are listed in the RACT/BACT/LAER Clearinghouse listings for combustion turbines. Proper combustion control and the firing of fuels with negligible or zero ash content (natural gas for the turbine duct burners and auxiliary boiler and low sulfur transportation diesel for the fire-water pump) is the predominant control method listed.

Add on controls, such as ESPs or baghouses, have never been applied to commercial gas/oil fired turbines or diesels engines. The use of ESPs and baghouse filters is considered technically infeasible, and does not represent an available control technology.

Summary

The use of negligible or zero ash fuels such as natural gas and low sulfur diesel and good combustion control is concluded to represent BACT for PM_{10} control for the proposed gas turbines, duct burners, auxiliary boiler and emergency diesel engine. These operational controls will limit PM_{10} emissions (EPA Reference Method 5/202) to approximately 32 lbs/hr per turbine, including duct burners.

4.5.3 Cooling Tower

Cooling towers are designed to efficiently evaporate water. As water evaporates, it absorbs heat, causing the remaining water to become colder. The cold water is then circulated in non-contact heat exchangers to remove heat from the steam condenser. This is the same effect that causes a person to feel a chill when wearing wet clothing. Water not lost to evaporation in the cooling tower is used for non-contact cooling of the steam turbine condenser. This water will likely contain dissolved solids such as calcium, sodium and potassium. As the water is evaporated in the cooling tower, these total dissolved solids (TDS) tend to concentrate in the water that remains circulating within the cooling tower.

To improve evaporation rate, cooling towers are designed to induce a flow of fresh air across a large wetted surface area (called "fill"). This induced air flow, however, entrains some of the fine water droplets which carry out of the tower, referred to as drift. These fine droplets subsequently evaporate in the ambient air, but when they do they liberate the total dissolved solids that were formerly in solution as emissions of particulate and PM_{10}. It is interesting to note that cooling towers also exhibit a "scrubbing effect" as airborne particulate in the ambient air that is drawn into the tower tends to be captured upon collision with the wetted fill. This is why cooling towers tend to collect pollen during the springtime. No credit for ambient air scrubbing has been taken in this analysis.

The technologies which are available to control PM_{10} emissions from evaporative cooling towers are limited to devices which seek to minimize drift. Known as Drift Eliminators, this technology represents the top level of control for PM_{10} emissions from evaporative cooling towers. , Drift Eliminators typically consist of layers of plastic chevrons located within the tower to knock out and coalesce fine water droplets before they can be emitted to the atmosphere.

EPA's compilation of emission factors for air emission sources (EPA AP-42) gives a value for the amount of drift emitted from evaporative cooling towers at 0.02 percent of the water circulating in the tower. Arlington Valley Energy solicited cooling tower manufacturers for drift performance guarantees based on use of state-of-the-art Drift Eliminators. Based on this solicitation, Marley Cooling Towers Inc. responded that Drift Eliminators could reduce drift to a guaranteed level of 0.003 percent of circulating water flow. This level of control results in a total annual emission of

PM_{10} of only 47.8 tpy. Drift Eliminators are therefore concluded to represent BACT for PM_{10} from the Arlington Valley Energy evaporative cooling tower.

4.6 BACT for Sulfur Dioxide

Although the sulfur dioxide emissions are not over the PSD significance level of 40 tpy, a BACT analysis for this pollutant was also performed as required under MCAPCR Rule 241.

4.6.1 Formation

Sulfur dioxide (SO_2) is exclusively formed through the oxidation of sulfur present in the fuel. Therefore the emission rate of SO_2 from a gas turbine is a function of the sulfur content of the fuel, since virtually all fuel sulfur is converted to SO_2 or SO_3.

4.6.2 Gas Turbines, Duct Burners and Auxiliary Boiler

The gas turbines, duct burners and auxiliary boiler will exclusively fire pipeline quality natural gas. Natural gas from El Paso Natural Gas contains an annual average sulfur content of 0.75 grains per 100 dscf. This sulfur content represents an SO_2 emission rate of 4.7 lbs/hr from each combustion turbine at ISO (59°F, 60% R.H., 1 atm). Total estimated SO_2 emissions from the gas turbines are 39 tpy based on use of this pipeline quality natural gas. Total estimated SO_2 emissions from the auxiliary boiler are less than 0.1 tpy.

The most stringent method of control for SO_2 that has been demonstrated for gas turbines is limiting operation to pipeline quality natural gas only. Of 85 turbines listed in the RACT/BACT/LAER Clearinghouse, 64 have limits on SO_2. According to this list, low sulfur fuel is the only available SO_2 control method for gas turbines.

The use of pipeline natural gas as the exclusive fuel is, therefore, representative of BACT for SO_2 from the gas turbines, duct burners and auxiliary boiler.

4.6.3 Diesel Fire-Water Pump

The only control technique available for diesel engines that operate 500 hours or less per year, is the use of low sulfur fuel. Therefore, the use of very low sulfur diesel fuel (0.05%S) represents BACT for SO_2 from the diesel fire-water pump.

4.7 BACT for Hydrocarbons (VOCs) and Trace Organics

4.7.1 Formation

Non-methane hydrocarbons (also referred to as volatile organic compounds or VOCs) and trace organics are emitted from gas-fired turbines as a result of incomplete combustion of fuel. Control

of these pollutants is accomplished by providing adequate fuel residence time and high temperature in the combustion zone to ensure complete combustion.

4.7.2 Gas Turbines

The most stringent VOC control level for gas turbines has been achieved through advanced low-NO_x combustors or catalytic oxidation for CO control. According to the list of turbines in the RACT/BACT/LAER Clearinghouse with limits on VOC (see Appendix D), oxidation catalyst systems represent BACT for VOC control in only two of the 21 facilities listed. An oxidation catalyst designed to control CO would provide a side benefit of controlling in the range of 5 to 20 percent of VOC emissions. The next level of control is combustion controls where VOC emissions are minimized by optimizing fuel mixing, excess air, and combustion temperature to assure complete combustion of the fuel.

The same technical factors that apply to the use of oxidation catalyst technology for control of CO emissions (narrow operating temperature range, loss of catalyst activity over time, and system pressure losses) apply to the use of this technology for collateral control of VOC. Since Arlington Valley Energy will not employ a CO catalyst, such collateral reductions in VOC are not available.

Since an oxidation catalyst was shown to not be cost effective for control of 234 tons/yr of CO, it could not be cost effective for control of at most 44 percent of 40 tpy, or 17.6 tpy of VOC, per turbine (cost effectiveness would be $68,200 per ton). This information is shown in Table 4-6. An oxidation catalyst cannot, therefore, be considered to represent VOC BACT for Arlington Valley Energy. The proposed emission rate, based on operational controls only is in the same range as facilities which also employ oxidation catalyst. Therefore, this level of operational control is concluded to represent BACT for Arlington Valley Energy gas turbines.

4.7.3 Duct Burners and Auxiliary Boiler

The duct burners and auxiliary boiler will employ good combustion control for emissions of VOC, with a VOC emission rate of 0.016 lb/MMBtu, or less. The use of natural gas and good combustion control represent BACT for VOC from the duct burners and auxiliary boiler.

4.7.4 Diesel Fire-Water Pump

Add on control technology is not available for control of VOC emissions from diesel engines which operate less than 500 hours/yr. Good combustion control practices, therefore represent BACT for VOC from the Arlington Valley Energy diesel engine.

Table 4-6
Oxidation Catalyst for VOC Control

Control Efficiency (%)	44

Facility Input Data

Item	Value
Operating Schedule	
Shifts per day	3
Hours per day	24
Days per week	7
Hours per year	8,760
Source(s) Controlled	Power Block, ~ 290 MW @ Average Ambient Conditions
Power Output of Turbine (CTG Only) (kW)	170,405
Power Output CTG & Unfired HRSG (kW)	252,830
Power Output CTG & Fired HRSG (kW)	289,575
Estimated Total Flowrate (acfm)	885,525
Estimated Temperature (F)	187
Total Flowrate (scfm)	722,654
CO From Source(s) (lb/hr)	9
CO From Source(s) (tpy)	40
Site Specific Enclosure (Building) Cost	NA
Site Specific Electricity Value (Base Load) ($/kWh)	0.035
Site Specific Electricity Value (Peak Load) ($/kWh)	0.065
Site Specific Operating Cost ($/kWh)	0.010
Site Specific Operating Labor Cost ($/hr)	35
Site Specific Maint. Labor Cost ($/hr)	35

Capital Costs

	Value	Basis
Direct Costs		
1.) Purchased Equipment Cost		
a.) Equipment cost + auxiliaries	$1,288,522	Engelhard quote plus auxiliaries, A
b.) Instrumentation	$128,900	0.10 x A
c.) Sales taxes	$64,400	0.05 x A
d.) Freight	$64,400	0.05 x A
Total Purchased equipment cost, (PEC)	$1,546,222	B = 1.22 x A
2.) Direct installation costs		
a.) Foundations and supports	$123,700	0.08 x B
b.) Handling and erection	$216,500	0.14 x B
c.) Electrical	$61,800	0.04 x B
d.) Piping	$30,900	0.02 x B
e.) Insulation for ductwork	$15,500	0.01 x B
f.) Painting	$15,500	0.01 x B
Total direct installation cost	$463,900	0.30 x B
3.) Site preparation, SP	NA	NA
4.) Enclosure, Bldg.	NA	NA
Total Direct Cost, DC	$2,010,100	1.30B + SP + Bldg.
Indirect Costs (Installation)		
5.) Engineering	$154,600	0.10 x B

Table 4-6 (continued)
Oxidation Catalyst for VOC Control

6.) Construction and field expenses	$77,300	0.05 x B
7.) Contractor fees	$154,600	0.10 x B
8.) Start-up	$30,900	0.02 x B
9.) Performance test	$15,500	0.01 x B
10.) Contingencies	$46,400	0.03 x B
11.) Simple Interest During Construction	$54,117.79	PEC x 7% x 0.5 years
Total Indirect Cost, IC	$533,418	0.31B + Other
Total Capital Investment (TCI) = DC + IC	**$2,543,500**	**1.61B + Bldg. + Other**

Annual Costs

Item	Value	Basis	Source
1) Electricity			
Press. Drop (in. W.C.)	3.0	Pressure drop - catalyst bed with dilution air	Vendor, estimate
Power Output of Turbine (kW)	170,405		Vendor
Power Loss Due to Pressure Drop (%)	0.30%	0.1% for every 1" pressure drop	Vendor
Power Loss Due to Pressure Drop (kW)	511		
Unit Cost ($/kWh)	$0.035	Estimated Market Value	Estimate
Cost of Heat Rate Loss ($/yr)	$156,740		
Total Cost ($/yr)	$156,740		
2) Operating Labor			
CO Catalyst Requirement (hr/yr)	1095	8,760 operating hours per year	Estimate
Catalyst Cleaning (hr/yr)	80.0	2 workers x 40 hours per year	
Unit Cost ($/hr)	$35.00	Facility Data	Estimate
Cost ($/yr)	$41,125		
3) Supervisory Labor			
Cost ($/yr)	$6,170	15% Operating Labor	OAQPS
4) Maintenance			
CO Catalyst Labor Req. (hr/yr)	547.5	1/2 hour per shift	OAQPS
Catalyst Replacement Labor Req. (hr/yr)	106.7	8 workers for 40 hours every 3 yrs	Estimate
Unit Cost ($/hr)	$35.00	Facility Data	Estimate
Labor Cost ($/yr)	$22,896		
Material Cost ($/yr)	$22,900	100% of Maintenance Labor	OAQPS
Total Cost ($/yr)	$45,800		
5) Catalyst Replacement			
Catalyst Cost ($)	$710,373	Catalyst modules	Vendor
Catalyst Disposal Cost ($)	$50,000	Disposal of catalyst modules	Estimate
Sales Tax ($)	$38,019	5% Sales Tax	as of 1/1/99
Power Output of CTG & Unfired HRSG (kW)	252,830		
Power Output of Fired HRSG (Peak) (kW)	36,745		
Base Load Power Loss During Replacement (kWh)	18,203,760	3 days shut down every three years	
Peak Load Power Loss During Replacement (kWh)	2,645,604		
Cost of Energy Loss During Catalyst Replacement ($)	$600,602		
Catalyst Life (yrs)	3	n	OAQPS
Interest Rate (%)	7	i	
CRF	0.38	Amortization of Catalyst	OAQPS
Annual Cost ($/yr)	$533,090	(Volume)(Unit Cost)(CRF)	

TABLE 4-6 (continued)
Oxidation Catalyst for VOC Control

7) Indirect Annual Costs			
Overhead	$55,860	60% of O&M Costs	OAQPS
Administration	$50,870	2% of Total Capital Investment	OAQPS
Property Tax	$25,440	1% of Total Capital Investment	OAQPS
Insurance	$25,440	1% of Total Capital Investment	OAQPS
Capital Life (yrs)	10	n	
Interest Rate (%)	7	I	
CRF	0.14	Amortization of Capital Costs	
Capital Recovery	$261,000	(Capital Cost)(CRF)	OAQPS
Total Indirect ($/yr)	$418,610		
Total Annualized Cost ($/yr)	**$1,201,500**		
Total VOC Controlled (tpy)	**17.6**		
Cost Effectiveness ($/ton)	**$68,200**		

4.8 Summary and Conclusions

A summary of technologies determined to represent BACT for Arlington Valley Energy is presented in Table 4-7. Potential annual emissions for operation of this facility are summarized in Table 3-6, based on combustion turbine operation at 100 percent load for 8,760 hours per year (including duct burners), maximum start-up emissions, and application of BACT as determined in this analysis.

Table 4-9 provides potential manufacturer's information on the proposed control equipment. This information is required by the MCESD completeness checklist.

Table 4-7
Summary of Selected BACT for Arlington Valley Energy

	Control Technology			
Pollutant	**Gas Turbine with Duct Burner**	**Cooling Tower**	**Auxiliary Boiler**	**Diesel Engine**
NO_x	GE Dry low-NO_x comb. and SCR (3 ppmd, 15% O_2, 3-hr average)	NA	Good combustion control (0.05 lb/MMBtu)	Good combustion control (14 gm/bhp-hr)
CO	Dry low-NO_x comb. (20 ppm, 15% O_2, 24-hr average)	NA	Good combustion control (0.037 lb/MMBtu)	Good combustion control (3 gm/bhp-hr)
VOC	Good combustion control (1.4 ppm, 15% O_2)	NA	Good combustion control (0.016 lb/MMBtu)	Good combustion control (1.1gm/bhp-hr)
PM_{10}	Good combustion control; low ash fuel (32 lbs/hr)	Drift Eliminator (0.003%)	Good combustion control; low ash fuel (0.01 lb/MMBtu)	Good combustion control (less than 30% opacity)
SO_2	Low sulfur fuel; natural gas (4 lbs/hr)	NA	Low sulfur fuel; natural gas (0.001 lb/MMBtu)	Good combustion control; 0.05% sulfur diesel

Table 4-8
Control Equipment Summary for Arlington Valley Energy

Equipment	Manufacturer[1]	Model	Serial Number	Control Efficiency
Selective Catalytic Reduction	Peerless Mfg. Co.	TBD	TBD	NO_x to 3 ppm
Drift Eliminator	GEA	10 cell	TBD	0.003%

TBD – to be determined
[1] Preliminary Information, subject to change

5.0 APPLICABLE REQUIRMENTS

This section presents a review of the applicable requirements that will govern operation of Arlington Valley Energy. Federal, State and Local air quality regulations were reviewed for applicability to the proposed project. For the MCESD regulations, both the State Implementation Plan (SIP) approved versions and the current versions of the regulations are discussed, since only the SIP-approved rules are federally enforceable.

The applicability tables show regulations determined to be applicable to this facility. In general, the regulations are listed hierarchically, that is, the regulation citation listed in the applicable requirements also determine that all of the subsections are also applicable. Each table also shows the current Federal or State enforceability status for each of the applicable regulations and an indication whether the rule contains administrative (A) or substantive (S) compliance requirements. The regulations that are coded "administrative" have only procedural requirements, such as definitions and permitting; specify a design characteristic, such as a pollution control efficiency or equipment configuration; or are one-time submittals, such as notifications. These types of requirements do not necessitate a plan for on-going demonstration of compliance. Those regulations which contain requirements for which ongoing compliance must be demonstrated have been coded as "substantive" and are included in the compliance plan in Section 5.6.

5.1 Federal Regulatory Review

The Federal regulatory programs, as administered by the United States Environmental Protection Agency (EPA), have been developed under the authority of the Clean Air Act (CAA) and its amendments. The following subsections review the key elements of the federal regulatory program, and the impact they have on the permitting and operation of the proposed project. Attention is placed on Prevention of Significant Deterioration (PSD) (40 CFR 52.21), New Source Performance Standards (NSPS) (40 CFR 60), the Title IV Acid Rain Program and the Title V Operating Permits Program (40 CFR 70). All of these federal programs have been adopted by Maricopa County. The County has adopted its own regulations to implement the Title V and PSD programs. EPA has approved the County's Title V program [61 Fed. Reg. 55910 (1996]. EPA has not approved the County's PSD regulations but has delegated authority to the County to administer the PSD program at 40 CFR § 52.21 [59 Fed. Reg. 1730 (1994)]. The County has incorporated EPA's NSPS, NESHAP and Acid Rain rules by reference and has received delegation to administer the NSPS and NESHAP from EPA [54 Fed. Reg. 18495 (1989)]. A summary of the federal requirements applicable to Arlington Valley Energy is shown in Table 5-1. In some cases, only the applicable subsections are shown to distinguish which parts of the regulation are relevant.

Table 5-1
Federal Applicable Requirements

Regulatory Requirements		Enforce[1]	Type[2]
Citation	**Summary**		
40 CFR Subparts	***Description or Title of Subpart or Section***		
52.21	**Prevention of Significant Deterioration**	F	A
60	**New Source Performance Standards**	F	A
Subpart A	General Provisions		
60.7(a)	Notifications - Construction Start-Up, Modification, Performance Testing	F	S
60.8	Performance Testing	F	S
60.11(b), (c), (e)	Compliance with Standards and Maintenance Requirements – Opacity	F	S
60.13	Monitoring Requirements	F	S
60.14, 60.15	Modification and Reconstruction	F	S
60.18	General Control Requirements	F	S
60.19	General notification and reporting requirements	F	S
Subpart Db	Standards of Performance for Industrial-Commercial-Institutional Steam Generating Units	F	S
60.49b(d)	Reporting and recordkeeping requirements	F	S
Subpart Dc	Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units	F	S
60.48c(g)	Reporting and recordkeeping requirements	F	S
Subpart GG	Standards of Performance for Stationary Gas Turbines	F	S
60.330	Applicability and Designation of affected facility	F	S
60.332	Standard for Nitrogen Oxides	F	S
60.333	Standard for Sulfur Dioxide	F	S
60.334	Monitoring of Operations	F	S
60.335	Test Methods and Procedures	F	S
68	**Chemical Accident Prevention Provisions**	F	A
70[3]	**Title V Permit Requirements**	F	A
72	**Permits Regulation**		
Subpart A	Acid Rain Program General Provisions	F	S
72.9	Standard Requirements	F	S
(a)	Permit Requirements	F	S
(b)	Monitoring Requirements	F	S
(c)	Sulfur dioxide Requirements	F	S
(e)	Excess emissions requirement	F	S
(f)	Recordkeeping and reporting requirements	F	S
(g)(4)	Acid Rain Program requirements	F	S
Subpart B	Designated Representative	F	S
72.20	Authorizations and responsibilities of the designated representative	F	A
72.21	Submissions	F	S

Table 5-1
Federal Applicable Requirements

Regulatory Requirements		Enforce[1]	Type[2]
Citation	**Summary**		
40 CFR Subparts	***Description or Title of Subpart or Section***		
72.22	Alternate designated representative	F	A
72.23	Changing the designated representative	F	A
72.24	Certificate of Representation	F	S
Subpart C	Acid Rain Permit Applications	F	S
72.30	Requirements to apply	F	S
(a)	Duty to reapply	F	S
(b)(2)(ii)	Deadlines for Phase II - New Units	F	S
(c)	Duty to reapply	F	S
(d)	Original and three copies shall be submitted	F	A
72.31	Information requirements for Acid Rain permit applications	F	A
(a)	Identification of the affected source	F	S
(b)	Identification of each Phase II unit at the source for which the permit application is submitted for Phase II	F	S
(c)	complete compliance plan for each unit	F	S
(d)	Standard requirements under 40 CFR 72.9	F	S
72.32	Permit application shield and binding effect of permit application	F	S
Subpart D	Acid Rain Compliance Plan and Compliance Options	F	S
72.40	General	F	S
(a)(1)	Compliance plan for sulfur dioxide emissions	F	S
Subpart E	Acid Rain Permit Contents	F	S
72.50	General	F	S
Subpart F	Federal Acid Rain Permit Issuance Procedures	F	A
72.61	Completeness	F	A
(b)(2)(i)	Submit supplemental information within 30 days	F	A
Subpart H	Permit Revisions	F	A
72.80	General	F	A
72.81	Permit Modifications	F	A
72.83	Administrative Permit Amendment	F	A
Subpart I	Compliance Certification	F	S
72.90	Annual compliance certification report	F	S
72.95	Allowance deduction formula	F	S
Appendix A	Methodology for Annualization of Emission Limits	F	S
Appendix B	Methodology for Conversion of Emission Limits	F	S
Appendix C	Actual 1985 Yearly SO_2 Emissions Calculation	F	S
Appendix D	Calculation of Potential Electric Output Capacity	F	S
73	**Sulfur Dioxide Allowance System**	F	A

Table 5-1
Federal Applicable Requirements

Regulatory Requirements		Enforce[1]	Type[2]
Citation	**Summary**		
40 CFR Subparts	***Description or Title of Subpart or Section***		
73.13	Procedures for Submittals	F	A
(a), (b)	All submittals under this subpart made by Designated Representative to Administrator at address listed	F	A
73.33	Authorized Account Representative	F	A
(a)	All account matters must be undertaken by the account representative	F	A
73.50	Scope and Submission of Transfers	F	A
(b)	Submission of Allowance Transfer Form by authorized account representative	F	A
73.70	Auctions	F	A
(c)	Offer of allowances for sale at auction by authorized account representative	F	A
75	**Continuous Emission Monitoring**	F	A
Subpart A	General	F	A
75.2	Applicability	F	A
(a)	Affected Units	F	A
75.4	Compliance Dates	F	A
75.5	Prohibitions	F	A
Subpart B	Monitoring Provisions	F	S
75.10	General operating requirements.	F	S
75.11(d)(2)	Specific provisions for monitoring SO2 emissions (SO2 and flow monitors).	F	S
75.12	Specific provisions for monitoring NOx emissions (NOx and diluent gas monitors).	F	S
75.13(b)	Specific provisions for monitoring CO2 emissions.	F	S
Subpart C	Operation and Maintenance Requirements	F	A
75.20	Certification and recertification procedures.	F	S
75.21	Quality assurance and quality control requirements.	F	S
75.22	Reference test methods.	F	A
Subpart D	Missing Data Substitution Procedures	F	A
75.30	General provisions.	F	A
75.31	Initial missing data procedures.	F	A
75.32	Determination of monitor data availability for standard missing data procedures.	F	A
75.33	Standard missing data procedures.	F	A
75.34	Units with add-on emission controls.	F	A
75.35	Missing data procedures for CO_2 data.	F	A

Table 5-1
Federal Applicable Requirements

Regulatory Requirements		Enforce[1]	Type[2]
Citation	**Summary**		
40 CFR Subparts	***Description or Title of Subpart or Section***		
75.36	Missing data procedures for heat input.	F	A
Subpart E	Alternative Monitoring Systems	F	A
75.40	General demonstration requirements.	F	A
75.41	Precision criteria	F	A
75.42	Reliability criteria	F	A
75.43	Accessibility criteria	F	A
75.44	Timeliness criteria	F	A
75.45	Daily quality assurance criteria	F	A
75.46	Missing data substitution criteria	F	A
75.47	Criteria for a class of affected units	F	A
75.48	Petition for an alternative monitoring system	F	A
Subpart F	Recordkeeping Requirements	F	A
75.53	Monitoring plan	F	A
75.54	General recordkeeping provisions	F	A
75.55	General recordkeeping provisions for specific situations	F	S
Subpart G	Reporting Requirements	F	S
75.60	General provisions	F	S
75.61	Notifications	F	S
75.62	Monitoring plan	F	S
75.63	Initial certification or recertification application	F	S
75.64	Quarterly reports	F	S
Appendix A through J	Appendices to Part 75	F	S
82	**Protection of Stratospheric Ozone**	F	S
Subpart F	Recycling and Emissions Reduction	F	S
82.154	Prohibitions	F	S
82.156	Required practices	F	S
82.158	Standards for recycling and recovery equipment	F	S

[1] F= Federal Enforceability S= County/State only enforceability. Maricopa County has independent statutory authority to administer its air quality programs.
[2] A= Administrative; S = Substantive Requirements
[3] Part 70 sets forth the requirements for state and local Title V programs and is not independently enforceable against permitted sources. Rather, MCESD's approved Title V rules at MCAPCR 220 constitute the enforceable Title V program and Maricopa County
Note: For each Part, Subpart or Section reference listed, all subsequent subsections are assumed to be applicable. All other subparts or sections not listed are not applicable to this permit application.

5.1.1 Prevention of Significant Deterioration of Air Quality

The determination of whether PSD regulations are applicable is based on the attainment status of the area and the type and quantity of PSD-regulated pollutants that will be emitted. Since the area within Maricopa County where the proposed project will be located is designated as attainment or unclassifiable for all criteria pollutants (see Figure 1-1), PSD review will apply as discussed below.

For PSD purposes, a major stationary source is defined as either one of the sources identified in 40 CFR 52.21 and which has a potential to emit 100 tons or more per year of any regulated pollutant, or any other stationary source (not specifically identified in 40 CFR 52.21) which has the potential to emit 250 tons or more per year of a regulated pollutant. "Potential to emit (PTE)" has a special meaning here as it is determined on an annual basis after the application of air pollution control equipment, or any other federally enforceable restriction. Once it is determined that the emissions from the facility of a pollutant exceeds the PSD major source threshold, additional pollutants will be subject to PSD Review if their PTE exceeds the PSD Significant Emission Rates listed in Table 5-2.

By this definition, and based on the emissions presented in Section 3, the Duke Arlington Valley Energy project will constitute a major stationary source as it falls within one of the 28 named source categories and will emit more than 100 tpy of at least one regulated pollutant, i.e., NO_x, PM_{10}, and CO. In addition, emissions of VOC will be greater than the applicable significance thresholds shown in Table 5-2. Therefore, the project is subject to PSD pre-construction permitting review in addition to any other federal or state requirements. The various requirements of the PSD program are addressed in this application.

Table 5-2
PSD Significant Emission Rates

Pollutant	Emission Rate (tons per year)
Carbon monoxide	100
Nitrogen oxides	40
Sulfur dioxide	40
Particulate Matter	25
Fine particulate matter (PM_{10})	15
Ozone	40 (as VOCs)
Lead	0.6
Fluorides	3
Sulfuric acid mist	7
Total reduced sulfur	10
Source: 40CFR 52.21	

5.1.2 New Source Performance Standards (NSPS)

The regulation of new sources, through the development of standards applicable to a specific category of sources, was a significant step taken by the 1970 CAA Amendments (P.L. 91-604). The Administrator was directed to prepare and publish a list of stationary source categories which, in the Administrator's judgement, cause or contribute significantly to air pollution and which may reasonably be anticipated to endanger public health. Further, the Administrator was to publish a proposed regulation establishing a Standard of Performance for any new source which fell into that category. The significant feature of the law is that it applies to all sources within a given category, regardless of its geographic location or the ambient air quality at that location. The standards define emission limitations that would be applicable to a particular source group.

The only NSPS determined to be applicable to emission units at the proposed facility are Subparts A, Db, Dc and GG. Subpart GG applies to gas turbines and includes emissions standards for NO_x and SO_2. However, since the proposed turbines will be gas-fired, and due to the stringent BACT requirements, emissions limits for this facility will be significantly lower that the Subpart GG standards. Arlington Valley Energy will comply with emissions monitoring and other NSPS Subpart GG requirements.

Subpart Db applies to the duct burner portions of both gas turbines, which meet the definition of steam generating units firing more than one hundred (100) million British thermal units per hour. However, since the duct burners exclusively fire natural gas fuel, Arlington Valley Energy will only be subject to the subpart's recordkeeping and reporting requirements under 40 CFR 60.49b(d).

The Arlington Valley Energy auxiliary boiler was reviewed for applicability of NSPS Subpart Dc. However, the emissions standards of this NSPS are limited to those units within the size range defined in 40 CFR 60.40c(a) that are fired by coal, wood or oils and any mixture or combination of these fuels. The combustion units proposed in this application will burn only pipeline quality natural gas as mentioned previously. Consequently, the auxiliary boiler will only be subject to the subpart's recordkeeping and reporting requirements of 40 CFR 60.487c(a),(g).

Subpart Kb was reviewed with respect to the expected installation and operation of the diesel fuel tank and acid tanks. However, this Subpart only applies to storage vessels of organic liquids with a capacity greater than or equal to 40 m^3 or ~10,500 gallons (40 CFR 60.110b (a)). The maximum capacity of any of the planned storage vessels that will contain a volatile organic liquid (i.e., diesel) is less than 10,000 gallons; therefore, Subpart Kb is not an applicable requirement.

5.1.3 National Emission Standards for Hazardous Air Pollutants (NESHAP)

National Emission Standards for Hazardous Air Pollutants contain emissions standards related to hazardous air pollutants (HAP) for both new and existing sources. NESHAP promulgated before the CAA Amendments of 1990 are contained in 40 CFR 61, and are generally focused on a

specific pollutant, e.g., asbestos. The 1990 CAA Amendments greatly changed the way NESHAP were adopted, and these NESHAP generally focus on source categories. Post-1990 NESHAP are found in 40 CFR 63 and are known as Maximum Achievable Control Technology (MACT) Standards.

A MACT standard for gas turbines is scheduled to be developed by November 2000. Since a MACT standard is expected but not yet promulgated, the facility could be subject to "case-by-case MACT" under Section 112(g) of the CAA. This requirement only applies to major sources of HAP (40 CFR 60.40(b)). As shown in Section 3, the facility is not a major source of HAP, and hence case-by-case MACT does not apply. Therefore, there are currently no NESHAP (40 CFR 61 or 40 CFR 63) applicable to the proposed facility.

5.1.4 Title IV Acid Rain Provisions

Acid Rain provisions adopted as part of the 1990 Clean Air Act Amendments are primarily designed to control SO_2 and NO_x emissions that could form acid rain from fossil fuel fired combustion devices in the electricity generating industry. In an effort to accomplish this goal, an Acid Rain permitting program was established to mandate fuel based control, monitoring, recordkeeping, and reporting requirements.

The proposed facility combustion turbines are fossil fuel fired combustion devices used to generate electricity for sale and exceed the twenty-five (25) MW new Acid Rain unit exemption. Therefore, both proposed gas turbines meet the definition of an affected Phase II "utility unit" under the Acid Rain Deposition Control Program pursuant to Title IV of the CAA Amendments of 1990.

This will require the proposed facility to apply for a Title IV permit. An Acid Rain Permit application must include a compliance plan, the date that the unit will commence operation and a deadline for monitoring certification. Regulatory provisions specify that the Acid Rain Permit application should be submitted twenty-four (24) months before the start of operation. Duke Energy Maricopa, LLC intends to submit such an application by this deadline.

The Title IV permit will require that the facility evaluate allowances for emissions of SO_2 and conduct emissions monitoring for CO_2 and NO_x pursuant to the requirements in 40 CFR Parts 72, 73, and 75. Additional Acid Rain Permit controls will not be necessary to meet regulatory requirements, since the exclusive firing of natural gas will result in sufficiently reduced turbine emission levels.

Duke Energy Maricopa, LLC will be in compliance and will maintain compliance with all applicable provisions of the Title IV Acid Rain rules as adopted under Maricopa County's Rule 371. The

facility will also continue to meet all applicable acid rain requirements that become effective after the issuance of the facility's acid rain permit.

A Title IV Acid Rain compliance plan will be submitted with the acid rain permit application as required under 40 CFR 72. The plan will include the installation, proper operation and maintenance of continuous monitoring systems for NO_x and CO_2 (as the units will be fired with only natural gas, they are exempt from continuous monitoring of SO_2 and opacity). Depending on the monitoring technology available at the time of installation, the plan will cite the specific operating practices and maintenance programs that will be applied to the instruments. The plan will also cite the specific form of records that will be maintained, their availability for inspection, and the length of time that they will be archived. The plan will cite that the acid rain permit and applicable regulations will be reviewed at specific intervals for continued compliance and specific mechanism that will be used to keep current on rule applicability. The acid rain permit will be renewed prior to its expiration.

5.1.5 Title V Operating Permit Program

In 1990, Congress passed the 1990 CAA Amendments, which in part required EPA to develop and promulgate an operating permit program that meets federal standards. The section of the 1990 CAA Amendments, for which the operating permit program requirement is established, is Title V. On July 21, 1992, EPA issued a regulation outlining the specific minimum requirements that states must meet in their operating permits program. This regulation is codified in 40 CFR Part 70 (Part 70). The function of Title V permit and the Part 70 regulations are to assemble all applicable requirements for a source in a single operating permit.

State and local agencies were required to submit programs to EPA by November 15, 1993. EPA's operating permits regulation requires states to develop comprehensive operating permit programs that cover "major" sources of air pollution. State programs that "substantially" met the regulatory requirements may be granted interim approval for up to two years (now extended) by EPA. The State of Arizona, as well as the three local air pollution control agencies (including Maricopa County), submitted their programs in November of 1993 and received EPA interim approval on October 30, 1996.

Arlington Valley Energy is subject to Title V because it is defined as a major source as defined in both 40 CFR 70.2 and the Maricopa County Title V Permit Provision (Regulation II, Rule 210). By virtue of this Title V application and its contents and supporting documents (i.e., applicable requirements, emissions, certification statement, compliance plan and insignificant sources, etc.), compliance with 40 CFR 70 and the applicable subparts are met.

5.1.6 Accidental Release Provisions under the Clean Air Act Section 112(r)

Title III of the CAA Amendments of 1990 contained requirements for subject facilities, i.e., those facilities which used listed hazardous chemicals and materials, to prepare Risk Management

Plans (RMP). These requirements are contained in Section 112(r) of the CAA and codified in 40 CFR 68. These requirements are meant to identify, prevent and minimize the consequences of accidental releases of listed and other extremely hazardous substances. Ammonia is one of these substances. Since the facility will store ammonia (for the NO_x control SCR system) in amounts above the threshold quantities, the facility will be required to prepare an RMP prior to operation.

5.1.7 Compliance Assurance Monitoring

On October 22, 1997, EPA promulgated the Compliance Assurance Monitoring (CAM) Rule, 40 CFR Part 64, which addresses monitoring for certain emission units at major sources, thereby assuring that facility owners and operators conduct effective monitoring of their air pollution control equipment. In order to be subject to CAM, the following criteria must be met:

- The unit is subject to an emissions limitation or standard for the pollutant of concern
- A "active" control device is used to achieve compliance with the emission limit
- The emission unit's pre-control potential to emit is greater than the applicable major source threshold

The CAM rule does not apply to facilities that are subject to Sections 111 (NSPS) or 112 (NESHAP) of the CAA issued after November 15, 1990; or those sources subject to the acid rain program and emissions trading programs. The only emissions units at Arlington Valley Energy that could potentially be subject to the CAM Rule are the turbines/duct burners, which are controlled by SCR for NO_x, and the cooling tower, which is controlled for PM_{10} by drift eliminators. However, NOx emissions from the combustion turbine units are subject to monitoring under the acid rain program required by Title IV of the CAA Amendments of 1990. The facility will comply with the monitoring, recordkeeping and reporting requirements within 40 CFR 75, so is exempt from CAM for the combustion turbines. In the case of the cooling towers, drift eliminators do not require continual adjustments, and hence would be classified as a "passive" rather than active control device. Therefore, this unit would not meet the applicability criteria of CAM.

5.2 State Applicability Discussion

In general, the MCESD retains jurisdiction within the county with full delegation from the ADEQ/EPA to enforce the air quality programs under the CAA. Discussion with Mr. Dale Lieb of the MCESD confirms that there are "pass through" ADEQ regulations that could apply to the proposed facility. This is mainly based on the fact that MCESD does not have an adopted fossil-fuel fired generator/turbine rule that is as strict or stricter than the SIP-approved State rule. Therefore, in this case, the only applicable State requirement is as follows:

Arizona Administrative Code [Applicable in Maricopa County through the operation of ARS § 49-106].

R9-3-524.C.1 For fossil-fuel fired industrial and commercial equipment (auxiliary boilers) with a heat input rate of 4200 million Btu per hour or less, the maximum allowable particulate emissions rate in pounds-mass per hour is (E) = 1.02 $Q^{0.769}$ where Q = heat input in million Btu per hour.

The boiler will emit less than the maximum 10.99 lbs of particulate emissions per hour required by this regulation.

5.3 Maricopa County Applicability Discussion

A facility subject to Title V of the CAA Amendments of 1990 must identify all federally enforceable applicable requirements in its application. These requirements include state and local regulations that have been approved by the EPA in the State Implementation Plan (SIP), as well as federal regulations. In Maricopa County, the SIP approved regulations include previously adopted rules and regulations that entail a different numbering scheme than the current Maricopa County Air Pollution Control Regulations (MCAPCR). Although the regulations that are approved into the SIP have generally been replaced by the current adopted rules and regulations, only the SIP-approved versions are considered "federally-enforceable". MCESD's policy is that a Title V application should include listings of both the applicable SIP requirements and the current MCAPCR. Therefore, this application lists all applicable rules, including those that are administrative in nature.

The MCESD has incorporated the federal PSD, NSPS, NESHAP, Acid Rain and Title V regulations either by incorporation by reference or have adopted a rule that incorporates the elements of the federal program into their local rules. MCESD has received full delegation from EPA and authority under AR-S-49-402 to enforce the air quality programs under the CAA, so their regulations are federally enforceable.

These Maricopa County requirements are listed in Tables 5-3 and 5-4. Table 5-3 identifies the SIP-approved applicable requirements. Table 5-4 identifies the current MCAPCR regulations. It is unknown when the EPA will approve the current regulations into the SIP.

Table 5-3
Maricopa County – State Implementation Plan Applicable Requirements

Regulatory Requirements		Enforce[1]	Type[2]
Citation	**Summary**		
Regulation I	**General Provisions**		
Rule 3	Air Pollution Prohibited	F	A
Regulation II	**Permits**		
Rule 220	Permits to Operate	F	A
§301	Permit Requirements	F	A
§401	Application Procedures for Permits to Operate	F	A
§410	Fees Required	F	A
Rule 21	Permit Conditions	F	A
A.	Form and content of permit applications	F	A
Rule 22	Permit-Denial-Action–Transfer-Posting-Revocation-Compliance-Expiration	F	A
D.	Permit-Denial-Action–Transfer-Posting-Revocation-Compliance-Expiration	F	A
F.	Permit Non-Transferable	F	A
Rule 25	Posting of Permit	F	A
Rule 26	Emissions Test Methods and Procedures	F	A
Rule 28	Air Quality Models	F	A
Regulation III	**Control of Air Contaminants**	F	A
Rule 30	Visible Emissions – Opacity < 40% as determined by reference method 9.	F	S
Rule 31	Emissions of Particulate Matter	F	S
A.	Non-Point Sources of Particulate Matter	F	S
1.	Open Areas – Take reasonable measures to prevent excessive amounts of particulate matter from becoming airborne.	F	S
2.	Parking lots – Take all effective measures to prevent excessive amounts of dust from becoming airborne.	F	S
3.	Disturbed soil surfaces – Do not disturb or place soil on any area greater than 5 acres and permit fragile soil conditions to remain vacant for more than 6 months or leave an open area vacant for more than 24 months without taking reasonable and semi-permanent precautions to prevent excessive amounts of fugitive dust from becoming airborne.	F	S
4.	Storage Piles – Do not allow dust-producing material to be stored without taking reasonable precautions to prevent excessive amounts of particulate matter from becoming airborne.	F	S
6.	Roadways and Streets – Take reasonable precautions to prevent excessive amounts of particulate matter from becoming airborne when using, repairing or constructing any roadway or when transporting materials likely to give rise to airborne dust remove material deposited by trucking and earth-moving equipment on paved streets.	F	S
7.	Material Handling and Practices – Do not conduct sandblasting or other abrading operations, or conduct other operations which may cause airborne dust, without taking reasonable precautions to prevent excessive amounts of particulate matter from becoming airborne.	F	S
H.	Fuel Burning	F	S
1.a	For equipment having a heat input rate of 4200 million BTU per hour or less, the maximum allowable particulate emissions rate in pounds-mass per hour (E) =	F	S

Table 5-3
Maricopa County – State Implementation Plan Applicable Requirements

Regulatory Requirements		Enforce[1]	Type[2]
Citation	Summary		
	1.02Q0.769 where: Q = Heat input in million BTU per hour.		
Rule 300	Visible Emissions	F	S
Rule 310	Open Fugitive Dust Sources [Approved 4/10/95]	F	S
§301	Limitation – Opacity: Opacity from sources of fugitive dust must not exceed 20% or any other stricter limitation imposed by country, state or federal regulations.	F	S
§302	Dust Generating Operations Permits Required	F	S
§303	Control Plan Required With Permit Application	F	S
§304	Control Plan Revision	F	S
§305	Vehicle Use in Open Areas and Vacant Parcels – Do not allow motor vehicles to drive on open areas without first implementing RACM.	F	S
§306	Unpaved Parking Areas/Staging Areas – Do not use unpaved area larger than 5,000 square feet for parking, storing, servicing or dispatching motor vehicles without first implementing RACM.	F	S
§307	Unpaved Haul/Access Roads – Do not allow use of unpaved road more than 100 feet in length unless no more than 20 vehicular trips per day and speed does not exceed 15 mph. Alternatively, effectively treat and maintain road with dust suppressant or gravel.	F	S
§308	Disturbed Surface Areas – Do not disturb soil without implementing RACM. Within 8 months of terminating dust generating operations, stabilize disturbed area with permanent RACM.	F	S
§309	Vacant Areas – Do not leave open area vacant for more than 15 days without implementing RACM. Within 8 months implement permanent RACM.	F	S
§310	Material Handling – No material handling without implementing RACM.	F	S
§311	Material Transport – Do not transport bulk materials without implementing RACM. Remove particulate matter from the exterior surface of equipment and deposited on paved roads using RACM. Remove deposits of bulk materials from vehicles onto roads within 6 hours of occurrence.	F	S
§311.2	Haul Trucks – Standards	F	S
§312	Roadways, Streets and Alleys – Do not use, repair or construct a roadway without implementing RACM.	F	S
§313	Erosion, Sedimentation and Deposition of Bulk Materials Onto Paved Surfaces – Standards for removing deposition of bulk material onto paved roadway, paved parking or paved storage area from adjacent real property.	F	S
§401	Information Required to Be Included in a Control Plan.	F	A
§402	Permit and Control Plan Posting Required.	F	A
§501	Opacity Determination – Use EPA Reference Method 9.	F	S
§502	Wind Speed Determination.	F	S
§503	Recordkeeping – Daily written log of implementation of Control Plan.	F	S
§504	Records Retention – 3 years.	F	S
Rule 32	Odors and Gaseous Emissions	F	S
A.	Emit no gaseous or odorous material from equipment, operations or premises in such quantities or concentrations as to cause air pollution.	F	S

Table 5-3
Maricopa County – State Implementation Plan Applicable Requirements

Regulatory Requirements		Enforce[1]	Type[2]
Citation	Summary		
C.	Materials including, but not limited to, solvents or other volatile compounds, paints, acids, alkalies, pesticides, fertilizer and manure shall be processed, stored, used and transported in such a manner and by such means that they will not unreasonably be discharged into the air so as to contribute to air pollution; install and use available control methods to reduce the contribution to air pollution from evaporation, leakage or discharge.	F	S
E.	Emissions of hydrogen sulfide may not exceed 0.3 ppm by volume for any averaging period of 30 minutes or more at any occupied area beyond the premises on which the source is located.	F	S
F.	Do not emit any sulfur oxide or sulfuric acid resulting in ground level concentrations at any place beyond the premises on which the source is located exceeding regulated thresholds.	F	S
Rule 33	Storage and Handling of Petroleum Products Unless Drybreak Couplings are Used	F	S
1.	Repair visible leaks within 15 days.	F	S
33.3	Loading Into Stationary Storage Containers.	F	S
(B)(2)	Exemption from rule applicability.	F	S
Rule 34	Organic Solvents – Volatile Organic Compounds	F	S
C.	Metal Cleaning Operations.	F	S
1.	Do not engage in any organic solvent metal cleaning or degreasing without conforming to listed operating requirements and affixing a conspicuous label in a permanent locations listing those operating requirements.	F	S
2.a	Requirements for Cold Organic Solvent Cleaning.	F	S
E.	Spray Paint and Other Surface Coating Operations.	F	S
1.	No person shall conduct any spray paint operation except architectural coating without utilizing an enclosed area (3-sided structure with walls a minimum of 8 feet high) designed to contain not less than 96% by weight of the overspray.	F	S
2.	Use no architectural coating containing photochemically reactive solvents.	F	S
G.	Discharge no more than 40 lbs/day of organic material into the atmosphere from any device for employing, applying, evaporating or drying any photochemically reactive solvent.	F	S
K.	Dispose no more than 1-1/2 gallons per day of any photochemically reactive solvent by means which will permit the evaporation of the solvent.	F	S
Rule 300	Visible Emissions	F	S
Rule 335	Architectural Coatings	F	S
§301	Prohibition – Bituminous Pavement Sealers	F	S
§302	Interim Lights – Non-Flat Architectural Coatings.	F	S
§303	Final Limits – Flat Architectural Coatings	F	S
§304	Limits – Flat Architectural Coatings	F	S
§305	Do not apply or sell any architectural coating that exceeds listed limits.	F	S
§306	Exemptions – Specific Use Coatings	F	S
§307	Exemption – Small Containers	F	S
Regulation IV	Production of Records: Monitoring, Testing and Sampling Facilities	F	S
Rule 40	Recordkeeping and Reporting	F	S
Rule 41	Monitoring	F	S
A.	Provide, install, maintain and operate such air contaminant monitoring devices as	F	S

Table 5-3
Maricopa County – State Implementation Plan Applicable Requirements

Regulatory Requirements		Enforce[1]	Type[2]
Citation	Summary		
	are reasonable and required to determine compliance.		
Rule 42	Testing and Sampling	F	S
Rule 43	Right of Inspection	F	S

[1] F= Federal Enforceability S= County/State only enforceability. Maricopa County has independent statutory authority to administer its air quality programs.
[2] A= Administrative; S = Substantive Requirements
Note: For each Part, Subpart or Section reference listed, all subsequent subsections are assumed to be applicable. All other subparts or sections not listed are not applicable to this permit application.

The following is a summary of the more significant Maricopa County requirements and their applicability to Arlington Valley Energy.

Rule 200 - Permits
Describes the permits that are required for construction, operation, or modification of air emission sources. This rule also contains provisions for fees, confidentiality issues and accelerated permitting programs.

Rule 210 - Title V Permit Provisions
Provides for the implementation of the Title V Operating Permit Program. The requirements for the Title V permit application are contained in this submittal.

Rule 240 – New Source Review Provisions
Provides for the implementation of New Source Review (NSR) permitting. The requirements under this rule are contained within this PSD/Title V permit application submittal.

Rule 241 – Maricopa County Control Technology Requirements
Provides for the review of control technology requirements for pollutants not subject to Rule 240 permitting requirements. For Arlington Valley Energy, the only additional applicable pollutant is SO_2. A BACT analysis for SO_2 is included in Section 4.

Rule 245 – Continuous Monitoring Requirements
Provides for continuous monitoring of pollutants from various sources. Although this rule applies to fossil-fuel fired steam generators, sources are exempt if they are subject to NSPS requirements. This rule does not apply as the monitoring requirements for Arlington Valley Energy are contained within the applicable NSPS and Acid Rain monitoring requirements.

Rule 270 – Performance Testing

Establishes the requirements for testing criteria, conditions, and facilities and reporting of performance test results. Continuous emissions monitoring as an alternate method is described in Rule 270. Maricopa County retains the right to require testing in accordance with this rule. Therefore, this rule may be applicable to this facility.

Rule 300 – Opacity

Sets a 20% opacity limit on the visible emissions from any source of air contaminants. Excluded are periods of start-up, shutdown, and unavoidable, temporary operating conditions. This rule also provides provisions for compliance monitoring of opacity and applies to this facility.

Rule 310 – Fugitive Dust

Gives the requirements for the control of fugitive dust sources. A dust control plan will be prepared and submitted per the requirements of this rule prior to the start of construction for this facility.

Rule 311 – Particulate Matter

Sets a particulate matter emissions limit for various process operations. The limit for any fuel burning operation, such as Arlington Valley Energy, is contained in an equation and based on its heat input. The recordkeeping and reporting provisions of this rule require that the facility operator maintain records of the total weight of fuel consumed on a daily basis and maintain these records for at least 3 years.

Rule 320 – Odors and Gaseous Contaminants

This rule sets SO_2 and NO_x limitations for electrical generating plants. However, the SO_2 limit applies only to oil-fired plants and, therefore, does not apply to this facility. The rule sets a limit of 0.2 lb NO_2/MMBTU for a unit that is natural-gas fired and hence will apply to this project. There are no specific monitoring, recordkeeping, or reporting requirements that apply to the facility under this rule.

Rule 360 – New Source Performance Standards

As federal NSPS authority has been delegated to Maricopa County, Rule 360 refers to all federal, applicable NSPS requirements. The combustion turbines are subject to NSPS Subpart GG, the auxiliary boiler is subject to NSPS Subpart Dc, and the duct burners are subject to NSPS Subpart Db.

Rule 370 – Hazardous Air Pollutants

Rule 370 incorporates both the federal (40 CFR 61 and 63) and state (A.R.S. Section 426.06) hazardous air pollutant rules into one area of requirements. This facility is not currently subject to any promulgated NESHAP.

Rule 371 – Acid Rain

Maricopa County has adopted the federal acid rain rules from 40 CFR 72-75 into this rule. As Arlington Valley Energy is an electrical generating facility and is not exempt from the acid rain rules, Section 5.1.4 of this application provides a description of the applicability of this rule to the facility.

Table 5-4
Current Maricopa County Air Pollution Control Regulations

Regulatory Requirements		Enforce[1]	Type[2]	Date Adopted or Amended
Citation	**Summary**			
Regulation I	**General Provisions**			
Rule 100	General Provisions and Definitions	S	A	5/20/98
Rule 110	Violations	S	A	2/15/95
Rule 120	Conditional Orders	S	A	11/15/93
Regulation II	**Permits and Fees**			
Rule 200	Permit Requirements	S	S	5/20/98
Section 301	Permits Required	S	S	
Section 302	Title V Permit	S	S	
Section 305	Earth Moving Permit	S	S	
Section 308	Standards for Applications	S	S	
Section 309	Permit Conditions	S	A	
Section 310	Prohibition - Permit Modification	S	S	
Section 311	Permit Posting Required	S	A	
Section 312.2	Title V Sources with an Installation, Operating, or Conditional Permit	S	S	
Section 313	Accelerated Permitting	S	A	
Section 402	Permit Openings: Revocation and Reissuance; Termination	S	A	
Section 404	Permit Transfers	S	A	
Section 407	Air Quality Impact Models	S	A	
Section 408	Testing Procedures	S	S	
Section 409	Permit Fees	S	A	
Rule 210	Title V Permit Provisions	S	S	5/20/98
Section 301	Permit Application Processing Procedures	S	A	
Section 302	Permit Contents	S	A	
Section 303	Permit Review by the EPA and Affected States	S	A	
Section 304	Emission Standards and Limitations	S	A	
Section 305	Compliance Plan; Certification	S	S	

Table 5-4
Current Maricopa County Air Pollution Control Regulations

Regulatory Requirements		Enforce[1]	Type[2]	Date Adopted or Amended
Citation	Summary			
Section 401	Fees Required	S	A	
Section 402	Permit Term	S	A	
Section 403	Source Changes Allowed Without Permit Revisions	S	A	
Section 404	Administrative Permit Amendments	S	A	
Section 405	Minor Permit Revisions	S	A	
Section 406	Significant Permit Revisions	S	A	
Section 407	Permit Shields	S	A	
Section 408.6	Public Participation	S	A	
Rule 240	Permits for New Major Sources and Major Modifications to Existing Major Sources	S	S	2/15/95
Section 301	Permit or Permit Revision Required	S	A	
Section 302	Application completeness	S	A	
Section 303	Air Impact Analysis for Any Geographical Area	S	A	
Section 308	Permit Requirements for Sources Located in Attainment and Unclassified Areas	S	A	
Section 501	Pollutants to be included in Analysis of Ambient Air Quality	S	A	
Section 508	Visibility and Air Quality Impact Analysis	S	A	
Section 510	Air Quality Models	S	A	
Rule 241	Permits for New Sources and Modifications to Existing Sources	S	S	6/19/96
Section 301	Best Available Control Technology (BACT) Required	S	A	
Section 302	Reasonable Available Control Technology (RACT) Required	S	A	
Section 303	Circumvention	S	A	
Rule 270	Performance Tests	S	S	11/15/93
Section 301.1	Applicable Procedures and Testing Methods	S	S	
Section 301.2	Opacity Determination by Reference Method 9 of the Arizona Testing Manual	S	S	
Section 401	Performance Tests Required	S	A	
Section 402	Testing Criteria	S	A	
Section 403	Testing Conditions	S	A	
Section 404	Notice of Testing	S	A	
Section 405	Testing Facilities Provided	S	A	
Section 406	Minimum Testing Required	S	A	
Section 407	Compliance with the Emission Limits	S	A	
Section 408	Additional Testing	S	A	

Table 5-4
Current Maricopa County Air Pollution Control Regulations

Regulatory Requirements		Enforce[1]	Type[2]	Date Adopted or Amended
Citation	Summary			
Rule 280	Fees	S	A	8/19/98
Section 301	Title V Fees	S	A	
Section 304	Calculation of Emission Fees	S	A	
Section 310	Earth Moving Permit Fee	S	A	
Section 312	Hourly Rate	S	A	
Section 401	Payment of Fees			
Regulation III	**Control of Air Contaminants**			
Rule 300	Visible Emissions	S	A	8/5/94
Section 301	Limitations - Opacity/General: Opacity <20%	S	S	
Section 302	Exceptions	S	S	
Section 501	Compliance Determination – Opacity	S	S	
Section 502	Compliance Determination - Opacity of Visible Emissions from Intermittent Sources	S	S	
Rule 310	Fugitive Dust Sources	S	S	6/16/99
Section 301	Opacity Limitation for Fugitive Dust Sources	S	S	
Section 302	Stabilization Requirements for Fugitive Dust Sources	S	S	
Section 303	Dust Control Plan Requirements	S	S	
Section 304	Elements of a Dust Control Plan	S	S	
Section 305	Dust Control Plan Revision	S	S	
Section 306	Control Measures	S	S	
Section 307	Project Information Sign	S	S	
Section 308	Work Practices	S	S	
Section 401	Dust Control Plan Posting	S	S	
Section 402	Compliance Schedule	S	S	
Section 501	Opacity Observations	S	S	
Section 502	Stabilization Observations	S	S	
Section 503	Wind Gust Determination	S	S	
Section 504	Recordkeeping	S	S	
Section 505	Records Retention	S	S	
Section 506	Test Methods Adopted by Reference	S	S	
Rule 311	Particulate Matter from Process Industries	S	S	8/2/93
Section 304	Limitations – Fuel Burning Equipment	S	S	

Table 5-4
Current Maricopa County Air Pollution Control Regulations

Regulatory Requirements		Enforce[1]	Type[2]	Date Adopted or Amended
Citation	Summary			
Section 502	Recordkeeping and Reporting	S	S	
Section 503	Record Retention	S	A	
Section 504	Test Methods	S	S	
Rule 320	Odors and Gaseous Air Contaminants	S	S	7/13/88
Section 302	Material Containment Required	S	S	
Section 303	Reasonable Stack Height Required	S	S	
Section 308.1	Nitrogen Oxides from Electrical Power Plants – Gaseous Fossil Fuels	S	S	
Section 310	Carbon Monoxide	S	S	
Rule 330	Volatile Organic Compounds	S	S	6/19/96
Section 301	Limitations - Operations Involving Heat	S	S	
Section 302	Limitations - Non Complying Solvents	S	S	
Section 304	Reductions Required	S	S	
Section 305	Equipment Cleanup	S	S	
Section 306	VOC Containment and Disposal	S	S	
Section 501	Providing and maintaining Monitoring Devices	S	S	
Section 502	Determination of Compliance	S	S	
Section 503	Recordkeeping and Reporting	S	S	
Section 504	Test Methods	S	S	
Rule 331	Solvent Cleaning	S	S	4/7/99
Section 301	Solvent Handling Requirements	S	S	
Section 302	Equipment Requirements for all Cleaning Machines	S	S	
Section 303	Specific Operating and Signage Requirements for Cleaning Machines	S	S	
Section 304	Solvent Specifications for Non-Vapor Cleaning and Degreasing	S	S	
Section 305	Non-Vapor Batch Cleaning Machines	S	S	
Section 307	Special-Vapor Cleaning Situations	S	S	
Section 308	Exemptions	S	S	
Section 309	Requirements for Air Pollution Control Equipment and ECS Monitoring Equipment	S	S	
Section 501	Recordkeeping and Reporting	S	S	
Section 502	Compliance Determination and Test Methods	S	S	
Rule 335	Architectural Coatings	S	S	7/13/88
Section 301	Prohibition– Bituminous Pavement Sealers	S	S	

Table 5-4
Current Maricopa County Air Pollution Control Regulations

Regulatory Requirements		Enforce[1]	Type[2]	Date Adopted or Amended
Citation	Summary			
Section 302	Interim Limits - Non-Flat Architectural Coatings	S	S	
Section 303	Final Limits - Non-Flat Architectural Coatings	S	S	
Section 304	Limits - Flat Architectural Coatings	S	S	
Section 305	Limits - Specialty coatings	S	S	
Section 306	Exemptions - Specific-Use Coatings	S	S	
Section 307	Exemptions- Small Containers	S	S	
Rule 360	New Source Performance Standards	S	S	4/7/99
Section 300	Adopted Federal Standards 40 CFR 60 [July 1, 1998]	S	S	
Section 301	Subpart A - General Provisions	S	S	
Section 301	Subpart Db - Standards of Performance for Industrial-Commercial Institutional Steam Generating Units	S	S	
Section 301	Subpart GG - Standard Of Performance For Stationary Gas Turbines	S	S	
Rule 370	Federal Hazardous Air Pollutant Program	S	S	8/19/98
Section 302	Standards of Performance for Federally Listed Hazardous Air Pollutants	S	S	
Section 302.1	Subpart A - General Provisions	S	S	
Section 303	Additional Requirements			
Rule 371	Acid Rain	S	S	4/3/96
Section 301	Incorporates Subparts of the Federal Acid Rain Regulations	S	S	
Section 301.1	Subparts A through I of 40 CFR Part 72 (Permits Regulation) and all accompanying appendices, adopted as of January 1, 1996.	S	S	
Section 301.2	40 CFR Part 74 (Sulfur Dioxide Opt-Ins), 40 CFR Part 75 (Continuous Emission Monitoring), and 40 CFR 76 (Acid Rain Nitrogen Oxides Emission Reduction Program) and all accompanying appendices, adopted as of January 1, 1996.	S	S	
Regulation IV	**The Hearing Board**			
Rule 400	Procedure before the Hearing Board	S	A	11/15/93
Regulation V	**Air Quality Standards and Area Classification**			
Rule 500	Attainment Area Classification	S	A	11/15/93
Rule 510	Air Quality Standards	S	A	7/13/88
Regulation VI	**Emergency Episodes**			
Rule 600	Emergency Episodes	S	A	7/13/88
	Appendices			
Appendix B	Standard Application Form and Filing Instructions	S	A	2/15/95

Table 5-4
Current Maricopa County Air Pollution Control Regulations

Regulatory Requirements		Enforce[1]	Type[2]	Date Adopted or Amended
Citation	Summary			
Appendix C	Describes methods to visually determine opacity of emissions from unpaved roads, unpaved haul/access roads, unpaved parking lots, and sources for time-averaged regulations. Also gives test methods for dust stabilization.	S	A	6/16/99

This MCAPCR Applicable Requirements Table references the most current adopted rule applicable to the project.
[1] F= Federal Enforceability S= County/State only enforceability. Maricopa County has independent statutory authority to administer its air quality programs.
[2] A= Administrative; S = Substantive Requirements
Note: For each Part, Subpart or Section reference listed, all subsequent subsections are assumed to be applicable. All other subparts or sections not listed are not applicable to this permit application..

5.4 Insignificant Activities

Section 70.4(b)(2) requires States to include in their Part 70 programs any criteria used to determine insignificant activities or emission levels for the purposes of determining complete applications. Therefore, a Title V source must, in a permit application, list and generally group its insignificant activities. To comply with this requirement, the Arizona Department of Environmental Quality as has adopted regulations that define insignificant activities. Currently, the MCESD has drafted Appendix D on December 1, 1998 that is patterned on the State of Arizona's adopted rule for insignificant activities. In this case, the adopted rule and proposed draft MCESD Appendix D contains non-quantifiable and quantifiable insignificant activities. Table 5-5 lists those activities that may be found at Arlington Valley Energy and which meet the requirements of the Maricopa County draft list.

5.5 Permit Shield

Any requirement not specifically identified in this application is considered not applicable. Therefore, the applicant requests a permit shield to include all adopted federal, state and Maricopa County regulations not identified as applicable in the tables provided above.

5.6 Compliance Plan

The applicable requirements for the planned Arlington Valley Energy are listed in Sections 5.1 through 5.3 of this permit application. The facility will meet in a timely manner all requirements that become effective once the permit is issued and during the permit term.

Table 5-5
List of Insignificant Activities at Arlington Valley Energy

Building HVAC Exhaust Vents
Turbine Compartment Ventilation Exhaust Vents
Sanitary Sewer Vents
Compressed Air Systems
Turbine Lube Oil Vapor Extractors and Lube Oil Mist Eliminator Vents
Steam Drum Safety Relief Valve Vents
Building Air Conditioning Units
Emergency Diesel Fire Pump
Emergency Diesel Fire Pump Fuel Storage Tank
Various Steam Release Vents
Welding Equipment
Lab Hood Vents
Water Wash System Storage Tank Vents
Neutralization Basin
Sodium Hypochlorite Storage Tank
Hydrazine Storage Tank Vent
Fuel Purge Vents
Condenser Vacuum Pump Vents
Acetylene, Butane and Propane Torches
Landscaping, building maintenance, or janitorial activities
Source: MCESD Draft Appendix D – List of Insignificant Activities – June 17, 1999.

Arlington Valley Energy will employ the compliance demonstration methods set forth in Table 5-6. The performance test methods to be used are shown in Table 5-7.

Table 5-6
Compliance Plan

Applicable Requirement	Applicable Source	Compliance Monitoring Determination Method
42 U.S.C. §7412(r)(7) [CAA §112(r)(7)]	Plant	Review the facility to identify, prevent and minimize the consequences of accidental releases.
40 CFR Part 68	Aqueous Ammonia Storage	Maintain records supporting implementation of the Risk Management Plan once aqueous ammonia or other regulated substances are present onsite above the threshold quantity in a process.
40 CFR Part 60, Subpart A	Gas Turbine Units 1&2	Conduct performance tests and submit the required notifications and documentation and maintain required recordkeeping.
40 CFR Part 60, Subpart Db, Rule 360	Gas Turbine Unit 1&2 Duct Burners	Keep records and report as set forth in Subpart Db.
40 CFR Part 60, Subpart GG, Rule 360	Gas Turbine Units 1&2	Monitor, keep records, and report as set forth in Subpart GG.
40 CFR Part 72 Rule 371	Gas Turbine Units 1&2	Maintain records of Designated Representative Certification and other Part 72 submittals, including a complete Title IV Acid Rain permit application.
40 CFR Part 73	Gas Turbine Units 1&2	Maintain documentation of all Part 73 submittals.
40 CFR Part 75	Gas Turbine Units 1&2	Install, certify, operate and maintain emission monitors and submit reports and keep records as required by Part 75.
40 CFR Part 82	Plant	Comply with 40 CFR §82.156 practices when servicing or disposing of applicable appliances.
Regulation I Rule 100	Plant	Perform requirements listed in this permit application; not circumvent the rules; allow proper inspections; report emergencies in accordance with Rule 100 §501; maintain required records; prepare and submit required emission statements and , annual emissions inventory questionnaires.
Regulation II Rules 200, 210, 240, 271, 280	Plant	Obtain required permits; post and not modify the permit when issued; transfer the permit only as provided in Rule 200 §414; perform modeling and testing as required using applicable procedures in Rule 270; pay applicable fees; make appropriate notifications under Rule 210 §403; and revise permit pursuant to the applicable requirements.
Rule 30 (SIP) Rule 300	Plant	Monitor visible emissions using EPA Ref. Method 9 *[frequency?]*

Table 5-6
Compliance Plan

Applicable Requirement	Applicable Source	Compliance Monitoring Determination Method
Rule 31.A (SIP) Rule 310 (SIP and County)	Open Areas Parking Lots Disturbed Soil Surfaces Storage Piles Roadways and Streets Material Handling Unpaved Haul Access Roads Material Transport	Submit, implement and post a control plan as required in Rule 310 §303 and §401; monitor opacity using EPA Ref. Method 9; maintain a written log of implementation of RACM as required by Rule 310 §503; and maintain records and retain records for three years.
Rule 31.H.1.a (SIP)	Gas Turbine Units 1&2	Perform initial calculation for fuel burning based on AP42 (5th Edition) emission factors. Recalculate when applicable factors change. Track compliance.
Rule 32.A,C,E and F (SIP) Rule 320 §300, §302, and §304	Plant	Contain volatile and other listed materials and employ reasonable available controls to prevent unreasonable discharge into the air; the plant does not emit hydrogen sulfide and only insignificant amount of sulfur oxide; demonstrate compliance with Rule 32.F and Rule 320 §304 by modeling.
Rule 33 (SIP)	Diesel Storage Tanks	Conduct periodic inspections to ensure repair of visible leaks within 15 days as required by Rule 33(1).
Rule 34 E, G, K (SIP) Rule 330	Volatile Organic Compounds	Maintain good operating practices by containing any non-architectural spray painting operation, discharge no more than 40 lbs/day or 1 ½ gallons per day to atmosphere, maintain records and retain for minimum five years as required by Rule 34 and Rule 330 §503.
Rule 34.C (SIP) Rule 331	Solvent Cleaning	Maintain good operating practices, post operating requirements, and maintain records as required by Rule 331 §501.
Rule 335	Architectural Coatings	Restrict use of any prohibited coatings for architectural application.
Rule 40 (SIP)	Gas Turbine Units 1&2	Maintain and retain records and submit required reports.
Rule 41 (SIP)	Gas Turbine Units 1&2	Provide, install, and maintain monitoring devices

Table 5-6
Compliance Plan

Applicable Requirement	Applicable Source	Compliance Monitoring Determination Method
		and associated records as required.
Rule 42 (SIP)	Gas Turbine Units 1&2	Perform all testing and sampling as required by rule.
Rule 43 (SIP)	Gas Turbine Units 1&2	Provide access to emission units as required by rule.

Table 5-7
Performance Test Methods

Pollutant	Performance Test Method
NO_x	Methods 19 and 20
CO	Method 10
PM_{10}	Methods 5 and 202
Opacity	Method 9
SO_2	Gas Supplier S content guarantee
TDS	Monthly conductivity test

6.0 METHODOLOGY FOR AIR DISPERSION MODELING

This Section presents a discussion of the air quality modeling and analysis that was performed for the Arlington Valley Energy project. The procedures used for assessing ambient air quality impacts from the proposed facility emissions, the source data that were modeled, and the standards to which the predicted impacts were compared are discussed. The dispersion modeling analyses conducted for this project adhere to the EPA "Guideline on Air Quality Models" (GAQM), dated 1997 and the Arizona Department of Environmental Quality (ADEQ) PSD Modeling Guidelines (1998) provided by MCESD.

6.1 Background Discussion

This facility will be a new major facility and, as discussed earlier in this document, PSD review will be required for NO_x, CO and PM_{10}. Therefore, modeling analyses were performed to evaluate compliance with applicable PSD increments for these pollutants. In addition, compliance with the National Ambient Air Quality Standards (NAAQS) and Arizona standards and guidelines were also evaluated. Additional PSD requirements such as visibility and growth analyses are also addressed.

Based on current project design, the natural gas-fired combustion turbines, the auxiliary boiler, and the cooling tower are the primary sources of criteria pollutant emissions at this facility. Much smaller quantities of criteria pollutants are emitted from a small emergency diesel fire-water pump. Since it will only be used on an intermittent basis, emissions from this fire-water pump were not included in the air quality impact analyses.

The dispersion modeling for Arlington Valley Energy was conducted in two phases. The first phase included a significant impact analysis for the project and the second phase consisted of a "major source" analysis. The significant impact analysis was preceded by a screening analysis to determine the turbine load producing the worst-case operating parameters for the combustion turbines. Eleven turbine load and temperature scenarios were evaluated. Maximum predicted impacts from these scenarios were compared to the Significant Impact Levels (SILs) listed in Table 6-1. For those pollutants for which maximum predicted impacts were below the applicable SIL based on the screening modeling, no additional analyses were necessary since, by definition, insignificant impacts cannot cause or contribute to a NAAQS violation.

Table 6-1
Criteria Pollutant Significant Impact Levels

Pollutant	Averaging Time				
	Annual	24-hour	8-hour	3-hour	1-hour
SO_2	1 μg/m^3	5 μg/m^3	-	25 μg/m^3	-
PM_{10}	1 μg/m^3	5 μg/m^3	-	-	-
NO_2	1 μg/m^3	-	-	-	-
CO	-	-	500 μg/m^3	-	2000 μg/m^3
Source: 40 CFR 51.165(b)(2); MCAPCR 240.308.1.3(2)					

6.2 Modeling Methodology

All modeling analyses supporting the permitting of Arlington Valley Energy utilized the Industrial Source Complex Short Term 3 (ISCST3) dispersion model, version 99155. The load screening, SIL, NAAQS, and PSD modeling were performed using five years (1994-1998) of on-site meteorological data collected at the nearby Palo Verde Nuclear Generating Station (PVNGS). Although all years were modeled, impacts have only been included in the discussion for the worst-case year. The following sections discuss the methodology used in performing these analyses.

6.2.1 Dispersion Environment

A review of the land use within a 3-kilometer radius of the proposed facility location was performed using the USGS topographic map of the area. In accordance with the Auer land use classification procedure, the dispersion environment within a 3-kilometer radius of the site is predominately rural. Approximately 75 percent of the area within 3-kilometer is undeveloped or low-density residential (rural) and approximately 25 percent is compact residential (urban) or industrial (urban). Therefore, rural dispersion coefficients were selected for the modeling analysis.

6.2.2 Aerodynamic Downwash Analysis

The 1977 CAA Amendments require that the degree of emission limitation required for control of any pollutant not be affected by a stack which exceeds the Good Engineering Practice (GEP) stack height. Further, no dispersion credit is given during air quality modeling for stacks that exceed GEP.

A GEP stack height analysis was performed using EPA's BPIP algorithm (version 95086) to determine the potential for building-induced aerodynamic downwash affecting plume dispersion

from the proposed stacks at the power generating facility. Specifically, *Bee-Line software's GEP-BPIP* program was used. The analysis procedures were based on information contained in EPA's Guideline for Determination of Good Engineering Practice Stack Height (EPA, 1985), the Stack Height Regulations (40 CFR 51), and current Model Clearinghouse guidance. GEP stack height is defined as the **greater** of:

- 65 meters as measured from the base of the stack, or
- stack height as determined from the following formula:

$$H_G = H_B + 1.5L$$

where: H_G = the GEP stack height,

H_B = the height of the nearby structure, and
L = the lesser dimension (height or projected width) of the nearby structure.

For a structure having a projected width greater than its height, i.e., a squat structure, the formula reduces to:

$$H_G = 2.5H_B$$

Both the height and width of the structure are determined from the frontal area of the structure projected onto a plane perpendicular to the direction of the wind. In all instances, the GEP stack height is based on the plane projections of any nearby building that result in the greatest justifiable stack height. For purposes of the GEP analysis, "nearby" refers to the area of influence defined by a distance equal to 5L, or five structure heights or widths, whichever is less, downwind from the trailing edge of the structure.

The facility plot plan was given in Figure 2-1. The proposed stack height for each combustion turbine stack is 160 feet (48.8 meters). The proposed stack height for the auxiliary boiler is 37 feet (11.3 meters). All of the stacks to be constructed at the project will each be less than 65-meters and therefore, are in compliance with GEP regulations. Table 6-2 provides the dimensions of the major structures at the facility, the calculated GEP and the region of influence. The last column of the table indicates the stacks within the region of influence of each structure based on the results of the analysis. A plot of the structures included in the GEP-BPIP analysis along with the stack locations is included in Appendix B of this application.

Table 6-2
GEP Stack Height Analysis Data

Structure	Height (ft)	Width (ft)	Length (ft)	Calculated GEP (ft)	Region of Influence (ft)	Stacks Within 5L
Heat Recovery Steam Generator #1	74	44	133	185	925	1, 2, 3
Heat Recovery Steam Generator #2	74	44	133	185	925	1, 2, 3
Cooling Tower	47	53	432	118	588	4-13
Aux. Boiler Bldg.	20	30	35	50	250	None
Control Room	20	40	52	50	250	None
Substation Bldg.	20	20	80	50	100	None
Note: Stacks 1 & 2 represent each of the combustion turbine stacks, Stack 3 represents the auxiliary boiler stack, and Stacks 4-13 represent the 10 cooling tower cells.						

Since the proposed exhaust stacks at the facility are less than their respective GEP-formula height, there is a potential for aerodynamic downwash of exhaust plumes. Accordingly, modeling included the building downwash effects. The direction-specific building dimensions obtained from the GEP-BPIP analysis were input to the ISCST3 model to simulate the effects of building-induced downwash. A diskette containing the GEP-BPIP files can be found as an insert to Appendix E of this document. Please note that the distance from one of the HRSG structures to the fenceline is approximately 120 feet. The cavity lengths for the HRSG structures exceed the distance from the HRSG structures to the fenceline. Therefore, cavity impacts were evaluated for the sources controlled by the HRSG structures.

6.2.3 Screening Modeling

The screening modeling analysis was intended to identify the worst-case operating scenario for each pollutant and averaging period for the combustion turbines. The model was applied in its regulatory default mode with the complex terrain option enabled. The model provides for an evaluation of impacts in both simple and complex terrain in the same model run. Each of the modeling scenarios for the turbines is given in Table 6-3.

Table 6-3
Source Parameters and Criteria Pollutant Emission Rates[1] for Natural Gas-Fired Combustion Turbines

Scenario	Description[2]	Stack Height (ft)	Stack Diameter (ft)	Exit Temp. (F)	Exit Velocity (fps)	Hourly Emissions[3] (lb/hr)			
						SO_2	PM_{10}	NO_x[4]	CO
1	100% load @ 121°F Duct ON, Chiller ON	160	18	209	67.2	8.6	64	44	120
2	100% load @ 66.3°F Duct ON, Chiller ON	160	18	191	66.5	8.8	64	45	130
3	100% load @ 13°F Duct ON, Chiller OFF	160	18	188	70.0	9.3	64	48	130
4	100% load @ 121°F Duct OFF, Chiller ON	160	18	221	67.9	7.3	56	37	93
5	100% load @ 66.3°F Duct OFF, Chiller ON	160	18	205	67.5	7.4	56	38	95
6	100% load @ 13°F Duct OFF, Chiller OFF	160	18	216	76.2	7.9	56	40	100
7	75% load @ 121 F Duct OFF, Chiller OFF	160	18	202	47.9	5.0	56	26	66
8	75% load @ 66.3 F Duct OFF, Chiller OFF	160	18	183	51.5	5.8	56	30	75
9	75% load @ 13 F Duct OFF, Chiller OFF	160	18	200	56.6	6.3	56	33	81
10	ISO 100% load @ 59 F Duct ON, Chiller OFF	160	18	191	64.9	8.7	64	45	130
11	50% load @ 13 F Duct OFF, Chiller OFF	160	18	168	22.0	8.1	28	13	33

[1] Data provided by Duke Fluor Daniel
[2] Data presented are for three operating loads at three ambient temperatures. With consideration of operation of the duct burner and/or electric chiller, a total of eleven modeling scenarios were evaluated.
[3] Hourly emissions reflect operation of both combustion turbines firing pipeline-quality natural gas only.
[4] Hourly NOx emissions are based on an exhaust gas concentration of 3 ppm.

Included in Table 6-3 are the stack parameters and criteria pollutant emission rates that were modeled for the proposed natural gas-fired combustion turbines at Arlington Valley Energy. The

listed emission rates were provided by Duke Fluor Daniel, based on information obtained from the equipment manufacturer. Performance data are provided for operation of the turbines at 100 percent, 75 percent, and 50 percent operating loads and at three ambient temperatures (13°F, 66.3°F and 121°F) representing historic minimum, annual average, and historic maximum ambient temperatures, respectively. A run based upon 100 percent load at ISO conditions (59°F) was also performed. Screening analyses were performed for various realistic combinations of the above operating loads, ambient temperatures and operation of the duct burner and chiller, so as to identify the specific operating and ambient temperature combinations that result in the worst-case (i.e., highest) predicted impacts.

The load screening modeling for short-term averages identified the worst-case operating conditions as the 50 percent load (turbine modeling Scenario 11). In this scenario the lower emission rates are offset by the reduced plume rise due to the lower exhaust gas flow and exhaust temperature. This scenario resulted in impacts near the facility fenceline. Only the average ambient temperature scenarios (scenarios 2, 5, and 8) were considered in evaluating the worst-case operating conditions for the annual standards. The screening modeling for annual averages identified turbine Scenario 2 for NO_x and SO_2 and Scenario 8 for PM_{10} as the worst-case operating conditions. The worst-case turbine stack parameters were used in the subsequent modeling.

6.2.4 Refined Modeling

Once the worst-case turbine load scenario was identified, refined modeling was conducted. As with the screening, the refined modeling utilized five years of concurrent surface and upper air meteorological observations. For this project, 1994 through 1998 on-site surface meteorological data from the PVNGS were used for the refined dispersion analysis.

For pollutants with short term (i.e., 24-hours or less) averaging periods, the stack parameters and emission rates associated with the worst-case operating scenario as determined from the screening analysis were used. For example, the worst-case operating scenario for 24-hour PM_{10} ascertained from the screening analysis was the combustion turbines at 50 percent load at 13 °F. This scenario was combined with the auxiliary boiler emissions at 105 percent load and the cooling tower emissions. These worst-case turbine stack parameters along with the boiler and cooling tower parameters were used in refined modeling with respect to the 24-hour PM_{10} standard.

For refined modeling of the annual averaging period, the turbine stack parameters for worst-case scenario at 66.3°F ambient temperature (which represents the long-term annual average temperature) was considered. The highest predicted impacts from these analyses were then

compared to pollutant specific SILs. Only pollutants whose impacts were greater than the SILs were analyzed further.

6.3 Model Input Parameters

6.3.1 Source Data

The stack parameters and emission rates for the combustion turbines were provided in Table 6-3. Table 6-4 provides the stack parameters and criteria pollutant emission modeled for the proposed natural gas-fired auxiliary boiler and cooling tower.

Table 6-4
Source Parameters and Criteria Pollutant Emission Rates for Cooling Tower and Natural Gas-Fired Auxiliary Boiler

Source	Stack Height (ft)	Stack Diameter (ft)	Exit Temp. (F)	Exit Velocity (fps)	Hourly Emissions[3] (lb/hr)			
					SO_2	PM_{10}	NO_x	CO
Boiler[1]	37	2	450	35	0.026	0.264	3.11	3.95
Cooling Tower[2]	47	30.3	70	30	N/A	10.9	N/A	N/A

[1] Boiler data presented is for 105% operating load. Hourly emissions reflect operation of auxiliary boiler firing pipeline-quality natural gas only.
[2] Cooling tower modeled as 10 separate cells

6.3.2 Ambient Air Quality

Background ambient air quality data from the Palo Verde air quality monitoring station was used (AIRS 04-0135-9990). This station has been in operation since 1996. As discussed in Section 7, only PM_{10} required a full NAAQS analysis. The maximum 24-hour background concentration of 72.7 ug/m^3 PM_{10} and an annual mean background concentration of 20 ug/m^3 from this site were used in the NAAQS compliance demonstration.

6.3.3 Terrain Elevations and Receptor Grid for Refined Modeling

The terrain in the vicinity of the proposed facility is gently sloping with most of the elevations within 5-kilometer ranging between 800 and 950 feet mean sea level (MSL). Two volcanic cinder cones to the north of the project site have elevations of 1088 and 1437 feet. The facility will be located at an approximate base elevation of 881 feet MSL. With respect to the combustion turbine stack height of 160 feet, the cooling towers height of 47 feet, and the auxiliary boiler stack height of 37 feet, complex terrain dispersion modeling is required.

A single Cartesian grid was generated for use in the ISCST3 modeling. Receptors were placed 50 meters apart along the boundary. From the fenceline, a 100 meter grid of receptors extended out to 500 meters. A 250 meter grid was placed out to one kilometer. Beyond that, a spacing of 500 meters was used extending 5 kilometers from the facility. An additional 6 kilometers of grided area was added to the northern grid boundary to include maximum turbine impacts. Figure 6-1 presents a representation of the grid systems used in the modeling.

Terrain elevations were assigned to each modeled receptor using digitized terrain with a horizontal resolution of 30 meters. Furthermore, dense grid modeling (100 meter spacing) was conducted for peak impact locations within the 500 meter grid. The digital terrain data were obtained from a United States Geological Survey (USGS) Web site (http://edcwww.cr.usgs.gov/doc/edchome/ndcdb/7_min_dem/states.html) containing 7.5 minute quadrangle data.

As will be shown in Section 7, the extent of the receptor grid was sufficient to capture the maximum impacts for PM_{10}. Therefore, additional receptors beyond 5 kilometers were not required.

6.3.4 Meteorological Data for Modeling

EPA Guideline on Air Quality Models suggests five years of representative meteorological data for regulatory refined modeling. The surface meteorological data were measured at the Palo Verde Nuclear Generating Station (PVNGS). The monitoring site is located 5 kilometers north of the proposed facility. Data were available for the years 1994 through 1998. The elevation and terrain at the meteorological station are similar to the project site. Wind speed, direction, and sigma theta at 10-meter and 60 meter levels, temperature at 10 meters, 10- and 60- meter delta temperature, 10-meter dew point, and precipitation were collected at this meteorological monitoring tower.

The five yearly meteorological data sets for the PVNGS were prepared by Pinnacle West Capital corporation for the Pinnacle West (PNW) combined cycle air permit application submitted to the MCESD in September, 1999. In creating these data sets Pinnacle West extracted Tucson upper air data from the NCDC FSL data set for the same years (1994 through 1998). EPA's MIXHTS program was used to create twice-daily mixing heights from the PVNGS and Tucson data. Following EPA guidance, all single missing values of a morning or afternoon mixing height were replaced by interpolating between the previous and following morning or afternoon mixing heights. If more than one but less than five consecutive mixing heights were missing, seasonal morning or afternoon data were selected from EPA's Mixing Height of the Conterminous United States (Holzworth 1972). Once complete a combined hourly sequential meteorological data file suitable for input to ISCST3 was created for each of the five years with EPA's PCRAMMET (version 98226) meteorological data processing program. A wind rose for the five-year period is given in Figure 6-2.

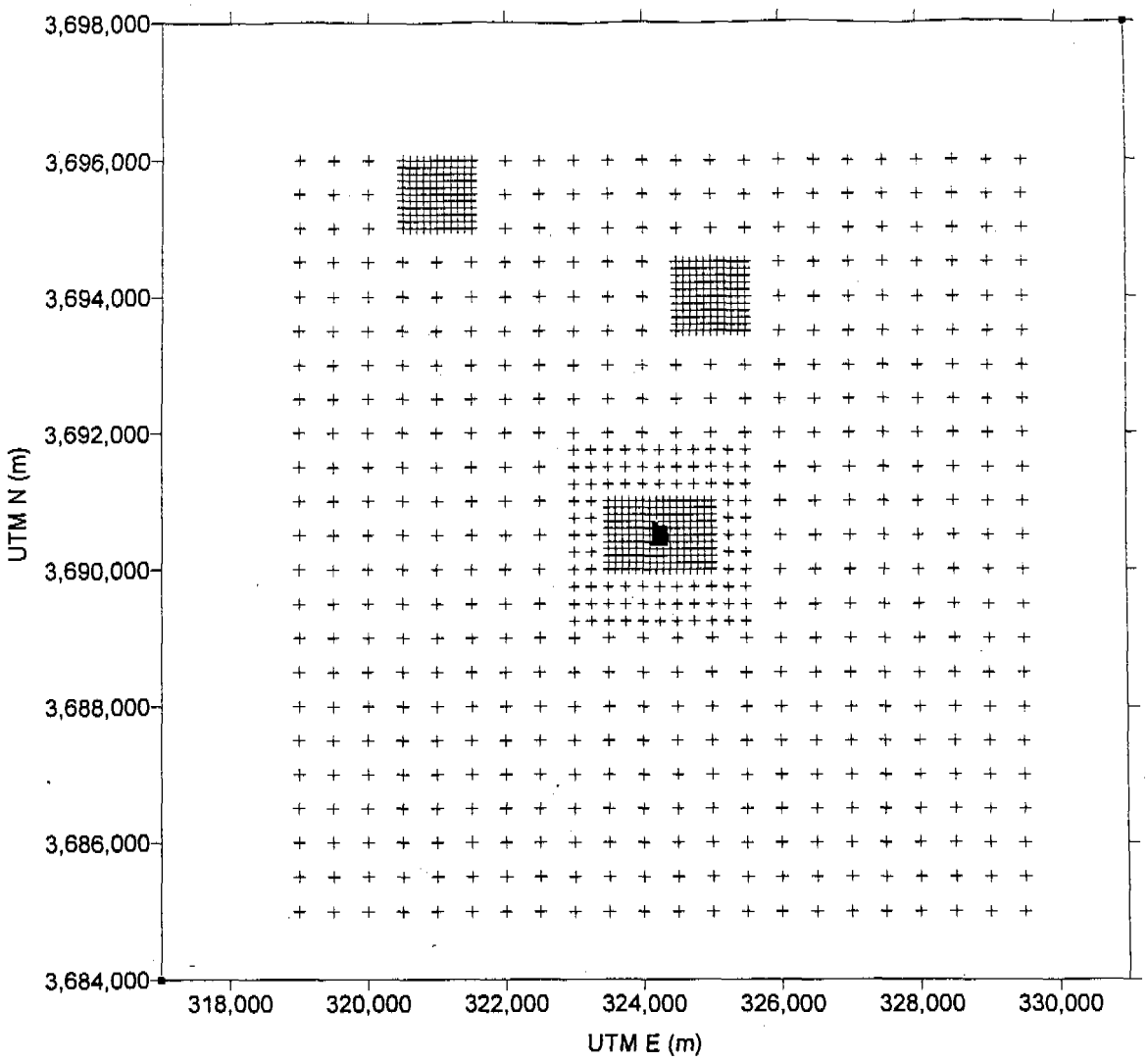


Figure 6-1 Arlington Valley Energy Project Receptor Grids Used for Screening and Refined Modeling

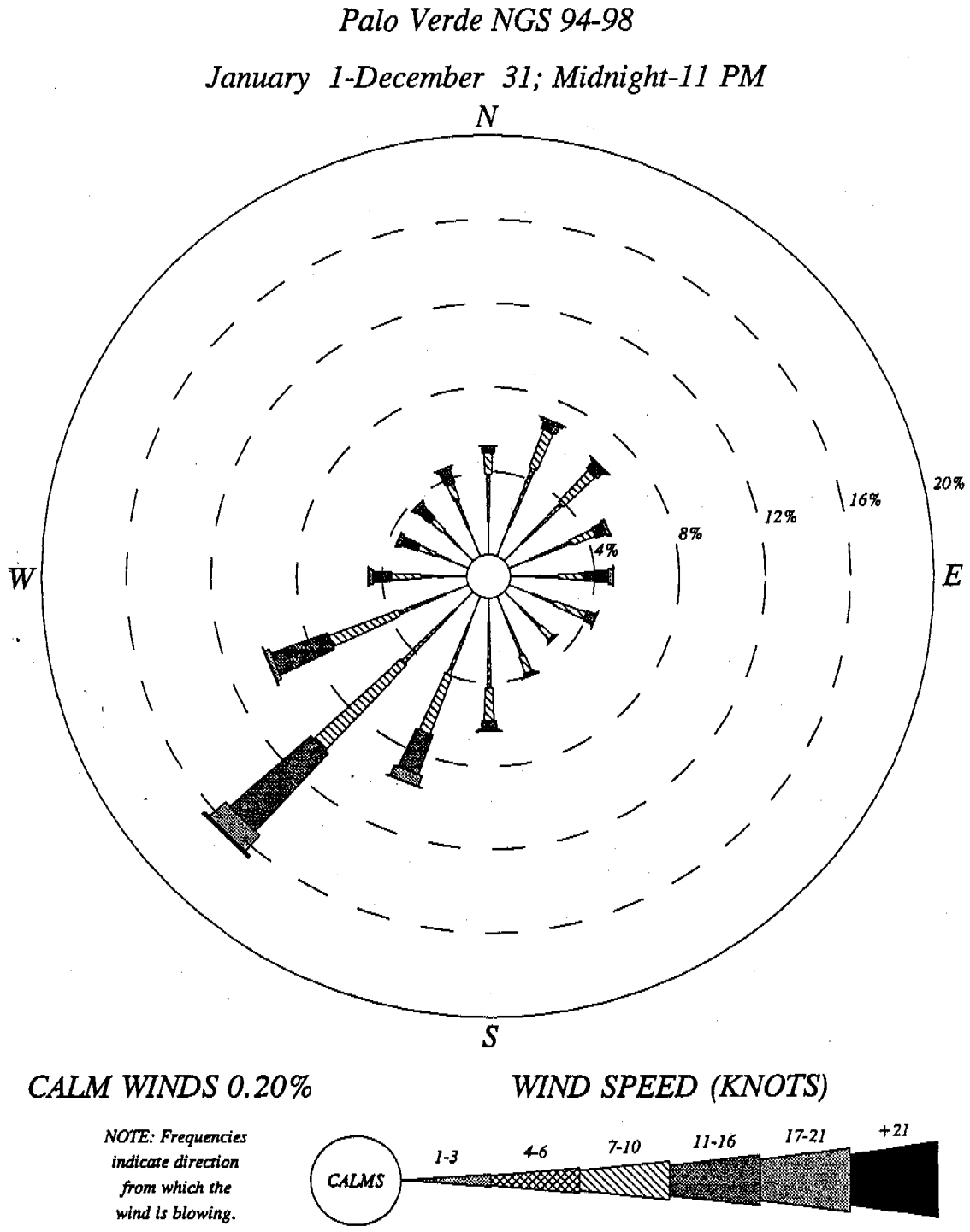


Figure 6-2. Palo Verde Nuclear Generating Station Wind Rose, 1994-1998

6.4 Regulatory Status

Arlington Valley Energy is located in an area designated as attainment for all criteria air pollutants. As was shown in Figure 1-1, the nearest ozone, CO and PM_{10} non-attainment areas in Maricopa County are the metropolitan Phoenix area located east of the facility.

The project is located in a PSD Class II area. The nearest Class I area to the facility is the Superstition Wilderness Area located 120 kilometers from the project site (See Figure 1-1). Duke Energy Maricopa, LLC understands that the U.S. Forest Service has requested modeling of impacts on certain Class II areas as part of the PNW combined cycle air permit application. It should be noted that the Forest Service does not have the authority to require analyses of Class II areas under the PSD or visibility regulations [40 CFR 52.21(p), 52.27]. However, as a courtesy, this application includes an analysis of impacts on the following Class II areas:

- Signal Hill Wilderness Area,
- Woolsey Peak Wilderness Area,
- Gila Bend Indian Reservation,
- North Maricopa Mountain Wilderness Area,
- Sierra Estrella Wilderness Area,
- Hummingbird Springs Wilderness Area,
- Big Horn Wilderness Area, and
- Eagletail Mountain Wilderness Area.

6.5 Methodology for the Air Quality Impact Analyses

6.5.1 Compliance with Air Quality Standards

The predicted impacts from the air quality impact analysis for Arlington Valley Energy will be compared to the appropriate standards. This analysis demonstrates that the proposed operation of the facility will not cause an exceedance of any NAAQS or PSD increment. A full NAAQS impact analysis, which includes project sources, other nearby major sources, and background air quality data, also shows compliance with the NAAQS. The other nearby sources included the existing PVNGS and the proposed Pinnacle West (PNW) projects. The stack data and PM_{10} emission rates for these sources are provided in Table 6-5.

Table 6-5
Source Parameters and PM_{10} Emission Rates for Other Nearby Major Sources

Source ID[1]	Stack Height (ft)	Stack Diameter (ft)	Exit Temp. (°F)	Exit Velocity (fps)	Hourly PM_{10} Emissions (lb/hr)
PNW CT 1A-4B	175	18.0	170	47.5	119
PNW CT 11-112	55.0	20.0	73.1	32.8	8.06
PNW CT 21-212	55.0	20.0	73.1	32.8	8.06
PNW CT 31-312	55.0	20.0	73.1	32.8	8.06
PNW CT 41-412	55.0	20.0	73.1	32.8	8.06
PV EDG	90.0	2.66	1000	180	17.8
PV COOL1-3[2]	63.5	30.0	110	31.6	13.7
PV Refurn	92.0	1.50	120	3.23	0.380
PV Lime 1	12.0	0.669	120	99.0	0.345
PV Lime 2	59.5	1.25	120	27.0	0.258
PV Lime 3	41.8	1.25	120	19.5	0.258

[1] Data provided by Pinnacle West PSD Permit Application PM_{10} cumulative modeling files
[2] Cooling towers modeled as several separate cells. Total (from all cells) cooling tower emissions are provided.

6.5.2 Pre-Construction Monitoring

To determine whether or not pre-construction monitoring is required, the highest predicted pollutant impacts from the proposed facility were compared to the EPA-specified de minimis monitoring concentrations (40 CFR 52.21).

6.5.3 Additional Impact Analyses

Pursuant to the PSD regulations, additional impact analyses must be addressed for projects subject to PSD review. The various components of the additional impact analyses are discussed below.

6.5.3.1 Visibility Analysis

Visibility analyses were conducted to determine potential plume blight on nearby Wilderness areas. The VISCREEN model was used for this analysis. No Class I areas are located within 100 km of the proposed project site, so no regional haze analysis was conducted.

6.5.3.2 Growth Analysis

A qualitative assessment was made as to the project's potential to cause general commercial, residential, industrial or other secondary growth in the area. Substantial growth due to this project is not expected. During operation, Arlington Valley Energy is expected to employ approximately 25 people, most of whom will be citizens of the local communities. Secondary growth from this project is not expected, and thus an analysis of such growth was not performed.

6.5.3.3 Soils and Vegetation Analysis

An analysis of the project's potential impact on soils and vegetation in the vicinity of the facility was performed in accordance with the procedures recommended in EPA's "A Screening Procedure for Impacts of Air Pollution Sources on Plants, Soils and Animals" (EPA-450/2-81-078). The highest predicted pollutant impacts from the proposed facility used in the NAAQS compliance analysis were compared to the screening concentrations listed in the above referenced document to demonstrate compliance.

7.0 RESULTS OF AIR QUALITY MODELING ANALYSIS

In this section, results of the various air quality impact analyses performed for the proposed Arlington Valley Energy are presented. These air quality analyses were conducted using the inputs and methodologies described in Section 6 of this application. All methodologies and protocols adhere to the EPA and MCESD guidelines. Discussions to be found in this section include the proposed facility's projected impacts relating to:

- Significant Impact Levels (de minimis concentrations),
- National and State Ambient Air Quality Standards, and
- PSD Class II increments.

The air quality modeling results are presented in the following discussions and are summarized in a series of tables. In accordance with the MCESD requirements, all modeling input and output files are included on diskette (or compact disc) in Appendix E.

7.1 Screening Modeling Analysis

The first step in an air quality analysis is to determine if the proposed facility will result in significant impacts for any criteria pollutant. Section 6 contained a discussion of the pollutant specific criteria for determination of significant impacts. The SILs were presented in Table 6-1. The SILs define the impact thresholds that establish the complexity of the air quality analysis required in support of the permitting of a new or modified facility. A refined modeling analysis, consisting of a cumulative impact study, must be conducted for each pollutant predicted to exceed its respective SIL. If results of the modeling analysis demonstrate that all maximum impacts are less that the SILs, then a cumulative evaluation is not required for criteria pollutants.

The source characteristics (including the modeled emission rates) for the combustion turbines were presented in Table 6-3 for the various operating loads and ambient temperatures evaluated. The source parameters for the cooling tower and auxiliary boiler were presented in Table 6-4. The modeling was performed in a manner to support maximum flexibility with regard to the facility's operation. Based on the compliance demonstration presented herein, the proposed facility is requesting a permit that will allow simultaneous operation of each of the following equipment items:

- Two combustion turbines firing pipeline-quality natural gas for up to 8,760 hours per year each, at operating loads ranging up to 100 percent of capacity,
- A ten cell cooling tower for up to 8,760 hour per year, and
- Auxiliary boiler operating for up to 1,000 hours per year.

Table 7-1 summarizes the maximum predicted impacts from each of the several screening level modeling runs for the combustion turbines for each criteria pollutant.

Table 7-1
Results of the Screening Level Modeling for Two Combustion Turbines

Pollutant	Worst-Case Scenario	Emission Rate (lb/hr)	Averaging Period[1]	Predicted Worst-Case Impact[2]				
				1994	1995	1996	1997	1998
SO_2	11	8.1	3-Hr	4.73	3.84	4.20	4.56	4.25
	11	8.1	24-Hr	1.51	1.44	1.52	1.31	1.43
	2	8.1	Annual	0.040	0.037	0.046	0.035	0.036
PM_{10}	11	28	24-Hr	5.23	4.99	5.25	4.54	4.46
	8	56	Annual	0.412	0.388	0.559	0.436	0.365
NO_2	2	50	Annual	0.229	0.208	0.263	0.222	0.205
CO	11	1188	1-Hr	936	900	921	1620	1510
	11	1188	8-Hr	459	373	393	347	424

[1] Annual averaging periods were evaluated for scenarios 2, 5, and 8.
[2] Listed emissions are from both turbines. Worst case SO_2 and PM_{10} emissions assume 8,760 hours per year operation. Worst-case CO emissions for both 1-hr and 8-hr averages are based on maximum hourly startup emissions. Worst-case annual NOx emissions include 283 hours of startup emissions and 8,477 hours of 100% load operation.

7.2 Refined Air Quality Impact Assessment

The refined modeling analysis was conducted in two steps. The first step consisted of a "coarse" grid modeling analysis for purposes of identifying high impact areas for PM_{10} (24 hour and annual). When the impact was located in the coarse grid, a second step consisted of dense grid modeling in the high impact areas to determine the highest pollutant impacts. For both the coarse and the dense grid modeling, the procedures discussed in Section 6.3.4 were used for refined modeling of a short term (i.e., 24 hours or less) averaging period and an annual averaging period. Figure 6-1 presented a graphical display of the "coarse" grid receptors and the "tight" grid receptors. A dense receptor grid was established around the coarse grid receptors with a maximum spacing of 100 meters. The dense grid was established in a manner to insure that the highest impact area was identified.

7.2.1 Significant Impact Level Analysis

The maximum impacts from the combustion turbines, cooling tower, and the auxiliary boiler are presented in Table 7-2, along with comparisons to the appropriate SIL. The maximum predicted impacts for NO_x, SO_2, and CO are lower than their corresponding SILs, while maximum impacts for PM_{10} are greater than their respective SILs. Therefore, further refined modeling was required for PM_{10} emissions only.

In this table, the highest combined impacts of both combustion turbines and the auxiliary boiler for NO_x, SO_2, and CO are presented for the maximum impact for the five years of meteorological data. The refined modeling analysis indicates the highest NO_x impact occurs during the 100 percent load, Scenario 2 condition for the combustion turbines and under the 1996 meteorological conditions. As can be seen, the highest impact is below the corresponding SIL for NO_x. Thus no additional refined modeling is required for this pollutant. The screening 8-hour CO impacts are 98 percent of the 8-hour SIL. However, this screening concentration was calculated with the very worst-case assumption that the maximum hourly emissions during startup continued for 8 continuous hours. This is a very conservative assumption that greatly overstates the potential emissions during an entire 8-hour averaging period. Consequently, while close to the SIL, the screening 8-hour CO impact indicates that there is an insignificant CO impact from the proposed project. Sulfur dioxide impacts are all very low.

The ISCST3 predicted impacts from the dispersion modeling for PM_{10} (annual) are also presented in Table 7-2. In this table, the highest combined impacts of the cooling tower, combustion turbines, and the auxiliary boiler for PM_{10} (annual) are presented for the maximum impact for five years of meteorological data. As shown in the refined modeling analysis, the highest PM_{10} (annual) impact occurs during the 75 percent load, Scenario 8 condition and under the 1996 meteorological conditions. The highest impact is just above the corresponding SIL for PM_{10} (annual). The highest 24-hour PM_{10} impact occurs under the 1996, Scenario 11 meteorological conditions. The highest impact is also above the corresponding SIL for 24-hour PM_{10}. Therefore, based on the PM_{10} modeling, additional refined modeling is required for this pollutant.

The modeling results indicate that NO_x, CO, and SO_2 are below their respective SILs. Therefore, operation of the proposed facility within the worst-case scenarios defined for permitting of this project is demonstrated to result in impacts that are less than significant with respect to ambient air quality from these impacts. Based on the results of the SIL analysis, a multi-source dispersion modeling analysis is required only for PM_{10} to support the permitting of the Arlington Valley Energy project.

Table 7-2
Significant Impact Analysis
Combined Results of Modeling Maximum Impacts for Arlington Valley Energy

Pollutant	Avg. Period	Combustion Turbine Impact[1] ($\mu g/m^3$)	Auxiliary Boiler Impact[2] ($\mu g/m^3$)	Cooling Tower Impact[3] ($\mu g/m^3$)	Combined Impact[4] ($\mu g/m^3$)	Significant Impact Level ($\mu g/m^3$)	Proceed to Refined Modeling? (Yes/No)
SO_2	3-Hr	4.73	0.850	N/A	4.92	25	No
	24-Hr	1.51	0.277	N/A	1.70	5	No
	Annual	0.0361	0.0681	N/A	0.0690	1	No
PM-10	24-Hr	5.25	2.67	23.1	23.1	5	Yes
	Annual	0.559	0.0794	1.30	1.32	1	Yes
NO_x	Annual	0.263	0.935	N/A	0.936	1	No
CO	1-Hr	1620	270	N/A	1660	2000	No
	8-Hr	459	72.8	N/A	490	500	No

[1] Maximum impacts from combustion turbines.
[2] Highest impacts from the auxiliary boiler during the same year.
[3] Maximum impacts from the cooling tower during the same year.
[4] Total impact at worst-case receptor.

7.2.2 Compliance with NAAQS

The Arizona and National Ambient Air Quality Standards are given in Table 7-3.

Table 7-3
Ambient Air Quality Standards

Pollutant	Averaging Period[2]	National AAQS[1]	
		Primary	Secondary
Sulfur Dioxide	Annual 24-hour 3-hour	80 365 --[3]	--[3] --[3] 1300
PM_{10}[4]	Annual 24-hour	50 150	50 150
Carbon Monoxide	8-hour 1-hour	10,000 40,000	--[3] --[3]
Ozone	1-hour	235	235
Nitrogen Dioxide	Annual	100	100
Lead	3-month	1.5	--[3]

[1] All standards in this table are expressed in $\mu g/m^3$.
[2] Short term ambient standards may be exceeded once per year; annual standards may never be exceeded. Ozone standard is attained when the expected number of days of an exceedance is equal to or less than one.
[3] No ambient standard for this pollutant and/or averaging period.
[4] The MCAPCR Rule 510, Section 301 lists the previous Total Suspended Particulate Matter (TSP) standards for 24-hr and annual averaging periods. According to the MCESD staff, the stated TSP standards are no longer being monitored and enforced.
Source: 40 CFR 52.21 and MCAPCR Rule 510

As shown in Table 7-4, the highest predicted PM_{10} impacts from the proposed facility when combined with the maximum background concentration will be less than the NAAQS.

Table 7-4
Maximum Air Quality Impacts Due to Arlington Valley Energy Sources

Pollutant	Averaging Period	Maximum Project Impact (µg/m³)	Background (µg/m³)	Maximum Concen-tration[1] (µg/m³)	NAAQS (µg/m³))	Location UTE (m)	Location UTN (m)
PM_{10}	24-hour	23.1	72.7	95.8	150	324,109	3,690,343
	Annual	1.32	20.0	21.3	50	324,500	3,690,600

[1] All concentration values rounded to three significant figures.

The area of influence for PM_{10} was modeled as 2 kilometers. This is the maximum distance to which the maximum modeled concentration for any averaging time drops to below the SIL. For the NAAQS analysis, all sources within the area of influence, or that are within 50 kilometer of the area of influence and have the potential to contribute a significant impact within the area, are modeled. However, if background air quality data are available, then only nearby sources, i.e., within the area of influence, need be modeled.

For this application, the only nearby sources are the PVNGS and the proposed PNW project. These sources were included in the NAAQS analysis for PM_{10}. Because of the very small area of influence of the project, and the limited potential for distance sources to produce significant impacts in the project area of influence, it is unlikely that inclusion of other sources would significantly change the modeling results.

The results of the modeling analysis, including the other nearby sources, are shown in Table 7-5.

Table 7-5
NAAQS Impact Analysis Results Due to Arlington Valley Energy and Other Nearby Sources

Pollutant	Averaging Period	Maximum Impact All Sources (µg/m³)	Background (µg/m³)	Maximum Concen-tration* (µg/m³)	NAAQS (µg/m³)	Location UTME (m)	Location UTMN (m)
PM_{10}	24-hour	25.7	72.7	98.4	150	324109	3690343
	Annual	3.73	20	23.7	50	329500	3690500

* All concentration values rounded to three significant figures

A comparison of Tables 7-4 and 7-5 show a slight contribution from the other nearby sources to the maximum impact receptor. Although the receptor grid extends close to the PVNGS and PNW facilities, emissions from these sources contribute only slightly to the PM_{10} impacts at the maximum receptor for the project. The maximum impacts for the annual and 24-hour averages occurred during the 1994 and 1996 meteorological years, respectively.

New annual and 24-hour $PM_{2.5}$ NAAQS were recently promulgated. EPA is not requiring an analysis of compliance for new sources with these standards at this time. However, EPA Region IX has a rule of thumb that if PM_{10} concentrations without background are within the new $PM_{2.5}$ NAAQS, that compliance is likely. This is the case for this proposed facility.

7.2.3 Compliance with PSD Requirements

As shown in Table 7-2, the highest predicted impacts from the proposed facility for all criteria pollutants will be less than significant impact levels with the exception of PM_{10}. Therefore, only PM_{10} was analyzed for compliance for compliance with the PSD Class II increments.

7.2.3.1 PSD Increment Analysis

A PSD increment analysis for PM_{10} was completed for the project sources included in the NAAQS analysis. The nearby sources were also included in the modeling analysis to determine compliance with the PM_{10} PSD increment. Other potential increment consuming source information has not been obtained yet from the MCESD. However, it is considered unlikely that the results presented herein will change significantly if this additional information is included in the analysis. Maximum impacts were identified for the Class II areas identified in Section 6.4, as well as the nearby Class II receptors.

As shown in Table 7-6, all modeled impacts from the incremental analysis were below the PSD increments. The maximum Class II daily impacts occur along the southeastern corner of the fenceline boundary and are within 86 percent of the 24-hour PM_{10} increment of 30 $\mu g/m^3$. The maximum annual cumulative PM_{10} impact occurs approximately 150 meters east of the facility fenceline and consumes only 19 percent of the 17 $\mu g/m^3$ increment.

PM_{10} impacts were also modeled at each of the Class II areas identified by the Forest Service ("FS-II areas"), but only the closest impact location is shown in the table. Impacts to FS-II areas are very small. The worst-case impact at an FS-II receptor occurred at Signal Hill Wilderness Area, approximately 16 kilometers south of the facility.

These impacts are well below the PSD Class II increments. In the case of the FS-II areas, they are well below the Class I increments. The PSD increments were established as a safety to insure that the air is not degraded beyond a set level and so that adequate industrial growth could occur in an area. However, PSD increment is not a static value. It is temporally and spatially

dependent based on dispersion modeling. At downwind distances beyond the property boundary, predicted increment concentrations decrease dramatically.

Table 7-6
Class II Increment Analysis Results

Class	Pollutant	Averaging Period	PSD Increment ($\mu g/m^3$)	Modeled Impact ($\mu g/m^3$)	% of Increment	UTMX (m)	UTMY (m)
FS-II	PM_{10}	24-hour	30	4.1	14	320888	3677057
		Annual	17	0.61	3.6	320888	3677057
II	PM_{10}	24-hour	30	25.7	86	324109	3690343
		Annual	17	3.3	19	329500	3690500

7.2.3.2 Pre-Construction Monitoring

Table 7-7 presents a comparison of the proposed facility's highest predicted impacts with the EPA-specified de minimis monitoring concentrations. CO, NO_x, and SO_2 predicted impacts are below the de minimis monitoring concentrations, as well as below the SILs. Therefore preconstruction monitoring is not needed. PM_{10} concentrations are above the de minimis and SIL thresholds, but PM_{10} monitoring data at the nearby Palo Verde site are adequate to fulfill this requirement.

Table 7-7
Comparison of Predicted Impacts with De Minimis Monitoring Concentrations

Pollutant	Averaging Period	Highest Predicted Impact ($\mu g/m^3$)	De Minimis Monitoring Concentration[1] ($\mu g/m^3$)
SO_2	24-Hr	1.7	13
PM_{10}	24-Hr	23.1	10
NO_x	Annual	0.94	14
CO	8-Hr	490	575

[1]40 CFR 52.21

7.3 Other Air Quality Considerations

The preceding sections of this permit application have focused on demonstrating that the proposed action will incorporate Best Available Control Technology and will not have significant criteria pollutant air quality impacts. PSD regulations also require review of additional air quality items as part of an application for a permit to construct. Normally, these analyses focus on Class I areas. However, there are no Class I areas within 100 kilometers of this project. The following section discusses considerations of impacts that could result from the proposed project with respect to the following:

- Visibility;
- Soils and Vegetation;
- Growth, and
- Acid Deposition

7.3.1 Visibility Impacts

The Superstition Wilderness Area is the nearest federally designated Class I area to Arlington Valley Energy. This Wilderness Area is approximately 120 kilometers (75 miles) east of the proposed facility. Since this distance is greater than 100 kilometers, no regional haze visibility analysis was performed.

As discussed in Section 6.4, the proposed facility is nearby to seven Class II Wilderness Areas and one Indian Reservation. As an accommodation, Duke Energy Maricopa, LLC has performed a voluntary visibility analysis for these areas. A plume blight screening was performed for the two closest of these wilderness areas: Woolsey Peak Wilderness and Signal Mountain Wilderness, located approximately 16 kilometers south and south-southwest of the project site, respectively.

Visibility is generally characterized either by visual range (the greatest distance that a large dark object can been seen), or by the light extinction coefficient (the attenuation of light per unit distance due to scattering and absorption by gases and particles in the atmosphere). The EPA VISCREEN (EPA, 1988) screening model was used to perform a plume blight screening analysis of the potential impact on visual perception of a plume emitted from the proposed facility. A Level 2 visibility screening analysis was performed following the guidance and methodology contained in the VISCREEN User's Guide.

A Level 2 visibility screening analysis makes use of representative meteorological data to determine worst-case plume dispersion conditions that allow transport of the plume from the source to the sensitive Class II area for time periods when a plume may be visible. For this

analysis, five years (1994-1998) of meteorological data for PVNGS were used. The Level 2 analysis is performed in two steps. First, the representative meteorological data are processed to create a three-way joint frequency distribution of wind direction, wind speed, and atmospheric stability class. The objective of this first step is to produce a cumulative frequency distribution of combinations of meteorological conditions that are conducive to plume blight.

Once the dispersion conditions are ranked from low to high dispersion potential, the cumulative frequency distribution is used to identify the specific combination of low-dispersion potential conditions that occur with a cumulative frequency of 1 percent or greater (i.e., less than approximately 90 hours per year). The dispersion conditions associated with a 1 percent threshold are defined in the VISCREEN User's Guide as the appropriate meteorological conditions for use in performance of a Level 2 visibility screening analysis. By contrast, the meteorological conditions associated with a Level 1 screening analysis are the worst possible dispersion conditions.

In the second step of the Level 2 analysis, the dispersion conditions associated with a cumulative frequency of 1 percent or greater are input to the VISCREEN model to determine the potential impact on visibility of the plume under those conditions. The set of meteorological conditions analyzed is given in Table 7-8. In preparing the cumulative frequency distribution, the meteorological data are stratified for the wind speed and stability class cases in the table for those wind directions that allow transport from the source to the subject area. Only occurrences of those wind speeds that will allow plume transport from the source to the area within 12 hours are counted as being potential worst-case conditions. This limitation is used to prevent analysis of those conditions that are unlikely to persist long enough to allow for a plume to maintain its integrity.

Table 7-8
VISCREEN Level 2 Meteorological Conditions Used to Produce Cumulative Frequency Distribution

Stability Class	Wind Speed Lower Limits (m/s)
D	2, 3, 4, 5, 6, 7, 8,
E	2, 3, 4, 5
F	2, 3

One key input to the screening analysis is the background visual range. The National Parks Service operates an IMPROVE visibility monitoring site in the Tonto National Monument east of Phoenix. The best visibility (highest visual range) at Tonto NM occurs in the winter. The mean

visual range for winter on the 20 percent of winter days (approximately 18 days) with the best visibility is 174 kilometers (EPA, 1993). Assuming independence of this best-case mean visual range and the 1 percent cumulative frequency meteorological conditions, the Level 2 meteorological conditions represent an annual frequency of occurrence of less than 2 hours per year (18 hours per year times 0.1).

In a Level 2 analysis, the cumulative frequency distribution is computed for six-hour increments throughout the day beginning with the period 0100 to 0600. In the winter, there is a very low probability of occurrence of plume blight conditions before the hours 0700 in the morning or after 1800 in the evening due to the shorter daylight hours in the winter. Therefore, for this analysis, we reviewed the cumulative frequency distribution for the two periods 0700-1200 and 1300-1800 for determination of the worst-case dispersion conditions for use in VISCREEN. For Woolsey Peak, the condition associated with a frequency of at least 1 percent was D stability, 1.0 m/s wind speed. For Signal Mountain Wilderness, the condition was E Stability, 2.0 m/s wind speed. Both of these conditions were for the period 0700-1200. The complete frequency distributions for the four time periods for the two Wilderness areas are given in Appendix F.

The VISCREEN output for the two VISCREEN runs are given in Tables 7-9 and 7-10. No visual plume screening criteria have been established for Class II areas. The screening criteria that are presented in Tables 7-9 and 7-10 are those applicable to Class I areas. Visual impacts outside the Class I area are applicable only for those locations where integral vistas from within a Class I area to a landmark outside the area have been defined. No integral vistas have been identified in Arizona, so the screening results for plume impacts outside the Class I area are not applicable to this analysis.

The Class I visual plume impact screening criteria within the Class II area are exceeded for both Wilderness Areas. These results indicate that there is the potential for an occasional visible plume to be observed from the proposed facility. However, these screening results are based upon a very conservative screening methodology. The impacts are based upon conditions that occur less than 2 days per year. With a more refined modeling analysis, it is likely that there would be no significant visual plume impacts in the nearby Class II Wilderness Areas. Therefore, we conclude that visual impacts from the proposed facility are not significant.

Table 7-9
Arlington Valley Energy VISCREEN Results for Woolsey Peak Wilderness Area

Visual Effects Screening Analysis for
Source: AVEP
Class I Area: Woolsey Peak Wilderness

*** User-selected Screening Scenario Results ***

Input Emissions for

Particulates	77.73	LB /HR
NOx (as NO2)	53.11	LB /HR
Primary NO2	.00	LB /HR
Soot	.00	LB /HR
Primary SO4	.00	LB /HR

PARTICLE CHARACTERISTICS

	Density	Diameter
Primary Part.	2.5	6
Soot	2.0	1
Sulfate	1.5	4

Transport Scenario Specifications:

Background Ozone:	.04	ppm
Background Visual Range:	174.00	km
Source-Observer Distance:	16.00	km
Min. Source-Class I Distance:	16.00	km
Max. Source-Class I Distance:	32.00	km
Plume-Source-Observer Angle:	11.25	degrees

Stability: 4
Wind Speed: 1.00 m/s

R E S U L T S

Asterisks (*) indicate plume impacts that exceed screening criteria

Maximum Visual Impacts INSIDE Class I Area
Screening Criteria ARE Exceeded

					Delta E		Contrast	
Backgrnd	Theta	Azi	Distance	Alpha	Crit	Plume	Crit	Plume
SKY	10.	158.	32.0	11.	2.00	5.684*	.05	.109*
SKY	140.	158.	32.0	11.	2.00	1.381	.05	-.048
TERRAIN	10.	158.	32.0	11.	2.00	14.859*	.05	.122*
TERRAIN	140.	158.	32.0	11.	2.00	1.655	.05	.029

Maximum Visual Impacts OUTSIDE Class I Area
Screening Criteria ARE Exceeded

					Delta E		Contrast	
Backgrnd	Theta	Azi	Distance	Alpha	Crit	Plume	Crit	Plume
SKY	10.	1.	1.0	168.	2.00	29.610*	.05	.667*
SKY	140.	1.	1.0	168.	2.00	8.044*	.05	-.270*

Table 7-10
Arlington Valley Energy VISCREEN Results for Signal Mountain Wilderness Area

Visual Effects Screening Analysis for
Source: AVEP
Class I Area: Signal Hill Wilderness A

*** User-selected Screening Scenario Results ***

Input Emissions for

Particulates	77.73	LB /HR
NOx (as NO2)	53.11	LB /HR
Primary NO2	.00	LB /HR
Soot	.00	LB /HR
Primary SO4	.00	LB /HR

PARTICLE CHARACTERISTICS

	Density	Diameter
Primary Part.	2.5	6
Soot	2.0	1
Sulfate	1.5	4

Transport Scenario Specifications:

Background Ozone:	.04 ppm
Background Visual Range:	174.00 km
Source-Observer Distance:	16.00 km
Min. Source-Class I Distance:	16.00 km
Max. Source-Class I Distance:	22.00 km
Plume-Source-Observer Angle:	11.25 degrees
Stability:	5
Wind Speed:	2.00 m/s

R E S U L T S

Asterisks (*) indicate plume impacts that exceed screening criteria

Maximum Visual Impacts INSIDE Class I Area
Screening Criteria ARE Exceeded

					Delta E		Contrast	
Backgrnd	Theta	Azi	Distance	Alpha	Crit	Plume	Crit	Plume
SKY	10.	142.	22.0	26.	2.00	3.431*	.05	.067*
SKY	140.	142.	22.0	26.	2.00	.957	.05	-.029
TERRAIN	10.	84.	16.0	84.	2.00	9.690*	.05	.050
TERRAIN	140.	84.	16.0	84.	2.00	.545	.05	.005

Maximum Visual Impacts OUTSIDE Class I Area
Screening Criteria ARE Exceeded

					Delta E		Contrast	
Backgrnd	Theta	Azi	Distance	Alpha	Crit	Plume	Crit	Plume
SKY	10.	1.	1.0	168.	2.00	23.965*	.05	.521*
SKY	140.	1.	1.0	168.	2.00	6.305*	.05	-.215*

7.3.2 Vegetation and Soils

The project lies in an area of primarily agricultural use. No significant off-site impacts will occur due to the proposed action. Therefore, secondary air quality standards will be preserved, meaning little or no potential for adverse impacts to either soils or vegetation exists. The following discussion reviews the project's potential to impact its surroundings, based on the facility's potential to emit and resulting ground level concentrations of SO_2 and NO_x. These two pollutants were selected for review as they have been shown to be capable of causing damage to vegetation at elevated ambient concentrations.

To evaluate the potential effects of air pollution on vegetation, Heck and Brandt (1977) recommend the use of a dose analysis. In their summary they presented data collected by several investigators on the growth response of plants to various concentrations and durations. While they qualify this data as being only preliminary and not having been subject to rigorous experimentation, the evaluation procedure is commonly employed for project review purposes. They further caution that the data should only be applied to exposures of periods no longer than 10 to 12 hours.

Table 7-11 presents data from Heck and Brandt's survey on the potential for plant injury from air pollution. The division of plants into sensitive, intermediate and resistant species is somewhat subjective and varies according to the literature reviewed. However, this table can be used as a general guide on the potential effects of the project. The concentrations presented on the table are those which can produces acute changes injury (i.e., leaf drop and leaf discoloration) in plants exposed to air pollutants from 0.5 to 8.0 hours. The general patterns presented by this data include:

- in terms of absolute concentration, the plants are sensitive to the pollutants in the following order: SO_2 and NO_x; and
- sensitive plants are affected by about 50 percent of the pollutant concentration that affects intermediate plants.

Table 7-11
Projected Pollutant Concentrations for Short-Term Exposures That Will Produce About 5% Injury to Vegetation Grown under Sensitive Conditions

Pollutant	Time	Concentration (ppm) Producing 5% Injury		
		Sensitive	Intermediate	Resistant
Ozone	0.5	0.20-0.35	0.30-0.55	≥0.50
	1.0	0.10-0.25	0.20-0.35	≥0.30
	2.0	0.07-0.20	0.15-0.30	≥0.25
	4.0	0.05-0.15	0.12-0.26	≥0.23
	8.0	0.03-0.12	0.10-0.22	≥0.20
Sulfur Dioxide	0.5	1.0-4.0	3.5-10	≥9.0
	1.0	0.50-2.5	2.0-7.5	≥7.0
	2.0	0.30-2.0	1.5-5.0	≥4.5
	4.0	0.15-1.25	1.0-3.5	≥3.0
	8.0	0.10-0.75	0.50-2.0	≥1.5
Nitrogen Dioxide	0.5	6.0-12	1.-25	≥20
	1.0	3.0-10	9.0-20	≥18
	2.0	2.5-7.5	7.0-15	≥13
	4.0	2.0-6.0	5.0-12	≥10
	8.0	1.5-5.0	4.0-9.0	≥8

Source: Heck and Brandt 1977
Note: These values were taken after some revision from Heggestad and Heck, the USEPA and the National Air Pollution Control Administration.

The lower concentration of SO_2 and NO_x that affect sensitive plants over 0.5 to 8.0 hours of contact can be extrapolated to longer exposure periods to provide a framework for evaluating the importance of the project air pollutant concentrations. As noted by Heck and Brandt, to rely on this extrapolation for exposure periods greater than 24 hours would be of questionable value.

The maximum 3-hour SO_2 concentration due to Arlington Valley Energy is estimated to be 10 $\mu g/m^3$ (0.004 ppm). This is below the 3-hour concentration of SO_2 that produces detectable plant damage in sensitive species, as extrapolated from Table 7-11. Similarly, the maximum 24-hour concentration (4.5 $\mu g/m^3$, 0.002 ppm) is far below the damage threshold values.

With respect to the longer-term exposures of vegetation to air pollutants, Heck and Brandt cite other data that can provide some basis for long-term evaluation:

- over a seven-month growing season, a slight chronic response was noted in a variety of plants (i.e., cereal, vegetables, trees, forage, and fruit crops) exposed to a concentration of about 400 $\mu g/m^3$ of SO_2, and
- slight changes were noted in pine trees exposed to SO_2 concentrations of about 280 $\mu g/m^3$ for six months.

The estimated maximum annual average SO_2 concentration due to Arlington Valley Energy is expected to be less than 1 $\mu g/m^3$ (0.0004 ppm). Thus, the expected annual maximum concentration can be seen to be insignificant with respect to possible vegetation damage.

With respect to the longer-term exposures of vegetation to air pollutants, the secondary NAAQS of 100 $\mu g/m^3$ for NO_2 is established on the basis of preventing damage to vegetation as well as other criteria. The total NO_2 emissions from Arlington Valley Energy are projected to result in an off-site impact of less than 1 $\mu g/m^3$, therefore insignificant effects to local vegetation are predicted.

The literature on vegetation impacts from NO_2 exposure clearly indicates that adverse impacts occur only when concentrations are much higher than those predicted for the proposed project. For example, considering long-term or chronic exposures where the impact of concern would be reduced yield, studies have shown that reduced yield is unlikely to occur in most crops at levels below 470 $\mu g/m^3$ (Taylor et al., 1975; EPA, 1982). Since the maximum increase in the annual average concentration of NO_2 for the proposed project is less than 1$\mu g/m^3$, it is unlikely that adverse vegetation impacts will result from the proposed action. Similarly, the small amount of nitrogen deposition to soil caused by the project will have a negligible impact on soil conditions.

Based on this evaluation, the project's emissions of both SO_2 and NO_x will not have an adverse impact on sensitive vegetation. Soils in the impact area, which would be affected mainly through the leaching of particulate contaminants (aerosols) which settle on the land surface will likewise not be measurably affected by the new emissions.

7.3.3 Associated Growth

Arlington Valley Energy will employ approximately 300 personnel during the construction phase and will employ approximately 25 personnel on a permanent basis. It is a goal of the project to hire from the local communities where possible (including the Phoenix metropolitan area). There should be no substantial increase in community growth, or need for additional infrastructure. Therefore, it is not anticipated that the proposed project will result in an increase in secondary emissions associated with non-project-related activities, or growth.

7.3.4 Acid Deposition

An acid deposition analysis for nitrates and sulfate was performed for the FS-II areas surrounding the project site. The analysis followed screening methodology defined in the IWAQM Phase I interim report (EPA, 1993). Only dry deposition was modeled. Wet deposition was approximated as being equal to twice the modeled dry deposition. Maximum estimated annual deposition of nitrate and sulfate at any of the FS-II areas is estimated to be less than 0.001 kg/hectare-year. No criteria has been established against which to compare the estimated deposition values. The acid deposition screening analysis is given in Appendix G.

7.4 Non-Attainment Area Analysis

Maricopa Rule 240 Section 308.1e(2) requires that any major source of VOC and NO_x located within a radius of 50 kilometer of an ozone non-attainment area shall be presumed to contribute to ozone violations unless it can be demonstrated that physical factors indicate the source emissions will not contribute to ozone violations in the non-attainment area. Arlington Valley Energy is located upwind of and is within 50 kilometers of the Maricopa County ozone non-attainment area. However, the potential impact of the project on ozone formation in the non-attainment area is expected to be negligible. The direct pollutant impacts from emissions of NO_x from the proposed project are below the significant impact level defined by EPA. If a pollutant (NO_2/NO_x) directly emitted by the proposed facility has an insignificant impact immediately adjacent to the facility, it is reasonable to expect that downwind impacts of the facility on an indirect pollutant such as ozone will likewise be insignificant.

The PM_{10} impact from the project was modeled to drop to less than the SILs within 2 kilometer of the project site. Hence, there will be no significant impact of the project within the PM_{10} non-attainment area.

The CO impact from the project is less than the SIL at the fenceline. Therefore, there will be no significant impact of the project within the CO non-attainment area.

7.5 Hazardous Air Pollutants

Arlington Valley Energy will not be a major source of hazardous air pollutants. Emissions of hazardous air pollutants were estimated for the combustion turbines and the auxiliary boiler and the potential impact of these emissions were then compared to the AAQG. The results of this analysis are given in Table 7-12 for the annual period and Table 7-13 for the short-term periods (1-hour and 24-hour). This analysis demonstrates that potential emissions of air pollutants from the proposed facility will not exceed any AAQG. In fact, the predicted impacts are many orders of magnitude below the respective AAQG.

Table 7-12
Annual AAQG Analysis for Arlington Valley Energy

Maximum Unit Impacts UTM 324,359E 3,690.540N (ug/m3)/(lb/hr)	
Source	Annual
Turbines (2)	0.00001
Auxiliary Boiler	2.6490
From run unit_98.out	

Annual AAAQG Impact Analysis

Compound	CAS Number	2 Turbine Stacks (lb/yr)	Auxiliary Boiler (lb/yr)	Annual Maximum Impact (ug/m3)	Arizona AAQG Annual (ug/m^3)	Compliance with Annual AAAQS
1,3-Butadiene	106-99-0	5.52E-04		6.30E-13	6.70E-02	OK
3-Methylchloranthrene	56-49-5		4.64E-08	1.40E-11	5.70E-04	OK
Acetaldehyde	75-07-0	2.98E-01		3.41E-10	5.00E-01	OK
Acrolein	107-02-8	1.03E-01		1.18E-10		
Arsenic	7440-38-2	8.87E-04	5.16E-06	1.56E-09	2.00E-04	OK
Barium	7440-39-3	1.91E-02	1.14E-04	3.43E-08		
Benzene	71-43-2	5.90E-02	5.42E-05	1.65E-08	1.40E-01	OK
Benzo(a)anthracene	56-55-3	9.83E-05	4.64E-08	1.42E-11	5.70E-04	OK
Benzo(a)pyrene	50-32-8	6.03E-05	3.10E-08	9.43E-12	5.70E-04	OK
Beryllium	7440-41-7	5.22E-05	3.10E-07	9.37E-11	5.00E-04	OK
Cadmium	7440-43-9	4.78E-03	2.84E-05	8.59E-09	2.90E-04	OK
Chromium	7440-47-3	6.09E-03	3.61E-05	1.09E-08		
Copper	7440-50-8	3.69E-03	2.19E-05	6.64E-09		
Dibenzo(a,h)anthracene	53-70-3	1.02E-04	3.10E-08	9.48E-12	5.70E-04	OK
Ethylbenzene	100-41-4	7.79E-02		8.90E-11		
Formaldehyde	50-00-0	4.78E-01	1.94E-03	5.86E-07	8.00E-02	OK
Hexane	110-54-3	1.13E+00	4.64E-02	1.40E-05		
Manganese	7439-96-5	1.65E-03	9.80E-06	2.97E-09		
Mercury	7439-97-6	1.13E-03	6.71E-06	2.03E-09		
Naphthalene	91-20-3	7.22E-03	1.57E-05	4.77E-09		
Nickel	7440-02-0	9.13E-03	5.42E-05	1.64E-08	4.00E-03	OK
Propylene Oxide	75-56-9	2.08E-01		2.37E-10	2.00E+00	OK
Selenium	7782-49-2	1.04E-04	6.19E-07	1.87E-10		
Toluene	108-88-3	3.09E-01	8.77E-05	2.69E-08		
Vanadium	7440-62-2	1.00E-02	5.93E-05	1.80E-08		
Xylene (m)	108-38-3	2.13E-01		2.43E-10		
Xylene (o)	95-47-6	1.04E-01		1.19E-10		
Xylene (p)	106-42-3	2.13E-01		2.43E-10		
Xylene (Total)	1330-20-7	1.13E-01		1.30E-10		

Table 7-13
Short-Term AAQG Analysis for Arlington Valley Energy

Maximum Unit Impacts UTM 324,209E 3,690,343N (ug/m3)/(lb/hr)		
Source	1-hr	24-hr
Turbines (2)	0.08302	0.00347
Auxiliary Boiler	96.674	12.229
From run unit_98.out		

Short-Term AAAQG Impact Analysis

		2 Turbine Stacks	Auxiliary Boiler	Short-Term Maximum Impact (ug/m3)		Arizona AAQG (ug/m^3)		Compliance with Short Term AAAQS	
Compound	CAS Number	lb/hr	lb/hr	1-hr	24-hr	1-hr	24-hr	1-hr	24-hr
1,3-Butadiene	106-99-0	5.52E-04		4.58E-05	1.91E-06	7.20E+00	1.90E+00	OK	OK
3-Methylchlorant	56-49-5		4.64E-08	4.49E-06	5.68E-07	7.90E-01	2.10E-01	OK	OK
Acetaldehyde	75-07-0	2.98E-01		2.48E-02	1.04E-03	2.30E+03	1.40E+03	OK	OK
Acrolein	107-02-8	1.03E-01		8.56E-03	3.58E-04	6.70E+00	2.00E+00	OK	OK
Arsenic	7440-38-2	8.87E-04	5.16E-06	5.72E-04	6.62E-05	2.80E-01	7.30E-02	OK	OK
Barium	7440-39-3	1.91E-02	1.14E-04	1.26E-02	1.45E-03	1.50E+01	4.00E+00	OK	OK
Benzene	71-43-2	5.90E-02	5.42E-05	1.01E-02	8.67E-04	6.30E+02	5.10E+01	OK	OK
Benzo(a)anthrac	56-55-3	9.83E-05	4.64E-08	1.26E-05	9.09E-07	7.90E-01	2.10E-01	OK	OK
Benzo(a)pyrene	50-32-8	6.03E-05	3.10E-08	8.00E-06	5.88E-07	7.90E-01	2.10E-01	OK	OK
Beryllium	7440-41-7	5.22E-05	3.10E-07	3.43E-05	3.97E-06	6.00E-02	1.60E-02	OK	OK
Cadmium	7440-43-9	4.78E-03	2.84E-05	3.14E-03	3.64E-04	1.70E+00	1.10E-01	OK	OK
Chromium	7440-47-3	6.09E-03	3.61E-05	4.00E-03	4.63E-04	1.10E+01	3.80E+00	OK	OK
Copper	7440-50-8	3.69E-03	2.19E-05	2.43E-03	2.81E-04	2.30E+00	7.50E-01	OK	OK
Dibenzo(a,h)ant	53-70-3	1.02E-04	3.10E-08	1.15E-05	7.34E-07		2.10E-01		OK
Ethylbenzene	100-41-4	7.79E-02		6.47E-03	2.70E-04	4.50E+03	3.50E+03	OK	OK
Formaldehyde	50-00-0	4.78E-01	1.94E-03	2.27E-01	2.53E-02	2.00E+01	1.20E+01	OK	OK
Hexane	110-54-3	1.13E+00	4.64E-02	4.58E+00	5.72E-01	5.30E+03	1.40E+03	OK	OK
Manganese	7439-96-5	1.65E-03	9.80E-06	1.08E-03	1.26E-04	2.50E+01	8.00E+00	OK	OK
Mercury	7439-97-6	1.13E-03	6.71E-06	7.42E-04	8.60E-05	1.50E+00	4.00E-01	OK	OK
Naphthalene	91-20-3	7.22E-03	1.57E-05	2.12E-03	2.18E-04	6.30E+02	4.00E+02	OK	OK
Nickel	7440-02-0	9.13E-03	5.42E-05	6.00E-03	6.94E-04	5.70E+00	1.50E+00	OK	OK
Propylene Oxide	75-56-9	2.08E-01		1.72E-02	7.20E-04	1.50E+03	4.00E+02	OK	OK
Selenium	7782-49-2	1.04E-04	6.19E-07	6.85E-05	7.93E-06	6.00E+00	1.60E+00	OK	OK
Toluene	108-88-3	3.09E-01	8.77E-05	3.41E-02	2.14E-03	4.70E+03	3.00E+03	OK	OK
Vanadium	7440-62-2	1.00E-02	5.93E-05	6.57E-03	7.60E-04	1.50E+00	4.00E-01	OK	OK
Xylene (m)	108-38-3	2.13E-01		1.77E-02	7.38E-04	5.50E+03	3.50E+03	OK	OK
Xylene (o)	95-47-6	1.04E-01		8.66E-03	3.62E-04	5.50E+03	3.50E+03	OK	OK
Xylene (p)	106-42-3	2.13E-01		1.77E-02	7.38E-04	5.50E+03	3.50E+03	OK	OK
Xylene (Total)	1330-20-7	1.13E-01		9.42E-03	3.94E-04	5.50E+03	3.50E+03	OK	OK

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APPENDIX A
MCESD FORMS AND TABLES

Compliance Certification

I, William L. Sigmon, Jr., a Senior Vice President and Responsible Official for the Duke Energy Maricopa, LLC project, hereby certify that:

The applicable requirements for the Duke Energy Maricopa, LLC project that are the basis of this certification are set forth in Section 5 of the permit application.

The Duke Energy Maricopa, LLC project will comply with the applicable requirements listed in Section 5 of the permit application and with additional requirements, if any, that become applicable during the permit term.

The methods to be used to determine compliance with the listed applicable requirements are set forth in Section 5 of the permit application, including a description of monitoring, recordkeeping, and reporting requirements and test methods.

Duke Energy Maricopa, LLC will submit annual compliance certifications during the permit term, postmarked within 90 days of each anniversary issuance of the permit.

There are currently no enhanced monitoring or compliance certification requirements applicable to the Duke Energy Maricopa, LLC project.

Based on information and belief formed after reasonable inquiry, the statements and information in the permit application are true, accurate and complete.

DUKE ENERGY MARICOPA, LLC

Date: 10/20/99

Name: William L. Sigmon, Jr.
Title: Senior Vice President

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY
Air Quality Division
3033 N. Central Ave. ♦ Phoenix, AZ 85012-2809-33 ♦ Phone: (602) 207-2338

STANDARD PERMIT APPLICATION FORM

(As required by A.R.S. § 49426, and Chapter 2, Article 3, Arizona Administrative Code)

1. **Permit to be issued to:** (Business license name of organization that is to receive permit)
   Duke Energy Maricopa, LLC
2. **Mailing Address:** 5400 Westheimer Ct.
   City: Houston **State:** Texas **ZIP:** 77056
3. **Previous Company Name:** (if applicable) None
4. **Name (or names) of Owners/Principals:** Duke Energy North America (DENA)
   FAX #: 713-627-6588 **Phone:** 713-627-5400
5. **Name of Owner's Agent:** William L. Sigmon Jr.
   FAX #: 704-382-9325 **Phone:** 704-382-8975
6. **Plant/Site Manager/Contact Person and Title:** Max Shilstone-Manager
   FAX #: 713-627-6588 **Phone:** 713-627-6572
7. **Plant Site Name:** Arlington Valley Energy
   Plant Site Location/Address: one mile west of intersection383 Ave. and Elliott Road
   City: Arlington **County:** Maricopa **ZIP:**
   Indian Reservation (if applicable, which one): Not applicable
   Latitude/Longitude, Elevation; 33° 20' 25"; 112° 53' 28"; 881 feet
8. **Equipment Purpose:** Power Generation
   Equipment List/Description: See Table A-1
9. **Type of Organization:**
   - **Corporation** **Individual Owner**
   - **Partnership** **Government Entity (Government Facility Code)**
   - **Other** Limited Liability Corporation

10. **Permit Application Basis: X New Source • Revision • Renewal of Existing Permit • Portable Source • General Permit** (Check all that apply.)
    For renewal or modification, include existing permit number (and exp. date): NA
    Date of Commencement of Construction or Modification: est. 3/1/01
    Is any of the equipment to be leased to another individual or entity? • Yes • No
    Standard Industrial Classification Code: 4911 **State Permit Class:**
11. **Signature of Responsible Official of Organization:** W. L. Sigmon Jr.
    Official Title of Signer: Senior Vice President
12. **Typed or Printed Name of Signer:** William L. Sigmon, Jr.
    Date: 10/20/99 **Telephone Number:** 704-382-4691

TABLE A-1
ADEQ EMISSIONS SUMMARY TABLE

COMPANY NAME: Duke Maricopa Energy, L.L.C.

EMISSION SOURCES

Estimated "Potential to Emit" per R18-2-101
Review of applications and issuance of permits will be expedited by supplying all necessary information in this Table.

DATE: 10/22/99

REGULATED AIR POLLUTANT DATA					EMISSION POINT DISCHARGE PARAMETERS									
EMISSION POINT [1]		CHEMICAL COMPOSITION OF TOTAL STREAM	R. AIR POLLUTANT EMISSION RATE		UTM COORDINATES OF EMISSION POINT [5]			STACK SOURCES [6]		EXIT DATA			NONPOINT SOURCES [7]	
NUMBER	NAME	REGULATED AIR POLLUTANT NAME [2]	#/HR [3]	TONS/YR [4]	ZONE	EAST (Mtrs.)	NORTH (Mtrs.)	HT ABOVE GROUND [ft]	HT ABOVE STRUCTURE [ft]	DIA [ft]	VEL [fps]	TEMP [oF]	LENGTH [ft]	WIDTH [ft]
Stack 1	Turbine w/duct burner	SO2	4.7	20.5	12	324282	3690470	160	86	18	70	188	NA	NA
Stack 1	Turbine w/duct burner	PM10	32.0	140.0	12	324282	3690470	160	86	18	70	188	NA	NA
Stack 1	Turbine w/duct burner	NOx	24.0	109.0	12	324282	3690470	160	86	18	70	188	NA	NA
Stack 1	Turbine w/duct burner	CO	67.0	326.5	12	324282	3690470	160	86	18	70	188	NA	NA
Stack 1	Turbine w/duct burner	VOC	9.7	42.5	12	324282	3690470	160	86	18	70	188	NA	NA
Stack 2	Turbine w/duct burner	SO2	4.7	20.5	12	324330	3690470	160	86	18	70	188	NA	NA
Stack 2	Turbine w/duct burner	PM10	32.0	140.0	12	324330	3690470	160	86	18	70	188	NA	NA
Stack 2	Turbine w/duct burner	NOx	24.0	109.0	12	324330	3690470	160	86	18	70	188	NA	NA
Stack 2	Turbine w/duct burner	CO	67.0	326.5	12	324330	3690470	160	86	18	70	188	NA	NA
Stack 2	Turbine w/duct burner	VOC	9.7	42.5	12	324330	3690470	160	86	18	70	188	NA	NA
Stack 3	Boiler	SO2	0.0	0.0	12	324255	3690476	37	17	2	35	450	NA	NA
Stack 3	Boiler	PM10	0.3	0.1	12	324255	3690476	37	17	2	35	450	NA	NA
Stack 3	Boiler	NOx	3.1	0.5	12	324255	3690476	37	17	2	35	450	NA	NA
Stack 3	Boiler	CO	4.0	0.5	12	324255	3690476	37	17	2	35	450	NA	NA
Stack 3	Boiler	VOC	0.4	0.2	12	324255	3690476	37	17	2	35	450	NA	NA
Stack 4	Cooling Tower	PM10	1.1	4.8	12	324182	3690358	47	0	30.3	30	70	NA	NA
Stack 5	Cooling Tower	PM10	1.1	4.8	12	324198	3690358	47	0	30.3	30	70	NA	NA
Stack 6	Cooling Tower	PM10	1.1	4.8	12	324214	3690358	47	0	30.3	30	70	NA	NA
Stack 7	Cooling Tower	PM10	1.1	4.8	12	324231	3690358	47	0	30.3	30	70	NA	NA
Stack 8	Cooling Tower	PM10	1.1	4.8	12	324247	3690358	47	0	30.3	30	70	NA	NA
Stack 9	Cooling Tower	PM10	1.1	4.8	12	324264	3690358	47	0	30.3	30	70	NA	NA
Stack 10	Cooling Tower	PM10	1.1	4.8	12	324280	3690358	47	0	30.3	30	70	NA	NA
Stack 11	Cooling Tower	PM10	1.1	4.8	12	324297	3690358	47	0	30.3	30	70	NA	NA
Stack 12	Cooling Tower	PM10	1.1	4.8	12	324313	3690358	47	0	30.3	30	70	NA	NA
Stack 13	Cooling Tower	PM10	1.1	4.8	12	324330	3690358	47	0	30.3	30	70	NA	NA

Note: a) Includes start-up emissions in annual total [tons/yr]

GROUND ELEVATION OF FACILITY ABOVE MEAN SEA LEVEL: 881 feet
ADEQ STANDARD CONDITIONS ARE 293K AND 101.3 KILOPASCALS (A.A.C. R18-2-101)

COMPLETENESS CHECKLIST FOR TITLE V AIR QUALITY PERMIT APPLICATIONS

PERMITTEE: Duke Energy Maricopa, LLC
ADDRESS: Arlington Valley Energy

APP. RCVD. DATE:
INCOMP. LTR. DATE:

APPLICATION #:
REVIEW ENGINEER:

COMPL. DATE:

App. B Item No.	Requirements	Yes	No	N/A	Comments
R.280	Have the appropriate application fees been submitted?	X			$10,500
Form	Has the standard application form been completed?	X			App A
Form	Has the responsible official signed the application?	X			App A
1	Has a description been included for each process?	X			Sec 2
2	Has the product description and raw materials been included?	X			Sec 1.3.1, Sec 2.6
3	Has a complete description of the Alternate Operating Scenarios been included?			X	
4	Has a description been provided for the alternate operating scenario products, if applicable?			X	
5	Has a flow diagram for all processes been included?	X			Fig 2-2
6	Has a Material Balance been included (if applicable)			X	
7.a	Has the emission sources form been completed and does it include potential emissions of regulated air pollutants (including fugitives)?	X			Table A-1
7.b	Has the facility identified and described all points of emissions of regulated air pollutants?	X			Sec 3
8	Has the facility identified all applicable SIP requirements?	X			Sec 5.3
8	Has the facility identified all applicable NSPS requirements?	X			Sec 5.1.2
8	Has the facility identified all applicable NESHAP requirements?			X	Sec 5.1.3
8	Have all applicable Installation Permit requirements been identified?	X			Sec 5
9	Has the applicant provided an explanation of any voluntarily accepted limits established pursuant to Rule 220?			X	
10.a,c	Have the maximum annual and hourly process rates for each piece of equipment, which generate air emissions been included?	X			Sec 3 Tables 3-1 thru 3-4
10.b,d	Have the maximum annual and hourly process rates for the whole plant been included?	X			Sec 3 Tables 3-5 and 3-6
10.e	Has the applicant included information about all fuel burning equipment including generators, a description of fuel used, including the type used, the quantity used per year, the maximum and the average quantity used per hour, the percent used for process heat and the higher heating value of the fuel. If solid fuels and fuel oils are used, has the sulfur and ash content been provided?	X			Sec 2.6 Table 2-1
10.f	Has the raw material maximum hourly, monthly or quarterly and annual usage information been included?			X	Sec 2.7
10.g	Have the operating schedules (hour/day, days/year, days/week, % annual production by season) been included?	X			Sec 2.8 Table 2-2
10.h	Have any limitations on operations and work practice standards affecting emissions been included (if applicable)?	X			Sec 2.8

App. B Item No.	Requirements	Yes	No	N/A	comments
10.i	Has the applicant provided a demonstration of how the source will meet any limitation accepted voluntarily in pursuant of Rule 220 (if applicable)?			X	
11.a-g	Does the application include a control equipment list with the type, name, make, model, serial number, size/capacity and date of manufacture (if applicable)?	X			Table 4-9
12.a-g	Does the application include necessary stack information including stack identification, description, exit height, inside dimensions, exit gas temperature and velocity, and building dimensions?	X			Sec 2.3.10 Tables 6-3, 6-4 and A-1
13.a-i	Does the application include the site diagram, which includes emission areas and air pollution control equipment?	X			Fig B-2
14.a	Have the applicable test methods for determining compliance been included?	X			Sec 5 Table 5-7
14.b	Does the application include an identification, location and description of pollution controls and monitoring equipment (if applicable)?	X			Sec 2.4, 2.5
14.c	Has the rated and operating efficiency of pollution controls been included?	X			Sec 4 Table 4-8
14.d	Has the data used to establish control efficiency been provided?	X			Sec 4
14.e	Has evidence that the new or modified source will not violate any Ambient Air Quality Standards or PSD increments been provided?	X			Sec 7
15	Has the applicant provided equipment manufacturer's bulletins and shop drawings (if applicable)			X	
16.a-d	Has a Compliance Plan been included? (The compliance plan must address acid rain provisions, if applicable)	X			Table 5-6 (Sec 5.1.4)
16.a	Does the application include a description of the Compliance Status of the source with respect to all applicable requirements (for constructed/operating sources)?			X	
16.a,b	Has a description of how the new source or alteration will comply with applicable requirements been included (for new sources or modifications to existing sources)?	X			Table 5-6
16.b.1	Does the application include a statement that the source will continue to comply with the applicable requirements with which they currently comply? (for constructed/operating sources)			X	
16.b.2	Has a statement that the source will meet the requirements, which become effective after permit issuance, been included?	X			Sec 5 App A
16.b.3	Has a compliance schedule with remedial measures, and an enforceable sequence of actions with milestones leading to compliance been included for applicable requirements with which the source does not currently comply?			X	
16.c	Has a schedule of Submission of Progress Reports (at least every 6 months) been included? (for sources required to have a compliance schedule)			X	

App. B Item No.	Requirements	Yes	No	N/A	Comments
16.d	If an acid rain compliance plan is required, does it meet the requirement of 16 a through c? (if applicable)			X	Sec 5.1.4
17	Does the application contain a compliance certification covering all applicable requirement, including voluntarily accepted limits and a statement whether the compliance is continuous or intermittent?	X			App A
17.a.1	Does the compliance certification identify the applicable requirements, which are the basis of the certification?	X			App A
17.a.2	Does the compliance certification include a Statement of Methods Used to Determine Compliance including monitoring, record keeping and reporting requirements and test methods?	X			App A
17.a.3	Has a Schedule for Submission of Compliance Certifications (at least annually) been included?	X			App A
17.a.4	Does the compliance certification include a statement indicating the compliance status with respect to any applicable enhanced monitoring and compliance certification requirements? (if applicable)			X	App A
17.a.5	**Certification of truth, accuracy and completeness:** Does the application contain certification signed by a responsible official stating that " based on information and belief formed after reasonable inquiry, the statements and information in the application are true, accurate and complete"	X			App A
17.b	Does the application include an acid rain compliance plan (if applicable) and if so, is it on nationally standardized forms?			X	Sec 5.1.4
19	Have all the calculations on which all information is based been included in the application?	X			App C
R210	Is any applicable Federal delayed compliance orders or consent decrees included?			X	
R210. 301.4.h	Does the application contain list of insignificant activities according to County Rule 210 Section 301.4?	X			Table 5-5
R210. 301.4.i	If a permit applicant requests terms and conditions allowing for the trading of emission increases and decreases in the permitted source solely for the purpose of complying with a federally enforceable emission cap that is established in the permit independent of otherwise applicable requirements, does the application include proposed replicable procedures and permit terms that ensure the emissions trades are quantifiable and enforceable?			X	
R210	Was the copy of the application sent to EPA Region IX? The copies of all correspondence regarding Title V application have to be sent to EPA Region IX.	X			Cover letter
R210	Does the notification precisely identify information in the application which is to be considered confidential?			X	None
R210	Does the notification contain sufficient supporting information to allow to evaluate whether the information satisfies the requirements related to trade secrets or, if applicable, how the information, if disclosed, is likely to cause substantial harm to the person's competitive position?			X	
R210	Any additional information submitted pursuant to Rule 210 Maricopa County Air Pollution Control Regulations shall contain certification by a responsible official stating that "based on information and belief formed after reasonable inquiry, the statements and information in the document are true, accurate and complete".			X	

SUPPLEMENTAL COMPLETENESS REVIEW OF APPLICATION FOR AIR QUALITY PERMIT FOR NEW MAJOR SOURCES OR MAJOR MODIFICATIONS TO SOURCES

App. B Item No.	Requirements	Yes	No	N/A	Comments
	All New Major Sources or Major Modifications to Sources				
R 240. 302.1	Does the application meet the requirements of Rule 240 Section 303?	X			Sec 7
R 240. 302.2	Does the application demonstrate that the more stringent of the applicable new source performance standards in Rule 360 of County rules or the existing source performance standards in Regulation III of County rules are applied to the proposed new major source or major modification of a major source?	X			Sec 3
R 240. 302.3	Did the application demonstrate that the new major source or major modification will not have an adverse impact on visibility as determined by Section 511 of County Rule 240 and will satisfy all the visibility requirements contained in Section 511 of County Rule 240? Was a demonstration of the impact on visibility made according to Section 508 of County Rule 240?	X			Sec 7.3.1
R 240. 302.4	Does the application include all applicable provisions of County Rules 200, 210, 240, 245, and 270?	X			All
R 240. 302.5	Does the application comply with all applicable requirements specified in County Rule 240 Section 302.5?	X			Sec 5
R 240. 302.6	Does the application contain demonstration that the new major source or major modification will not exceed the applicable standards for hazardous air pollutants contained in County Rule 370?	X			Sec 7.5
R 240. 302.7	Does the application contain demonstration that the new major source or major modification will not exceed the limitations, if applicable, on emission from fugitive sources contained in County Rules 310, 311, and 316?	X			Sec 5.3
R210. 301.4.d	Does the application for any major source of hazardous air pollutants contain a determination according to County Rule 210 Section 301.4.d that maximum achievable control technology (MACT) for new sources under Section 112 of the Act will be met?			X	Sec 5.1.3 Table 3-7
R 240. 302.8	Does the application contain demonstration that a stationary source that will emit five or more tons of lead per year will not violate the ambient air quality standards for lead contained in County Rule 510?			X	Sec 5

	New Major Sources or Major Modifications to Sources in Non-Attainment Areas:	Yes	No	N/A	Comments
18.a.1	In the case of a new major source as defined in Rule 240 of these rules or a major modification subject to an emission limitation which is LAER (Lowest Achievable Emission Rate) for that source or facility, does the application contain a determination of LAER that *is consistent with the requirements* of the definition of LAER contained in Rule 240 of these rules? Does the demonstration contain the data and information relied upon by the applicant in determining the emission limitation that is LAER for the source or facility for which a permit is sought?			X	

18.a.2	In the case of a new major source as defined in Rule 240 of these rules or a major modification subject to the demonstration requirement of Rule 240 of these rules, did the applicant submit such demonstration in a form that lists and describes all existing major sources owned or operated by the applicant and a statement of compliance with all conditions contained in the permits or conditional orders of each of the sources.			X	
18.a.3	In the case of a new major source as defined in Rule 240 of these rules or a major modification subject to the offset requirements described in Rule 240 of these rules, did the applicant demonstrate the manner in which the new major source or major modification meets the requirements of Rule 240 of these rules?			X	
18.a.4	Did an applicant for a new major source as defined in Rule 240 of these rules or a major modification for volatile organic compounds or carbon monoxide (or both) which will be located in a nonattainment area for ozone or carbon monoxide (or both) submit the analysis described in Rule 240 of these rules?			X	

	New Major Sources or Major Modifications to Sources in Attainment Areas:	Yes	No	N/A	Comments
18.b.1	Does the application include demonstration of the manner in which a new major source or major modification which will be located in an attainment area for a pollutant for which the source is classified as a major source as defined in Rule 240 of these rules or the modification is classified as a major modification will meet the requirements of Rule 240 of these rules?	X			Sec 5
18.b.2	In the case of a new major source as defined in Rule 240 of these rules or major modification subject to an emission limitation which is BACT (Best Available Control Technology) for that source or facility, does the application contain a determination of BACT that is consistent with the requirements of the definition of BACT contained in Rule 100 of these rules? Does the demonstration contain the data and information relied upon by the applicant in determining the emission limitation that is BACT for the source or facility for which a permit is sought?	X			Sec 4
18.b.3	In the case of a new major source as defined in Rule 240 of these rules or major modification required to perform and submit an air impact analysis in the form prescribed in Rule 240 of these rules, does such an analysis meet the requirements of Rule 240 of these rules? Unless otherwise exempted in writing by the Control Officer, the air impact analysis shall include all of the information and data specified in Rule 240 of these rules.	X			Sec 7
18.b.4	If an applicant seeks an exemption from any or all of the requirements of Rule 240 of these rules, did the applicant provide sufficient information and data in the application to demonstrate compliance with the requirements of the subsection(s) under which an exemption is sought?			X	Sec 5

	Remarks	Received by
1		
2		
3		

APPENDIX B
FACILITY DRAWINGS

OVERSIZED DOCUMENT

Map

SEE SUPERVISOR
(EXHIBIT CABINET)

APPENDIX C
EMISSION CALCULATIONS

TABLE C-1
Estimated Plant Performance and Emissions Data

2 x 1 Combined Cycle Plant - Using User-Defined Fuel
Two General Electric Model PG7241(FA) Combustion Turbine Generators
Two Fired Heat Recovery Steam Generators with SCR
One Reheat Condensing Steam Turbine Generator

											1x1 7FA
	Maximum	Aver. Amb.	Minimum	Maximum	Aver. Amb.	Minimum	Maximum	Aver. Amb.	Minimum	ISO	Minimum
Combustion turbine load	100%	100%	100%	100%	100%	100%	75%	75%	75%	100%	50%
Ambient temperature (°F)	121	66.3	13	121	66.3	13	121	66.3	13	59	13
Relative humidity (%)	33	41	66	33	41	66	33	41	66	60	66
Duct Firing	On	On	On	Off	Off	Off	Off	Off	Off	On	Off
Electric Chiller	On	On	Off	On	On	Off	Off	Off	Off	Off	Off
Compressor Inlet Gas Temperature (°F)	55	45	13	55	45	13	121	66	13	59	13
Net plant power output (kW)	534,916	579,149	617,955	467,716	505,880	533,256	309,132	381,380	416,349	577,626	145,214
Gross CTG power output (kW each)	166,311	170,405	181,200	166,506	170,600	181,200	94,400	121,200	135,900	167,707	90,600
Gross STG power output (kW)	233,218	258,048	273,491	163,380	182,058	183,400	133,310	152,578	154,956	259,811	60,276
Net plant heat rate, LHV basis (btu/kWh)	6,829	6,437	6,396	6,611	6,241	6,266	6,901	6,470	6,463	6,406	7,387
Net plant heat rate, HHV basis (btu/kWh)	7,512	7,080	7,036	7,272	6,865	6,893	7,591	7,117	7,109	7,047	8,126
CTG fuel flow rate (lb/h) - total for 2 CTGs	143,635	146,658	155,302	143,715	146,740	155,302	99,160	114,694	125,067	145,212	49,858
CTG heat input, LHV basis (MMbtu/h) - total for 2 CTGs	3,090	3,155	3,341	3,092	3,157	3,341	2,133	2,468	2,691	3,124	1,073
Duct burner fuel flow rate (lb/h) - total for 2 HRSGs	26,157	26,605	28,406	0	0	0	0	0	0	26,764	0
Duct burner heat input, LHV basis (MMbtu/h) - total for 2 HRSGs	563	572	611	0	0	0	0	0	0	576	0
Total fuel flow (lb/h)	169,792	173,263	183,708	143,715	146,740	155,302	99,160	114,694	125,067	171,977	49,858
Total fuel flow (scfh)	4,017,850	4,099,976	4,347,155	3,400,772	3,472,349	3,674,968	2,346,469	2,714,033	2,959,507	4,069,540	1,179,816
Stack exhaust gas flow (lb/h) - total	6,902,000	7,040,000	7,466,000	6,874,000	7,012,000	7,436,000	4,946,000	5,532,000	5,934,000	7,085,000	2,428,000
Stack exhaust gas composition (by volume)											
- Nitrogen + argon	74.46%	74.89%	75.46%	74.97%	75.40%	75.97%	73.18%	75.42%	75.95%	74.88%	76.02%
- Oxygen	11.06%	11.16%	11.29%	12.47%	12.57%	12.72%	12.37%	12.65%	12.64%	11.27%	12.85%
- Carbon dioxide	4.44%	4.45%	4.46%	3.78%	3.80%	3.80%	3.60%	3.76%	3.83%	4.39%	3.74%
- Water	10.04%	9.50%	8.80%	8.78%	8.23%	7.51%	10.85%	8.17%	7.58%	9.46%	7.39%
NOx as NO2 (lb/h) - 3 ppmvd @15% O2 - total for 2 stacks	44	45	48	37	38	40	26	30	33	45	13
CO (lb/h) - 20 ppmvd @ 15% O2 total for 2 stacks	123.0	125.9	134.2	92.9	95.1	101.4	65.9	75.1	80.9	126.8	33.1
NH3 (lb/h) - 10 ppmvd - total for 2 stacks	37.3	38.2	40.7	37.6	38.5	41.0	26.7	30.4	32.7	38.5	13.4
UHC as CH4 (lb/h) - 7 ppmvw - total for 2 CTGs	27.3	27.8	29.4	27.2	27.6	29.2	19.7	21.8	23.3	28.0	9.5
UHC contributions from duct burning (lb/hr) -total for 2 HRSGs	30.0	30.5	32.6	0	0	0	0	0	0	30.7	0
VOC as CH4 (lb/h) - 1.4 ppmvw - total for 2 CTGs	5.47	5.57	5.89	5.43	5.53	5.85	3.94	4.36	4.67	5.60	1.91
VOC contributions from duct burning (lb/hr) - total for 2 HRSGs	12.50	12.70	13.56	0	0	0	0	0	0	12.79	0
SOx as SO2 (lb/h) - total for 2 Stacks	8.6	8.8	9.3	7.3	7.4	7.9	5.0	5.8	6.3	8.7	8.1
Particulates (lb/h) - total for 2 stacks	64	64	64	56	56	56	56	56	56	64	28
Stack velocity (ft/s) - based on a 18 ft. diameter stack	67.2	66.5	70.0	67.9	67.5	72.6	47.9	51.5	56.6	64.9	22.0
Stack temperature (°F)	209	191	188	221	205	216	202	183	200	191	168

NOTES:
1) Final approval from DENA is required for the emissions limits to be listed in the air permit.
2) NOx stack emissions are based on the ppmvd value indicated in the table. The HRSG vendor guarantee point is 3 ppmvd @ 15% O2.
3) CO stack emissions are based on a guarantee of 20 ppmvd @ 15% O2 with duct firing and 15 ppmvd @ 15% O2 without duct firing.
4) UHC emissions from CTG are based on a GE guarantee of 7 ppmvw.
5) VOC emissions from CTG are based on a GE guarantee of 1.4 ppmvw.
6) SOx emissions are based on firing pipeline quality natural gas with a maximum sulfur content of 0.75 grains/100 scf.
7) Plant Performance estimated by Thermoflow GTMaster Software Program.
8) Maximum expected Ammonia slip is 10 ppmvd.
9) UHC and SOx emissions include the contributions of duct burning.
10) User defined gas = 1.09% N2, 0.99% CO2, 95.4% C1, 2.1% C2, 0.27% C3, 0.05% nC4, 0.03% IC4, 0.01% nC5, 0.01% iC5, and 0.03% C6+
11) Particulate emissions include back half condensables (reference US EPA method 5/202)

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TABLE C-1
Estimated Plant Performance and Emissions Data

2 x 1 Combined Cycle Plant - Using User-Defined Fuel
Two General Electric Model PG7241(FA) Combustion Turbine Generators
Two Fired Heat Recovery Steam Generators with SCR
One Reheat Condensing Steam Turbine Generator

	Maximum	Aver. Amb.	Minimum	Maximum	Aver. Amb.	Minimum	Maximum	Aver. Amb.	Minimum	ISO	Minimum
Combustion turbine load	100%	100%	100%	100%	100%	100%	75%	75%	75%	100%	50%
Ambient temperature (°F)	121	66.3	13	121	66.3	13	121	66.3	13	59	13
Relative humidity (%)	33	41	66	33	41	66	33	41	66	60	66
Duct Firing	On	On	On	Off	Off	Off	Off	Off	Off	On	Off
Electric Chiller	On	On	Off	On	On	Off	Off	Off	Off	Off	Off
Compressor Inlet Gas Temperature (°F)	55	45	13	55	45	13	121	66	13	59	13
Stack gas flow, wet (lb/h)	6,902,000	7,040,000	7,466,000	6,874,000	7,012,000	7,436,000	4,946,000	5,532,000	5,934,000	7,085,000	2,428,000
Mole % N2, wet (from simulation)	74.47%	74.90%	75.46%	74.97%	75.40%	75.97%	73.18%	75.42%	75.94%	74.88%	76%
Mole % O2, wet (from simulation)	11.06%	11.16%	11.29%	12.47%	12.57%	12.72%	12.37%	12.65%	12.64%	11.27%	12.85%
Mole % CO2, wet (from simulation)	4.44%	4.45%	4.46%	3.78%	3.80%	3.80%	3.60%	3.76%	3.83%	4.39%	3.74%
Mole % H2O, wet (from simulation)	10.04%	9.50%	8.80%	8.78%	8.23%	7.51%	10.85%	8.17%	7.58%	9.47%	7.39%
Mole % N2, wet (normalized)	74.46%	74.89%	75.46%	74.97%	75.40%	75.97%	73.18%	75.42%	75.95%	74.88%	76.02%
Mole % O2, wet (normalized)	11.06%	11.16%	11.29%	12.47%	12.57%	12.72%	12.37%	12.65%	12.64%	11.27%	12.85%
Mole % CO2, wet (normalized)	4.44%	4.45%	4.46%	3.78%	3.80%	3.80%	3.60%	3.76%	3.83%	4.39%	3.74%
Mole % H2O, wet (normalized)	10.04%	9.50%	8.80%	8.78%	8.23%	7.51%	10.85%	8.17%	7.58%	9.46%	7.39%
Stack gas temperature (°F)	208.90	190.80	188.00	221.40	205.40	216.00	202.00	183.00	200.00	191.00	168.00
Stack gas pressure (psia)	14.24	14.24	14.24	14.24	14.24	14.24	14.24	14.24	14.24	14.70	14.24
Stack gas MW, wet (lb/lbmol)	28.27	28.33	28.41	28.35	28.41	28.49	28.10	28.41	28.46	28.33	28.49
Stack gas density, wet (lb/cuft)	0.0581	0.0578	0.0582	0.0552	0.0567	0.0559	0.0563	0.0586	0.0573	0.0596	0.0602
Stack gas flow, wet (cuft/h)	123,055,230	121,860,614	128,316,200	124,493,973	123,749,429	132,948,475	87,800,202	94,343,426	103,619,436	118,836,362	40,327,900
Stack gas flow, wet (lbmol/h)	244,146	248,500	262,795	242,469	246,815	261,004	176,014	194,720	208,357	250,088	85,223
Stack gas flow, dry (lbmol/h)	219,636	224,895	239,678	221,180	226,502	241,395	156,916	178,819	192,564	226,418	78,924
Mole % N2, dry	82.77%	82.75%	82.73%	82.19%	82.16%	82.14%	82.09%	82.13%	82.17%	82.71%	82.09%
Mole % O2, dry	12.29%	12.33%	12.38%	13.67%	13.70%	13.75%	13.88%	13.78%	13.68%	12.45%	13.88%
Mole % CO2, dry	4.93%	4.92%	4.89%	4.14%	4.14%	4.11%	4.04%	4.10%	4.15%	4.85%	4.04%
Stack gas MW, dry	29.28	29.28	29.28	29.21	29.21	29.21	29.20	29.21	29.21	29.27	29.20
Stack gas density, dry (lb/cuft)	0.0581	0.0597	0.0600	0.0569	0.0583	0.0573	0.0585	0.0603	0.0587	0.0616	0.0617
Stack gas flow, dry (cuft/h)	110,701,720	110,285,013	117,028,901	113,563,402	113,564,851	122,960,356	78,273,785	86,639,265	95,765,569	107,590,536	37,347,235
NOx density as NO2 (lb/cuft)	0.0913	0.0938	0.0942	0.0896	0.0917	0.0903	0.0922	0.0949	0.0925	0.0968	0.0972
NOx ppmvd @ 15% O2	3	3	3	3	3	3	3	3	3	3	3
NOx ppmvd	4.4	4.4	4.3	3.7	3.7	3.6	3.6	3.6	3.7	4.3	3.6
NOx in stack gas (lb/h)	44	45	48	37	38	40	26	30	33	45	13
CO density (lb/cuft)	0.0556	0.0571	0.0573	0.0545	0.0558	0.0550	0.0561	0.0578	0.0563	0.0589	0.0592
CO ppmvd @ 15% O2	20	20	20	15	15	15	15	15	15	20	15
CO ppmvd	29.2	29.1	28.9	18.4	18.3	18.2	17.9	18.1	18.4	28.7	17.9
CO in stack gas (lb/h)	123.0	125.9	134.2	92.9	95.1	101.4	65.9	75.1	80.9	126.8	33.1
NH3 density (lb/cuft)	0.0337	0.0347	0.0348	0.0331	0.0339	0.0334	0.0341	0.0351	0.0342	0.0358	0.0359
NH3 ppmvd	10	10	10	10	10	10	10	10	10	10	10
NH3 in stack gas (lb/h)	37.3	38.2	40.7	37.6	38.5	41.0	26.7	30.4	32.7	38.5	13.4
UHC density as CH4 (lb/cuft)	0.0317	0.0326	0.0328	0.0312	0.0319	0.0314	0.0321	0.0330	0.0322	0.0337	0.0338
UHC ppmvw	7	7	7	7	7	7	7	7	7	7	7
UHC in stack gas (lb/h)	27.3	27.8	29.4	27.2	27.6	29.2	19.7	21.8	23.3	28.0	9.5
VOC density as CH4 (lb/cuft)	0.0317	0.0326	0.0328	0.0312	0.0319	0.0314	0.0321	0.0330	0.0322	0.0337	0.0338
VOC ppmvw	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
VOC in stack gas (lb/h)	5.47	5.57	5.89	5.43	5.53	5.85	3.94	4.36	4.67	5.60	1.91
SO2 density (lb/cu ft)	0.1270	0.1305	0.1311	0.1246	0.1276	0.1256	0.1283	0.1321	0.1287	0.1347	0.1352
Sulfur in Natural Gas (grains/100 scf)	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	2.4
SO2 in stack gas (lb/h)	8.6	8.8	9.3	7.3	7.4	7.9	5.0	5.8	6.3	8.7	8.1
SO2 ppmvw	0.6	0.6	0.6	0.5	0.5	0.5	0.4	0.5	0.5	0.5	1.5
Natural Gas to CTG (lb/h)	143,635	146,658	155,302	143,715	146,740	155,302	99,160	114,694	125,067	145,212	49,658
Natural Gas to Duct Burner (lb/h)	26,157	26,605	28,406	0	0	0	0	0	0	26,764	0
Natural Gas MW (lb/lbmol)	16.04	16.04	16.04	16.04	16.04	16.04	16.04	16.04	16.04	16.04	16.04
Natural Gas total (scfh)	4,017,850	4,099,976	4,347,155	3,400,772	3,472,349	3,674,968	2,346,469	2,714,033	2,959,507	4,069,540	1,179,816
Stack diameter (ft)	18	18	18	18	18	18	18	18	18	18	18
Stack velocity (ft/s)	67.2	66.5	70.0	67.9	67.5	72.6	47.9	51.5	56.6	64.9	22.0

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TABLE C-2
BOILER CRITERIA POLLUTANT EMISSIONS CALCULATIONS

Emission Source: Auxiliary Boiler

Source Type: Natural Gas Fired Boiler
525 Horsepower @ 105% Capacity
26,361,000 Btu/hr

Operating Hours per Year: 1000

Compound	Emission Factor (a) (Lbs/MMBtu)	Emission Rate Hourly (b) (Lbs/Hr)	Emission Rate Annual (c) (Tons/Year)
Nitrogen Oxides	3.50E-02	9.23E-01	4.60E-01
Carbon Monoxide	3.70E-02	9.75E-01	4.90E-01
Volatile Organic Compound	1.60E-02	4.22E-01	2.10E-01
Sulfur Oxides	1.02E-03	2.70E-02	1.00E-02
Particulate	1.00E-02	2.64E-01	1.30E-01
Compound	Emission Factor (d) (Lbs/MMcf)	Emission Rate Hourly (e) (Lbs/Hr)	Emission Rate Annual (f) (Tons/Year)
Lead	5.00E-04	1.29E-05	6.45E-06

Notes:

(a) Emission Factors supplied by Vendor
(b) Hourly Emission Rate (Lbs/Hr) = (Emission Factor, Lbs/MMBtu) * (Fuel Input, Btu) / 1,000,000
(c) Annual Emission Rate (Tons/Yr) = (Hourly Emission Rate, Lbs/Hr) * (Hour of Operation Per Year, Hr/Yr) / (2,000 Lbs/Ton)
(d) Emission Factor from AP-42 Table 1.4-2
(e) Hourly Emission Rate (Lbs/Hr) = (Emission Factor, Lbs/MMcf) * (Fuel Input, MMBtu/hr) / 1020 Btu/s
(f) Annual Emission Rate (Tons/Yr) = (Hourly Emission Rate, Lbs/Hr) * (Hours of Operation Per Year, H (2,000 Lbs/Ton)

TABLE C-3
AUXILIARY BOILER EMISSIONS

Pollutant	Load (%)	Emissions (lbs/hr)
NOx	105	3.11
	100	2.96
	75	2.22
	50	1.48
	25	0.74
CO	105	3.95
	100	3.77
	75	2.82
	50	1.88
	25	0.94
VOC	105	0.42
	100	0.4
	75	0.3
	50	0.2
	25	0.1
SO2	105	0.03
	100	0.03
	75	0.02
	50	0.01
	25	0.01
PM10	105	0.26
	100	0.25
	75	0.19
	50	0.13
	25	0.06
Lead	105	0.00

TABLE C-4
COOLING TOWER PM10 EMISSION CALCULATIONS

Item	Large Cooling Tower	
Number of Cells	10	
Water Recirculation Rate (single cell)	12,120	gal/min
Recirculation Rate (all cells)	121,200	gal/min
TDS	12,000	ppm (mg/l) 15 conc cycles
Liquid Drift Emission Fraction	0.003%	Drift Fraction
PM10 fraction of PM	50%	Assumption
Drift Release Rate	3.64	gal/min
Drift Release Rate	826	l/hr
Total PM_{10}	10.9	lb/hr
Total PM_{10}	47.8	tons/year

PM_{10} (ton/yr) = Recirculation rate (gal/min) * 60 min/hr * 3.785 liters/gal * TDS conc (mg/liter) * 1lb / 453.6 g * 1g / 10^3 mg * 8760 hrs/yr / 2000 lb/ton * PM10 Fraction

TABLE C-5
FIRE-PUMP CRITERIA POLLUTANT EMISSIONS SUMMARY

Emission Source: Fire-Water Pump Engine

Source Type: Diesel Fueled Reciprocating Engine
400 Horsepower

Operating Hours per Year: 500

Compound	Emission Factor (a) (Lbs/BHP)	Emission Rate Hourly (b) (Lbs/Hr)	Emission Rate Annual (c) (Tons/Year)
Nitrogen Oxides	0.031	12.400	3.100
Carbon Monoxide	0.00668	2.672	0.668
Volatile Organic Carbon	0.00247	0.988	0.247
Sulfur Oxides	0.00205	0.820	0.205
Particulate	0.0022	0.880	0.220

Notes:

(a) Emission Factors from AP-42, Section 3.3, Table 3.3-1
(b) Hourly Emission Rate (Lbs/Hr) = (Emission Factor, Lbs/BHP) * (Horsepower, BHP)
(c) Annual Emission Rate (Tons/Yr) = (Hourly Emission Rate, Lbs/Hr) * (Hour of Operation Per Year, Hr/Yr) / (2,000 Lbs/Ton)

TABLE C-6
OIL/WATER SEPARATOR EMISSIONS CALCULATIONS

API Separator Design Waste Water Flow Rates (a)		
Average Hourly Flow Rate (Gal/Min)	6.67	
Maximum Hourly Flow Rate (Gal/Min)	10	
Weight % of VOC in Waste Water (b)		
Weight % Total VOC	100	
VOC Emission Factor (c)		
	Uncontrolled	Controlled
Lbs VOC/1000 Gal Waste Water	5	0.2
Total VOC Emissions (d, e)		
Average Hourly Emission Rate (Lbs/Hr)	2.001	0.080
Maximum Hourly Emission rate (Lbs/Hr)	3.000	0.120
Annual Emission Rate (Tons/Year)	8.764	0.351

NOTES:

(a) Flow rates are estimated. Unit normaly only used for storm water or unit wash water.

(b) Weight % based on expected maximum concentrations of each component.

(c) AP-42, Section 5.1, Petroleum Refining, Table 5.1-2

(d) Annual emissions calculated as (Flow Rate, GPM) • (60 Min/Hr) • (8760 Hr/ Yr) • (Emission Factor) • (Wt % of Component) / 2000 Lbs/Ton

(e) Hourly emissions calculated as (Flow Rate, GPM) * (60 Min/Hr) • (Emission Factor) • (Wt % of Component)

TABLE C-7
TURBINE TOXIC EMISSION CALCULATIONS

Source	Total Fuel Usage (MMscf/hr)		Op Hrs/Yr
2 CTGs	4.347		8,760

Pollutant	CAS	CAS	CATEF/AP-42 Emission Factor (lb/MMscf)	EPA Rating	Emission Rate lb/hr	lb/yr	On AAAQS List ?	Is a HAPS?
Acenaphthene	83-32-9	83329	1.90E-05	A	8.26E-05	7.23E-01	0	0
Acenaphthylene	208-96-8	208968	1.47E-05	A	6.41E-05	5.62E-01	0	0
Anthracene	120-12-7	120127	3.38E-05	A	1.47E-04	1.29E+00	0	0
Benzo(a)anthrac	56-55-3	56553	2.26E-05	A	9.83E-05	8.61E-01	1	0
Benzo(a)pyrene	50-32-8	50328	1.39E-05	A	6.03E-05	5.29E-01	1	0
Benzo(b)fluorant	205-99-2	205992	1.13E-05	A	4.90E-05	4.29E-01	0	0
Benzo(e)pyrene	192-97-2	192972	5.44E-07	D	2.36E-06	2.07E-02	0	0
Benzo(g,h,i)pery	191-24-2	191242	1.37E-05	A	5.96E-05	5.22E-01	0	0
Benzo(k)fluorant	207-08-9	207089	1.10E-05	A	4.77E-05	4.18E-01	0	0
Chrysene	218-01-9	218019	2.52E-05	A	1.09E-04	9.59E-01	0	0
Dibenzo(a,h)ant	53-70-3	53703	2.35E-05	A	1.02E-04	8.96E-01	1	0
Fluoranthene	206-44-0	206440	4.32E-05	A	1.88E-04	1.64E+00	0	0
Fluorene	86-73-7	86737	5.80E-05	A	2.52E-04	2.21E+00	0	0
Indeno(1,2,3-cd)	193-39-5	193395	2.35E-05	A	1.02E-04	8.96E-01	0	0
Naphthalene	91-20-3	91203	1.66E-03	A	7.22E-03	6.33E+01	1	1
Phenanthrene	85-01-8	85018	3.13E-04	A	1.36E-03	1.19E+01	0	0
Pyrene	129-00-0	129000	2.77E-05	A	1.20E-04	1.05E+00	0	0
2-Chloronaphtha	91-58-7	91587	2.72E-07	D	1.18E-06	1.04E-02	0	0
2-Methylnaphtha	91-57-6	91576	5.29E-06	D	2.30E-05	2.02E-01	0	0
Ethylbenzene	100-41-4	100414	1.79E-02	N	7.79E-02	6.83E+02	1	1
Perylene	198-55-0	198550	7.00E-07	D	3.04E-06	2.66E-02	0	0
1,3-Butadiene	106-99-0	106990	1.27E-04	D	5.52E-04	4.83E+00	1	1
Acetaldehyde	75-07-0	75070	6.86E-02	B	2.98E-01	2.61E+03	1	1
Acrolein	107-02-8	107028	2.37E-02	B	1.03E-01	9.03E+02	1	1
Benzene	71-43-2	71432	1.36E-02	A	5.90E-02	5.17E+02	1	1
Formaldehyde	50-00-0	50000	1.10E-01	N	4.78E-01	4.19E+03	1	1
Hexane	110-54-3	110543	2.59E-01	D	1.13E+00	9.87E+03	1	1
Propylene	115-07-1	115071	7.71E-01	B	3.35E+00	2.93E+04	0	0
Propylene Oxide	75-56-9	75569	4.78E-02	E	2.08E-01	1.82E+03	1	1
Toluene	108-88-3	108883	7.10E-02	N	3.09E-01	2.71E+03	1	1
Xylene (mixed is	1330-20-7	1330207	2.61E-02	C	1.13E-01	9.94E+02	1	1
Xylene (m)	108-38-3	108383	4.89E-02	D	2.13E-01	1.86E+03	1	1
Xylene (o)	95-47-6	95476	2.40E-02	D	1.04E-01	9.14E+02	1	1
Xylene (p)	106-42-3	106423	4.89E-02	D	2.13E-01	1.86E+03	1	1
Arsenic	7440-38-2	7440382	2.04E-04	E	8.87E-04	7.77E+00	1	1
Barium	7440-39-3	7440393	4.40E-03	D	1.91E-02	1.68E+02	1	0
Beryllium	7440-41-7	7440417	< 1.20E-05	E	5.22E-05	4.57E-01	1	1
Cadmium	7440-43-9	7440439	1.10E-03	D	4.78E-03	4.19E+01	1	1
Chromium	7440-47-3	7440473	1.40E-03	D	6.09E-03	5.33E+01	1	1
Cobalt	7440-48-4	7440484	8.40E-05	D	3.65E-04	3.20E+00	0	1
Copper	7440-50-8	7440508	8.50E-04	C	3.69E-03	3.24E+01	1	0
Manganese	7439-96-5	7439965	3.80E-04	D	1.65E-03	1.45E+01	1	1
Mercury	7439-97-6	7439976	2.60E-04	D	1.13E-03	9.90E+00	1	1
Molybdenum	7439-98-7	7439987	1.10E-03	D	4.78E-03	4.19E+01	0	0
Nickel	7440-02-0	7440020	2.10E-03	C	9.13E-03	8.00E+01	1	1
Selenium	7782-49-2	7782492	< 2.40E-05	E	1.04E-04	9.14E-01	1	1
Vanadium	7440-62-2	7440622	2.30E-03	D	1.00E-02	8.76E+01	1	0
Zinc	7440-66-6	7440666	2.90E-02	E	1.26E-01	1.10E+03	0	0
Lead	7439-92-1	7439921	5.00E-04	D	2.17E-03	1.90E+01	0	0

Organics: California Air Toxic Emission Factors (CATEF) Database, Version 1.2
Metals: AP-42 Table 1.4-4, Natural Gas External Combustion
Lead: AP-42 Table 1.4-2, Natural Gas External Combustion

TABLE C-8
BOILER TOXIC EMISSIONS CALCULATIONS

Natural Gas Combustion

Source	Gas Usage (MMBtu/hr)	Op Hrs/Yr
Auxiliary Boiler	26.3	1,000

Pollutant	CAS	AP-42 Emission Factor (lb/MMscf)	Rating Factor	Emission Rate lb/hr	lb/yr	On AAAQS List	Is a HAPS?
3-Methylchloranthrene	56-49-5	< 1.8E-06	E	4.64E-08	4.64E-05	1	0
2-Methylnaphthalene	91-57-6	0.000024	D	6.19E-07	6.19E-04	0	0
7,12-Dimethylbenz(a)anthracene		< 0.000016	E	4.13E-07	4.13E-04	0	0
Acenaphthene	83-32-9	< 1.8E-06	E	4.64E-08	4.64E-05	0	0
Acenaphthylene	203-96-8	< 1.8E-06	E	4.64E-08	4.64E-05	0	0
Anthracene	120-12-7	< 2.4E-06	E	6.19E-08	6.19E-05	0	0
Arsenic	7440-38-2	0.0002	E	5.16E-06	5.16E-03	1	1
Barium	7440-39-3	0.0044	D	1.14E-04	1.14E-01	1	0
Benz(a)anthracene	56-55-3	< 1.8E-06	E	4.64E-08	4.64E-05	1	0
Benzene	71-43-2	0.0021	B	5.42E-05	5.42E-02	1	1
Benzo(a)pyrene	50-32-8	< 1.2E-06	E	3.10E-08	3.10E-05	1	0
Benzo(b)fluoranthene	205-99-2	< 1.8E-06	E	4.64E-08	4.64E-05	0	0
Benzo(g,h,i)pelylene	191-24-2	< 1.2E-06	E	3.10E-08	3.10E-05	0	0
Benzo(k)fluoranthene	205-82-3	< 1.8E-06	E	4.64E-08	4.64E-05	0	0
Beryllium	7440-41-7	< 0.000012	E	3.10E-07	3.10E-04	1	1
Butane	106-97-8	2.1	E	5.42E-02	5.42E+01	0	0
Cadmium	7440-43-9	0.0011	D	2.84E-05	2.84E-02	1	1
Chromium	7440-47-3	0.0014	D	3.61E-05	3.61E-02	1	1
Chrysene	218-01-9	< 1.8E-06	E	4.64E-08	4.64E-05	0	0
Cobalt	7440-48-4	0.000084	D	2.17E-06	2.17E-03	0	1
Copper	7440-50-8	0.00085	C	2.19E-05	2.19E-02	1	0
Dibenzo(a,h)anthracene	53-70-3	< 1.2E-06	E	3.10E-08	3.10E-05	1	0
Dichlorobenzene	25321-22-6	0.0012	E	3.10E-05	3.10E-02	0	0
Ethane	74-84-0	3.1	E	8.00E-02	8.00E+01	0	0
Fluoranthene	206-44-0	0.000003	E	7.74E-08	7.74E-05	0	0
Fluorene	86-73-7	2.8E-06	E	7.22E-08	7.22E-05	0	0
Formaldehyde	50-00-0	0.075	B	1.94E-03	1.94E+00	1	1
Hexane	110-54-3	1.8	E	4.64E-02	4.64E+01	1	1
Indenol,2,3-cd)pyrene	193-39-5	< 1.8E-06	E	4.64E-08	4.64E-05	0	0
Manganese	7439-96-5	0.00038	D	9.80E-06	9.80E-03	1	1
Mercury	7439-97-6	0.00026	D	6.71E-06	6.71E-03	1	1
Molybdenum	7439-98-7	0.0011	D	2.84E-05	2.84E-02	0	0
Naphthalene	91-20-3	0.00061	E	1.57E-05	1.57E-02	1	1
Nickel	7440-02-0	0.0021	C	5.42E-05	5.42E-02	1	1
Pentane	109-66-0	2.6	E	6.71E-02	6.71E+01	0	0
Phenanathrene	85-01-8	0.000017	D	4.39E-07	4.39E-04	0	0
Propane	74-98-6	1.6	E	4.13E-02	4.13E+01	0	0
Pyrene	129-00-0	0.000005	E	1.29E-07	1.29E-04	0	0
Selenium	7782-49-2	< 0.000024	E	6.19E-07	6.19E-04	1	1
Toluene	108-88-3	0.0034	E	8.77E-05	8.77E-02	1	1
Vanadium	7440-62-2	0.0023	D	5.93E-05	5.93E-02	1	0
Zinc	7440-66-6	0.029	E	7.48E-04	7.48E-01	0	0
Lead	7439-92-1	0.0005	D	1.29E-05	1.29E-02	0	0

Utility Boiler rated at 600 HP.
1.0 boiler HP output = 33,475 Btu/hr heat output
Assume 80% efficieny output efficiency.
Emissions at 105% load and 525 hp
AP-42 Tables 1.4-3 and 1.4-4, Natural Gas External Combustion
Lead: AP-42 Table 1.4-2, Natural Gas External Combustion
Assumed gas heat content of 1,020 Btu/scf based on Footnote A, Table 1.4-3 and 1.4-4.

TABLE C-9
TOXIC EMISSIONS SUMMARY

Duke Energy Maricopa County

Combustion Air Toxic Emissions Summary

Pollutant	CAS Number	CAS Number	Short-Term Air Toxic Emissions			Annual Air Toxic Emissions			On AAAQS List?	Is a HAPS?	HAPS Emissions (ton/yr)
			Combustion Turbines (2) (lb/hr)	Auxiliary Boiler (lb/hr)	Total (lb/hr)	Combustion Turbines (2) (lb/yr)	Auxiliary Boiler (lb/yr)	Total (lb/yr)			
1,3-Butadiene	106-99-0	106990	5.52E-04	0.00E+00	5.52E-04	4.83E+00	0.00E+00	4.83E+00	1	1	2.42E-03
3-Methylchloranthrene	56-49-5	56495	0.00E+00	4.64E-08	4.64E-08	0.00E+00	4.64E-05	4.64E-05	1	0	0.00E+00
Acetaldehyde	75-07-0	75070	2.98E-01	0.00E+00	2.98E-01	2.61E+03	0.00E+00	2.61E+03	1	1	1.31E+00
Acrolein	107-02-8	107028	1.03E-01	0.00E+00	1.03E-01	9.03E+02	0.00E+00	9.03E+02	1	1	4.52E-01
Arsenic	7440-38-2	7440382	8.87E-04	5.16E-06	8.92E-04	7.77E+00	5.16E-03	7.77E+00	1	1	3.89E-03
Barium	7440-39-3	7440393	1.91E-02	1.14E-04	1.92E-02	1.68E+02	1.14E-01	1.68E+02	1	0	0.00E+00
Benz(a)anthracene	56-55-3	56553	9.83E-05	4.64E-08	9.83E-05	8.61E-01	4.64E-05	8.61E-01	1	0	0.00E+00
Benzene	71-43-2	71432	5.90E-02	5.42E-05	5.90E-02	5.17E+02	5.42E-02	5.17E+02	1	1	2.58E-01
Benzo(a)anthracene	56-55-3	56553	9.83E-05	4.64E-08	9.83E-05	8.61E-01	4.64E-05	8.61E-01	1	0	0.00E+00
Benzo(a)pyrene	50-32-8	50328	6.03E-05	3.10E-08	6.04E-05	5.29E-01	3.10E-05	5.29E-01	1	0	0.00E+00
Beryllium	7440-41-7	7440417	5.22E-05	3.10E-07	5.25E-05	4.57E-01	3.10E-04	4.57E-01	1	1	2.29E-04
Cadmium	7440-43-9	7440439	4.78E-03	2.84E-05	4.81E-03	4.19E+01	2.84E-02	4.19E+01	1	1	2.10E-02
Chromium	7440-47-3	7440473	6.09E-03	3.61E-05	6.12E-03	5.33E+01	3.61E-02	5.33E+01	1	1	2.67E-02
Cobalt	7440-48-4	7440484	3.65E-04	2.17E-06	3.67E-04	3.20E+00	2.17E-03	3.20E+00	0	1	1.60E-03
Copper	7440-50-8	7440508	3.69E-03	2.19E-05	3.72E-03	3.24E+01	2.19E-02	3.24E+01	1	0	0.00E+00
Dibenz(a,h)anthracene	53-70-3	53703	1.02E-04	3.10E-08	1.02E-04	8.96E-01	3.10E-05	8.96E-01	1	0	0.00E+00
Ethylbenzene	100-41-4	100414	7.79E-02	0.00E+00	7.79E-02	6.83E+02	0.00E+00	6.83E+02	1	1	3.41E-01
Formaldehyde	50-00-0	50000	4.78E-01	1.94E-03	4.80E-01	4.19E+03	1.94E+00	4.19E+03	1	1	2.10E+00
Hexane	110-54-3	110543	1.13E+00	4.64E-02	1.17E+00	9.87E+03	4.64E+01	9.92E+03	1	1	4.96E+00
Manganese	7439-96-5	7439965	1.65E-03	9.80E-06	1.66E-03	1.45E+01	9.80E-03	1.45E+01	1	1	7.24E-03
Mercury	7439-97-6	7439976	1.13E-03	6.71E-06	1.14E-03	9.90E+00	6.71E-03	9.91E+00	1	1	4.95E-03
Naphthalene	91-20-3	91203	7.22E-03	1.57E-05	7.24E-03	6.33E+01	1.57E-02	6.33E+01	1	1	3.16E-02
Nickel	7440-02-0	7440020	9.13E-03	5.42E-05	9.18E-03	8.00E+01	5.42E-02	8.00E+01	1	1	4.00E-02
Propylene Oxide	75-56-9	75569	2.08E-01	0.00E+00	2.08E-01	1.82E+03	0.00E+00	1.82E+03	1	1	9.09E-01
Selenium	7782-49-2	7782492	1.04E-04	6.19E-07	1.05E-04	9.14E-01	6.19E-04	9.15E-01	1	1	4.57E-04
Toluene	108-88-3	108883	3.09E-01	8.77E-05	3.09E-01	2.71E+03	8.77E-02	2.71E+03	1	1	1.35E+00
Vanadium	7440-62-2	7440622	1.00E-02	5.93E-05	1.01E-02	8.76E+01	5.93E-02	8.76E+01	1	0	0.00E+00
Xylene (m)	108-38-3	108383	2.13E-01	0.00E+00	2.13E-01	1.86E+03	0.00E+00	1.86E+03	1	1	9.32E-01
Xylene (o)	95-47-6	95476	1.04E-01	0.00E+00	1.04E-01	9.14E+02	0.00E+00	9.14E+02	1	1	4.57E-01
Xylene (p)	106-42-3	106423	2.13E-01	0.00E+00	2.13E-01	1.86E+03	0.00E+00	1.86E+03	1	1	9.32E-01
Xylene (Total)	1330-20-7	1330207	1.13E-01	0.00E+00	1.13E-01	9.94E+02	0.00E+00	9.94E+02	1	1	4.97E-01
Arsenic	7440-38-2	7440382	8.87E-04	5.16E-06	8.92E-04	7.77E+00	5.16E-03	7.77E+00	1	1	3.89E-03
Barium	7440-39-3	7440393	1.91E-02	1.14E-04	1.92E-02	1.68E+02	1.14E-01	1.68E+02	1	0	0.00E+00
Beryllium	7440-41-7	7440417	5.22E-05	3.10E-07	5.25E-05	4.57E-01	3.10E-04	4.57E-01	1	1	2.29E-04
Cadmium	7440-43-9	7440439	4.78E-03	2.84E-05	4.81E-03	4.19E+01	2.84E-02	4.19E+01	1	1	2.10E-02
Chromium	7440-47-3	7440473	6.09E-03	3.61E-05	6.12E-03	5.33E+01	3.61E-02	5.33E+01	1	1	2.67E-02
Cobalt	7440-48-4	7440484	3.65E-04	2.17E-06	3.67E-04	3.20E+00	2.17E-03	3.20E+00	0	1	1.60E-03
Copper	7440-50-8	7440508	3.69E-03	2.19E-05	3.72E-03	3.24E+01	2.19E-02	3.24E+01	1	0	0.00E+00
Manganese	7439-96-5	7439965	1.65E-03	9.80E-06	1.66E-03	1.45E+01	9.80E-03	1.45E+01	1	1	7.24E-03
Mercury	7439-97-6	7439976	1.13E-03	6.71E-06	1.14E-03	9.90E+00	6.71E-03	9.91E+00	1	1	4.95E-03
Nickel	7440-02-0	7440020	9.13E-03	5.42E-05	9.18E-03	8.00E+01	5.42E-02	8.00E+01	1	1	4.00E-02
Selenium	7782-49-2	7782492	1.04E-04	6.19E-07	1.05E-04	9.14E-01	6.19E-04	9.15E-01	1	1	4.57E-04
Vanadium	7440-62-2	7440622	1.00E-02	5.93E-05	1.01E-02	8.76E+01	5.93E-02	8.76E+01	1	0	0.00E+00
HAPS Totals (tons/year)											14.74

APPENDIX D
SUPPORTING INFORMATION FOR CONTROL TECHNOLOGY REVIEW

Table D-1
RACT/BACT/LAER Clearinghouse
Results for Natural Gas Fired Combustion Turbines (NO_x)

Facility	City	St.	Permit Number	Permit Date	Process	Throughput	Throughput Units	Pollutant	Emission	Emission Units	Control Description	Basis
PDC EL PASO MILFORD LLC	MILFORD	CT	105-0068	4/16/99	TURBINE, COMBUSTION, ABB GT-24, #1 WITH 2 CHILLERS	1.97	MMCF/H	NOX	2.0000	PPMV @ 15% O2 GAS	SCR WITH AMMONIA INJECTION	LAER
PDC EL PASO MILFORD LLC	MILFORD	CT	105-0069	4/16/99	TURBINE, COMBUSTION, ABB GT-24E,#2 WITH 2 CHILLERS	1.97	MMCF/H	NOX	2.0000	PPMV @ 15% O2 GAS	SCR WITH AMMONIA INJECTION	LAER
ALABAMA POWER COMPANY - THEODORE COGENERATION	THEODORE	AL	503-6073	3/16/99	TURBINE, WITH DUCT BURNER	170.00	MW	NO2	0.0130	LB/MMBTU	DLN COMBUSTOR IN CT, LNB IN DUCT BURNER, SCR	BACT-PSD
WYANDOTTE ENERGY	WYANDOTTE	MI	279-98	2/8/99	TURBINE, COMBINED CYCLE, POWER PLANT	500.00	MW	NOX	4.5000	PPM	SCR	BACT
COLORADO SPRINGS UTILITIES	FOUNTAIN	CO	0410030	1/4/99	TURBINE, COMBINE, NATURAL GAS	30.00	MW EACH	NOX	15.0000	PPMVD ABOVE 70% LOAD	POLLUTION PREVENTION BUILT INTO EQUIPMENT.	BACT-PSD
SANTA ROSA ENERGY LLC	NORTHBROOK	FL	PSD-FL 253	12/4/98	TURBINE, COMBUSTION, NATURAL GAS	241.00	MW	NOX	9.8000	PPM@15%O2 DB ON	DRY LOW NOX BURNER	BACT-PSD
WESTBROOK POWER LLC	WESTBROOK	ME	A-743-71-A-N	12/4/98	TURBINE, COMBINED CYCLE, TWO	528.00	MW TOTAL	NOX	2.5000	PPM @15% O2	SELECTIVE CATALYTIC REDUCTION AND DRY LOW NOX BURNERS.	LAER
CHAMPION INTERNATL CORP. & CHAMP. CLEAN ENERGY	BUCKSPORT	ME	A-22-71-N-A	9/14/98	TURBINE, COMBINED CYCLE, NATURAL GAS	175.00	MW	NOX	9.0000	PPMVD @15% O2 GAS	DRY LOW NOX BURNER 1 OPTION IS CONSIDERED FOR OIL AND IS SELECTED.	BACT-OTHER
TNP TECHN, LLC (FORMERLY TX-NM POWER CO.)	LORDSBURG	NM	PSD-NM-90-M2	8/7/98	GAS TURBINES	375.00	MMBTU/H	NOX	15.0000	PPM	WATER INJECTION FOLLOWED BY SELECTIVE CATALYTIC REDUCTION (SCR)	BACT-PSD
CASCO RAY ENERGY CO	VEAZIE	ME	A-728	7/13/98	TURBINE, COMBINED CYCLE, NATURAL GAS,	170.00	MW EACH	NOX	3.5000	PPM @15% O2	SELECTIVE CATALYTIC REDUCTION	BACT-PSD
COLORADO SPRINGS UTILITIES-NIXON POWER PLANT	FOUNTAIN	CO	94EP132	6/30/98	SIMPLE CYCLE TURBINE, NATURAL GAS	1122.00	MM BTU/HR	NOX	25.0000	PPM @ 15% O2	DRY LOW NOX COMBUSTION	BACT-PSD
BRIDGEPORT ENERGY, LLC	BRIDGEPORT	CT	0150190 & 0150191	6/29/98	TURBINES, COMBUSTION MODEL V84.3A, 2 SIEMES	260.00	MW/HRSG PER TURBINE	NOX	6.0000	PPM NAT. GAS	DRY LOW NOX BURNER WITH SCR	BACT-PSD
RUMFORD POWER ASSOCIATES	RUMFORD	ME	A-724-71-A-N	5/1/98	TURBINE GENERATOR, COMBUSTION, NATURAL GAS	1906.00	MMBTU/H	NOX	3.5000	PPM @ 15% O2	SCR AMMONIA INJECTION SYSTEM AND CATALYTIC REACTOR TO REDUCE NOX.	BACT-PSD
SOUTHERN NATURAL GAS	WARD	AL	412-0013-X001 AND -X002	3/4/98	2-9160 HP GE MODEL MS3002G NATURAL GAS TURBINES	9160.00	HP	NO2	53.0000	LB/HR		BACT-PSD

Table D-1
RACT/BACT/LAER Clearinghouse
Results for Natural Gas Fired Combustion Turbines (NO_x)

SOUTHERN NATURAL GAS	AUBURN	AL	206-0021-X001 AND -X002	3/2/98	9160 HP GE MODEL M53002G NATURAL GAS FIRED TURBINE	9160.00	HP	NO2	53.0000	LB/HR		BACT-PSD
TWO ELK GENERATION PARTNERS, LIMITED PARTNERSHIP	15 MILES SE OF WRIGHT	WY	CT-1352	2/27/98	TURBINE, STATIONARY	33.30	MW	NOX	25.0000	PPM @ 15% O2	DRY LOW NOX BURNERS	BACT-PSD
TIVERTON POWER ASSOCIATES	TIVERTON	RI	RI-PSD-5	2/13/98	COMBUSTION TURBINE, NATURAL GAS	265.00	MW	NO2	3.5000	PPM @ 15% O2	SCR	LAER
AIR LIQUIDE AMERICA CORPORATION	GEISMAR	LA	PSD-LA-622	2/13/98	TURBINE GAS, GE, 7ME 7	966.00	MMBTU/H	NOX	9.0000	PPMV	DRY LOW NOX TO LIMIT NOX EMISSION TO 9PPMV	BACT-PSD
BASF CORPORATION	GEISMAR	LA	PSD-LA-613	12/30/97	TURBINE, COGEN UNIT 2, GE FRAME 6	42.40	MW	NOX	8.0000	PPMV NAT. GAS	STEAM INJECTION AND SCR TO LIMIT NOX TO 8 PPM FOR NATURAL GAS AND 25 PPM FOR WASTE GAS (60% H2)	BACT-PSD
BUCKNELL UNIVERSITY	LEWISBURG	PA	60-0001A	11/26/97	NG FIRED TURBINE, SOLAR TAURUS T-7300S	5.00	MW	NOX	25.0000	PPMV@15%O2	SOLONOX BURNER: LOW NOX BURNER	BACT-OTHER
DIGHTON POWER ASSOCIATE, LP	DIGHTON	MA	4B96096	10/6/97	TURBINE, COMBUSTION, ABB GT11N2	1327.00	MMBTU/H	NOX	17.1200	LB/H	DRY LOW NOX COMBUSTION TECHNOLOGY WITH SCR ADD-ON NOX CONTROL.	BACT-PSD
NORTHERN CALIFORNIA POWER AGENCY	LODI	CA	N-583-1-1	10/2/97	GE FRAME 5 GAS TURBINE	325.00	MMBTU/HR	NOX	25.0000	PPMVD @ 15% O2	DRY LOW NOX BURNERS	LAER
QUESTAR PIPELINE CORP. - RK SPRINGS COMPRESSOR COM	ROCK SPRINGS	WY	MD-333	9/25/97	TURBINE COMPRESSOR ENGINE, NATURAL	1001.00	HP	NOX	2.8000	G/B-HP-H		BACT-PSD
UNIVERSITY OF MEDICINE & DENTISTRY OF NEW JERSEY	NEWARK	NJ	087427/28/29 (3)	6/26/97	COMBUSTION TUR	56.00	MMBTU/H	NOX	0.1670	LB/MMBTU NAT.GAS		RACT
LORDSBURG L.P.	LORDSBURG	NM	PSD-NM-1975	6/18/97	TURBINE, NATURAL	100.00	MW	NO2	74.4000	LBS/HR	DRY LOW-NOX TECHNOLOGY WHICH ADOPTS STAGED OR SCHEDULED COMBUSTION	BACT-PSD
SOUTHERN CALIFORNIA GAS CO	WHEELER RID	CA	S-1792-5-3	5/14/97	VARIABLE LOAD NATURAL GAS FIRED TURBINE	50.10	MMBTU/HR	NOX	25.0000	PPMVD @ 15% O2	DRY LOW NOX COMBUSTOR	LAER
MEAD COATED BOARD, INC.	PHENIX CITY	AL	211-0004	3/12/97	COMBINED CYCLE	568.00	MMBTU/HR	NOX	25.0000	PPMVD@ 15% O2 (GAS)	FUEL OIL SULFUR CONTENT <=0.05% BY WEIGHT	BACT-PSD
FORMOSA PLASTICS CORPORATION, BATON ROUGE PLANT	BATON ROUGE	LA	PSD-LA-560 (M-2)	3/7/97	TURBINE/HSRG, GA	450.00	MM BTU/HR	NOX	9.0000	PPMV	DRY LOW NOX BURNER/COMBUSTION DESIGN AND CONSTRUCTION.	BACT-PSD
SOUTHWESTERN PUBLIC SERVICE COMPANY/ CUNNINGHAM STA	HOBBS	NM	PSD-NM-622-M-2	2/15/97	COMBUSTION TUR	100.00	MW	NOX	0.0000	SEE FACILITY NOTES	DRY LOW NOX COMBUSTION	BACT-PSD
CALRESOURCES LLC		CA	S-1543-5-3 AND 6-3	1/10/97	SOLAR MODEL 110	13.60	MMBTU/HR	NOX	69.0000	PPMVD @15% O2	NO CONTROL	LAER

Table 5-4
RACT/BACT/LAER Clearinghouse
Results for Natural Gas Fired Combustion Turbines (CO)

Facility	City	St.	Permit Number	Permit Date	Process	Throughput	Throughput Units	Pollutant	Emission	Emission Units	Control Description	Basis
PDC EL PASO MILFORD LLC	MILFORD	CT	105-0068	4/16/99	TURBINE, COMBUSTION, ABB GT	1.97	MMCF/H	CO	13.0000	LB/H NAT GAS	OXIDATION CATALYST	BACT-PSD
PDC EL PASO MILFORD LLC	MILFORD	CT	105-0069	4/16/99	TURBINE, COMBUSTION, ABB GT	1.97	MMCF/H	CO	13.0000	LB/H NAT GAS	OXIDATION CATALYST	BACT-PSD
ALABAMA POWER COMPANY - THEODORE	THEODORE	AL	503-8073	3/16/99	TURBINE, WITH DUCT BURNER	170.00	MW	CO	0.0860	LB/MMBTU	EFFICIENT COMBUSTION	BACT-PSD
WYANDOTTE ENERGY	WYANDOTTE	MI	279-98	2/8/99	TURBINE, COMBINED	500.00	MW	CO	3.0000	PPM	CATALYTIC OXIDIZER	LAER
WESTBROOK POWER LLC	WESTBROOK	ME	A-743-71-A-N	12/4/98	TURBINE, COMBINED	526.00	MW TOTAL	CO	15.0000	PPM @15% O2	USING 15 % EXCESS AIR.	BACT-PSD
SANTA ROSA ENERGY LLC	NORTHBROOK	FL	PSD-FL 253	12/4/98	TURBINE, COMBUSTIO	241.00	MW	CO	0.0000		DRY LOW NOX BURNER GOOD COMBUSTION PRACTICE	BACT-PSD
CHAMPION INTERNATL CORP. & CHAMP. CLEAN ENERGY	BUCKSPORT	ME	A-22-71-N-A	9/14/98	TURBINE, COMBINED	175.00	MW	CO	9.0000	PPMVD @15% O2 GAS		BACT-OTHER
TNP TECHN, LLC (FORMERLY TX-NM POWER CO.)	LORDSBURG	NM	PSD-NM-90-M2	8/7/98	GAS TURBINES	375.00	MMBTU/H	CO	18.0000	PPM	GOOD COMBUSTION PRACTICES	BACT-PSD
CASCO RAY ENERGY CO	VEAZIE	ME	A-728	7/13/98	TURBINE, COMBINED	170.00	MW EACH	CO	20.0000	PPM @ 15% O2	15% EXCESS AIR	BACT-PSD
COLORADO SPRINGS UTILITIES-NIXON POWER PLANT	FOUNTAIN	CO	94EP132	6/30/98	SIMPLE CYCLE TURBI	1122.00	MM BTU/HR	CO	0.8000	DRE	CATALYTIC OXIDATION	BACT-PSD
BRIDGEPORT ENERGY, LLC	BRIDGEPORT	CT	0150190 & 0150191	6/29/98	TURBINES, COMBUSTI	260.00	MW/HRSG PER TURBINE	CO	10.0000	PPM GAS & OIL	PRE-MIX FUEL FAIR TO OPTIMIZE EFFICIENCY ACTUAL EMISSIONS EXPECTED BETWEEN 5-7PPM	BACT-PSD
RUMFORD POWER ASSOCIA	RUMFORD	ME	A-724-71-A-N	5/1/98	TURBINE GENERATOR	1906.00	MMBTU/H	CO	15.0000	PPM @ 15% O2	GE DRY LOW-NOX COMBUSTOR DESIGN. GOOD COMBUSTION CONTROL.	BACT-PSD
TWO ELK GENERATION PARTNERS, LIMITED PARTNERSHIP	15 MILES SE OF WRIGHT	WY	CT-1352	2/27/98	TURBINE, STATIONAR	33.30	MW	CO	25.0000	PPM @ 15% O2		OTHER
AIR LIQUIDE AMERICA CORP	GEISMAR	LA	PSD-LA-622	2/13/98	TURBINE GAS, GE, 7M	966.00	MMBTU/H	CO	25.0000	PPMV	GOOD EQUIPMENT DESIGN, PROPER COMBUSTION TECHNIQUE AND MIN. 2% EXCESS O2	BACT-PSD
TIVERTON POWER ASSOCIA	TIVERTON	RI	RI-PSD-5	2/13/98	COMBUSTION TURBIN	265.00	MW	CO	12.0000	PPM @ 15% O2	GOOD COMBUSTION	BACT-PSD
BASF CORPORATION	GEISMAR	LA	PSD-LA-613	12/30/97	TURBINE, COGEN UNI	42.40	MW	CO	83.8300	LB/MMBTU	GOOD DESIGN, PROPER COMBUSTION TECHNIQUES, 2% EXCESS O2	BACT-PSD
BUCKNELL UNIVERSITY	LEWISBURG	PA	60-0001A	11/26/97	NG FIRED TURBINE, S	5.00	MW	CO	50.0000	PPMV@15%O2	GOOD COMBUSTION	BACT-OTHER
DIGHTON POWER ASSOCIAT	DIGHTON	MA	4B98096	10/6/97	TURBINE, COMBUSTIO	1327.00	MMBTU/H	CO	5.9700	LB/H	DRY LOW NOX COMBUSTION TECHNOLOGY WITH SCR ADD-ON NOX CONTROL.	BACT-PSD
QUESTAR PIPELINE CORP. - RK SPRINGS COMPRESSOR COM	ROCK SPRINGS	WY	MD-333	9/25/97	TURBINE COMPRESSOR ENGINE, NATURAL GAS FIRED, 2EA	1001.00	HP	CO	3.5000	G/B-HP-H		BACT-PSD
UNIVERSITY OF MEDICINE & DENTISTRY OF NEW JERSEY	NEWARK	NJ	087427/28/29 (3)	6/26/97	COMBUSTION TURBIN	56.00	MMBTU/H	CO	75.0000	PPMVD NAT. GAS		RACT
LORDSBURG L.P.	LORDSBURG	NM	PSD-NM-1975	6/18/97	TURBINE, NATURAL G	100.00	MW	CO	27.0000	LBS/HR	DRY LOW-NOX TECHNOLOGY BY MAINTAINING PROPER AIR- FUEL RATIO.	BACT-PSD
MEAD COATED BOARD, INC.	PHENIX CITY	AL	211-0004	3/12/97	COMBINED CYCLE TU	568.00	MMBTU/HR	CO	28.0000	PPMVD@15% O2 (GAS)	PROPER DESIGN AND GOOD COMBUSTION PRACTICES	BACT-PSD

Table D-2
RACT/BACT/LAER Clearinghouse
Results for Natural Gas Fired Combustion Turbines (CO)

FORMOSA PLASTICS CORPORATION, BATON ROUGE PLANT	BATON ROUGE	LA	PSD-LA-560 (M-2)	3/7/97	TURBINE/HSRG, GAS	450.00	MM BTU/HR	CO	70.0000	LB/HR	COMBUSTION DESIGN AND CONSTRUCTION.	BACT-PSD
SOUTHWESTERN PUBLIC SERVICE COMPANY/ CUNNINGHAM STA	HOBBS	NM	PSD-NM-622-M-2	2/15/97	COMBUSTION TURBIN	100.00	MW	CO	0.0000	SEE FACILITY NOT	GOOD COMBUSTION PRACTICES	BACT-PSD
ECOELECTRICA, L.P.	PENUELAS	PR	PR-0102	10/1/96	TURBINES, COMBINED	461.00	MW	CO, GAS	33.0000	PPMDV	COMBUSTION CONTROLS.	BACT-PSD
BLUE MOUNTAIN POWER, LP	RICHLAND	PA	09-328-009	7/31/96	COMBUSTION TURBIN	153.00	MW	CO	3.1000	PPM @ 15% O2	OXIDATION CATALYST 16 PPM @ 15% O2 WHEN FIRING NO. 2 OIL. AT 75% NG LIMIT SET TO 22.1 PPM	OTHER
PORTSIDE ENERGY CORP.	PORTAGE	IN	CP 127 5260	5/13/96	TURBINE, NATURAL G	83.00	MEGAWATT	CO, NON POWER MODE	12.0000	LBS/HR	GOOD COMBUSTION AND EMISSIONS NOT TO EXCEED 10 PPMVD AT 15% OXYGEN.	BACT-PSD
PORTSIDE ENERGY CORP.	PORTAGE	IN	CP 127 5260	5/13/96	TURBINE, NATURAL G	83.00	MEGAWATT	CO, POWER MODE	40.0000	LBS/HR	GOOD COMBUSTION AND EMISSIONS NOT TO EXCEED 40 PPMVD AT 15% OXYGEN.	BACT-PSD
PUBLIC SERVICE OF COLO.-F	PLATTEVILLE	CO	94WE609	5/1/96	COMBINED CYCLE TU	471.00	MW	CO	15.0000	PPMVD, SMPL CY	GOOD COMBUSTION CONTROL PRACTICES. COMMITMENT TO APATTERN OF OPERATION (LOAD VARIATIONS, ETC.) TO MINIMIZE OPERATION AT HIGH EMISSIONS.	BACT-PSD
MID-GEORGIA COGEN.	KATHLEEN	GA	4911-078-11753	4/3/96	COMBUSTION TURBIN	116.00	MW	CO	10.0000	PPMVD	COMPLETE COMBUSTION	BACT-PSD
GEORGIA GULF CORPORATI	PLAQUEMINE	LA	PSD-LA-592	3/26/96	GENERATOR, NATURA	1123.00	MM BTU/HR	CO	972.4000	TPY CAP FOR 3 TU	GOOD COMBUSTION PRACTICE AND PROPER OPERATION	BACT-PSD
KEY WEST CITY ELECTRIC S	KEY WEST	FL	AC44-245399 / PSD-FL-210	9/28/95	TURBINE, EXISTING C	23.00	MW	CO	20.0000	PPM @ 15% O2 FU	GOOD COMBUSTION	BACT-PSD
UNION CARBIDE CORPORATI	HAHNVILLE	LA	PSD-LA-590	9/22/95	GENERATOR, GAS TU	1313.00	MM BTU/HR	CO	198.6000	LB/HR	NO ADD-ON CONTROL GOOD COMBUSTION PRACTICE	BACT-PSD
BROOKLYN NAVY YARD COGENERATION PARTNERS L.P.	NEW YORK CITY	NY	2-6101-00185/00002-9	8/6/95	TURBINE, NATURAL G	240.00	MW	CO	4.0000	PPM @ 15% O2		LAER
PANDA-KATHLEEN, L.P.	LAKELAND	FL	AC53-251898/PSD-FL-218	6/1/95	COMBINED CYCLE CO	75.00	MW	CO	25.0000	PPM @ 15% O2	COMBUSTION CONTROLS STANDARD ONLY APPLIES IF GE CT IS SELECTED, THE ABB CT WAS LESS THAN SIGNIFICANT EMIS. INCR FOR CO	BACT-PSD
FORMOSA PLASTICS CORPORATION, LOUISIANA	BATON ROUGE	LA	PSD-LA-560 (M-1)	3/2/95	TURBINE/HRSG, GAS	450.00	MM BTU/HR	CO	25.8000	LB/HR	PROPER OPERATION	BACT-PSD
MARATHON OIL CO. - INDIAN BASIN N.G. PLAN	CARLSBAD	NM	PSD-NM-295-M-2	1/11/95	TURBINES, NATURAL	5500.00	HP	CO	13.2000	LBS/HR	LEAN-PREMIXED COMBUSTION TECHNOLOGY.	BACT-PSD
HERMISTON GENERATING C	HERMISTON	OR	30-0113	7/7/94	TURBINES, NATURAL	1696.00	MMBTU/H	CO	15.0000	PPM @ 15% O2	GOOD COMBUSTION PRACTICES	BACT-PSD
PORTLAND GENERAL ELECT	BOARDMAN	OR	25-0031	5/31/94	TURBINES, NATURAL	1720.00	MMBTU	CO	15.0000	PPM @ 15% O2	GOOD COMBUSTION PRACTICES	BACT-PSD
WEST CAMPUS COGENERAT	COLLEGE STATION	TX	23962/PSD-TX-837	5/2/94	GAS TURBINES	75.30	MW (TOTAL POWE	CO	300.0000	TPY	INTERNAL COMBUSTION CONTROLS	BACT
FLORIDA POWER CORPORATION POLK COUNTY SITE	BARTOW	FL	PSD-FL-195	2/25/94	TURBINE, NATURAL G	1510.00	MMBTU/H	CO	25.0000	PPMVD	GOOD COMBUSTION PRACTICES	BACT-PSD
INTERNATIONAL PAPER	MANSFIELD	LA	PSD-LA-93(M-3)	2/24/94	TURBINE/HRSG, GAS	338.00	MM BTU/HR TURBI	CO	185.9000	LB/HR	COMBUSTION CONTROL	BACT
MILAGRO, WILLIAMS FIELD S	BLOOMFIELD	NM	PSD-NM-859-M-4		TURBINE/COGEN, NAT	900.00	MMCF/DAY	CO	27.6000	PPM @ 15% O2		BACT-PSD
BALTIMORE GAS & ELECTRIC - PERRYMAN PLANT	PERRYMMAN	MD			TURBINE, 140 MW NAT	140.00	MW	CO	20.0000	PPM @ 15% O2	GOOD COMBUSTION PRACTICES	BACT-PSD

Table D-3
RACT/BACT/LAER Clearinghouse
Results for Natural Gas Fired Combustion Turbines (VOC)

Facility	City	St.	Permit Number	Permit Date	Process	hroughpu	Throughput Units	Pollutant	Emission	Emission Units	Control Description	Basis
PDC EL PASO MILFORD LLC	MILFORD	CT	105-0068	4/16/99	COMBUSTION, ABB GT-24, #1	1.97	MMCF/H	VOC	3.0000	LB/H NAT GAS	COMBUSTION CONTROLS	BACT
PDC EL PASO MILFORD LLC	MILFORD	CT	105-0069	4/16/99	COMBUSTION, ABB GT-24E,#2	1.97	MMCF/H	VOC	3.0000	LB/H NAT GAS	COMBUSTION CONTROLS	BACT
COMPANY - THEODORE	THEODORE	AL	503-8073	3/16/99	TURBINE, WITH DUCT BURNER	170.00	MW	VOC	0.0160	LB/MMBTU	EFFICIENT COMBUSTION	BACT-PSD
MOBILE ENERGY LLC	MOBILE	AL	503-8066	1/5/99	COMBINED CYCLE	168.00	MW	VOC	0.0060	LB/MMBTU	COMBUSTION PRACTICE	BACT-PSD
LIMITED PARTNERSHIP	GORHAM	ME	A-735	12/4/98	COMBINED CYCLE	900.00	MW TOTAL	VOC	0.0017	U NAT GAS	DISTILLATE OIL #2 IS USED.	BACT-PSD
WESTBROOK POWER LLC	WESTBROOK	ME	A-743-71-A-N	12/4/98	TURBINE, COMBINED CYCLE, TWO	528.00	MW TOTAL	VOC	0.4000	PPM @ 15% O2		BACT-PSD
CHAMPION INTERNATL CORP. & CHAMP. CLEAN ENERGY	BUCKSPORT	ME	A-22-71-N-A	9/14/98	TURBINE, COMBINED CYCLE, NATURAL GAS	175.00	MW	VOC	3.0000	LB/H GAS		BACT-OTHER
CASCO RAY ENERGY CO	VEAZIE	ME	A-728	7/13/98	TURBINE, COMBINED CYCLE, NATURAL GAS, TWO	170.00	MW EACH	VOC	1.0000	PPM	LOW NOX BURNER	BACT-PSD
TIVERTON POWER ASSOCIATES	TIVERTON	RI	RI-PSD-5	2/13/98	COMBUSTION TURBINE,	265.00	MW	VOC	2.0000	PPM @ 15% O2	GOOD COMBUSTION	BACT-PSD
BUCKNELL UNIVERSITY	LEWISBURG	PA	60-0001A	11/26/97	NG FIRED TURBINE, SOLAR	5.00	MW	VOC	25.0000	PPMV@15 %O2	GOOD COMBUSTION	BACT-OTHER
DIGHTON POWER ASSOCIATE, LP	DIGHTON	MA	4B96096	10/6/97	TURBINE, COMBUSTION, ABB GT11N2	1327.00	MMBTU/H	VOC	5.1000	LB/H	DRY LOW NOX COMBUSTION TECHNOLOGY WITH SCR ADD-ON NOX CONTROL.	BACT-PSD
NORTHERN CALIFORNIA POWER	LODI	CA	N-583-1-1	10/2/97	GE FRAME 5 GAS TURBINE	325.00	MMBTU/HR	VOC	8.0000	LB/HR	NATURAL GAS AS PRIMARY	LAER
SOUTHWESTERN PUBLIC SERVICE COMPANY/CUNNINGHAM STA	HOBBS	NM	PSD-NM-622-M	2/15/97	COMBUSTION TU	100.00	MW	VOC	0.0000			BACT-PSD
SOUTHWESTERN PUBLIC SERVICE CO/ CUNNINGHAM STATION	HOBBS	NM	PSD-NM-622-M	11/4/96	COMBUSTION TU	100.00	MW	VOC	0.0000	SEE P2	GOOD COMBUSTION PRACTICES	BACT-PSD
ECOELECTRICA, L.P.	PENUELAS	PR	PR-0102	10/1/96	TURBINES, COMBINED-CYCLE COGENERATION	461.00	MW	VOC, GA	5.0000	PPMDV	COMBUSTION CONTROLS.	BACT-PSD

Table D-3
RACT/BACT/LAER Clearinghouse
Results for Natural Gas Fired Combustion Turbines (VOC)

BLUE MOUNTAIN POWER, LP	RICHLAND	PA	09-328-009	7/31/96	COMBUSTION TURBINE WITH HEAT RECOVERY BOILER	153.00	MW	VOC	4.0000	PPM @ 15	OXIDATION CATALYST WHEN FIRING NO. 2 OIL EMISSION LIMIT = 4.4 PPMVD @ 15% O2. @ 75% LOAD ALTERNATE GAS LIMIT 7.6 PPM	LAER
PUBLIC SERVICE OF COLO. -FORT ST VRAIN	PLATTEVILLE	CO	94WE609	5/1/96	COMBINED CYCLE TURBINES (2), NATURAL	471.00	MW	VOC	1.4000	PPMVD, S	GOOD COMBUSTION CONTROL PRACTICES.	BACT-PSD
MID-GEORGIA COGEN.	KATHLEEN	GA	4911-076-1175	4/3/96	COMBUSTION TURBINE (2), NATURAL GAS	116.00	MW	VOC	6.0000	PPMVD	COMPLETE COMBUSTION	BACT-PSD
SEPCO	RIO LINDA	CA	10883	10/5/94	TURBINE, GAS COMBINED CYCLE GE MODEL 7	920.00	MMBTU/H	VOC	3.7000	LB/H	OXIDATION CATALYST	BACT
SACRAMENTO COGENERATION AUTHORITY P&G	SACRAMENTO	CA	11436	8/19/94	TURBINE, GAS, COMBINED CYCLE LM6000	421.40	MMBTU/H	VOC	1.1000	LB/H	OXIDATION CATALYST	BACT
WEST CAMPUS COGENERATION COMPANY	COLLEGE STA	TX	23962/PSD-TX-	5/2/94	GAS TURBINES	75.30	MW (TOTAL PO	VOC	38.0000	TPY	INTERNAL COMBUSTION CONTROLS	BACT
FLEETWOOD COGENERATION ASSOCIATES	FLEETWOOD	PA	06-328-001	4/22/94	NG TURBINE (GE LM6000) WITH WASTE HEAT BOILER	360.00	MMBTU/HR	VOC	4.4000	LB/HR	GOOD COMBUSTION PRACTICES	BACT-OTHER
FLORIDA POWER CORPORATION POLK COUNTY SITE	BARTOW	FL	PSD-FL-195	2/25/94	TURBINE, NATURAL GAS (2)	1510.00	MMBTU/H	VOC	7.0000	PPMVW	GOOD COMBUSTION PRACTICES	BACT-PSD
INTERNATIONAL PAPER	MANSFIELD	LA	PSD-LA-93(M-3	2/24/94	TURBINE/HRSG, GAS COGEN	338.00	MM BTU/HR TU	VOC	3.6000	LB/HR CO	COMBUSTION CONTROLS, FUEL SELECTION	BACT
BMW MANUFACTURING CORPORATION	GREER	SC	2060-0230-CA	1/7/94	TURBINE, NAT.GAS FIRED (3 -1 SPARE) AND 2 BOILERS	54.50	MM BTU/HR TURBINES	VOC	77.8600	LBS/DAY	EACH OF THE 2 BOILER-TURBINE USE A COMMON STACK	LAER
BRUSH COGENERATI	BRUSH	CO	91MR934I		TURBINE	350.00	MMBTU/H	VOC	26.7000	T/YR		OTHER

TABLE D-4
CAPITAL COST ESTIMATION FACTORS

Item	Basis
Direct Costs	
Purchased Equipment Cost	
Equipment cost + auxiliaries	A
Instrumentation	0.10 x A
Sales taxes	0.05 x A
Freight	0.05 x A
Total Purchased equipment cost, (PEC)	B = 1.22 x A
Direct installation costs	
Foundations and supports	0.08 x B
Handling and erection	0.14 x B
Electrical	0.04 x B
Piping	0.02 x B
Insulation for ductwork	0.01 x B
Painting	0.01 x B
Total direct installation cost	0.30 x B
Site Preparation	As Required
Buildings	As Required
Total Direct Cost, DC	1.30B + SP + Bldg.
Indirect Costs (Installation)	
Engineering	0.10 x B
Construction and field expenses	0.05 x B
Contractor fees	0.10 x B
Start-up	0.02 x B
Performance test	0.01 x B
Contingencies	Variable
Simple Interest During Construction (IDC)	
i = interest rate; n = interest periods	DC x i x n
Total Indirect Cost, IC	0.28B + IDC
Total Capital Investment (TCI) = DC + IC	**1.58B+ SP + Bldg. + IDC + Contingency**

TABLE D-5
ANNUALIZED COST FACTORS

Item	Cost Factor	Unit Cost
Direct Annual Costs, DC		
Operating labor		
Operator	0.5 hr/shift	$35.00/hr
Supervisor	15% Operating Labor	NA
Maintenance (SCR)		
SCR Labor Req.	1/2 hour per shift	$35.00/hr
Analyzer Labor Requirement	40 hr/yr	$35.00/hr
Catalyst Replacement Labor Req.	8 men for 40 hours every 3 yrs	$35.00/hr
Ammonia System Maintenance Labor Req.	40 hr/yr	$35.00/hr
Material	100% Maintenance Labor	NA
Supervisor	15% Labor	NA
Losses Due to Downtime	3 days/catalyst replacement	6.5 cents per kW-hr Peak Power 3.5 cents per kW-hr Base Load
Ammonia	29% aqueous ammonia	$315 per ton
Process Air	350 scf/lb NH_3	$0.20 per thousand scf
Catalyst	100% replaced/3 years	
Utilities		
Natural Gas	Saved Cost during Outage	$0.01/kWh
Electricity	NA	
Steam	NA	$4.19/1000 lb
Cooling Water	NA	$0.35/1000 gal
Wastewater Discharge	NA	$0.60/1000 gal
Solvent Waste Disposal	NA	$150/drum
Solid Waste Disposal	NA	$40/ton
Indirect Annual Costs, IC		
Overhead	60% labor + materials	
Administrative Charges	2% TCI	
Property Taxes	1% TCI	
Insurance	1% TCI	
Capital Recovery	CRF x TCI	
Total Indirect ($/yr)		
Total Annual Cost (TAC) ($)		Sum of Annual Costs
Total Pollutant Controlled (ton/yr)		As Calculated
Cost Effectiveness ($/ton)		**TAC/tpy controlled**

TABLE D-6
SCONOx COSTS

Control Efficiency (from 9 ppmvd to 2 ppmvd) (%)	78

Facility Input Data

Item	Value
Operating Schedule	
Shifts per day	3
Hours per day	24
Days per week	7
Hours per year	8,760
Source(s) Controlled	Power Block, ~ 290 MW @ Average Ambient Conditions
Power Output of Turbine (CTG Only) (kW)	170,405
Power Output CTG & Unfired HRSG (kW)	252,830
Power Output CTG & Fired HRSG (kW)	289,575
Estimated Total Flowrate (acfm)	885,525
Estimated Temperature (F)	187
Total Flowrate (scfm)	722,654
NOx From Source(s) (lb/hr)[1]	67.5
NOx From Source(s) (tpy)[2]	296
Site Specific Enclosure (Building) Cost	NA
Site Specific Electricity Value (Base Load) ($/kWh)	0.035
Site Specific Electricity Value (Peak Load) ($/kWh)	0.065
Site Specific Operating Cost ($/kWh)	0.010
Site Specific Operating Labor Cost ($/hr)	35
Site Specific Maint. Labor Cost ($/hr)	35

Capital Costs

	Value	Basis
Direct Costs		
1.) Purchased Equipment Cost		
a.) Equipment cost + auxiliaries	$7,299,250	Goal Line quote plus auxiliaries, A
b.) Instrumentation	$729,900	0.10 x A
c.) Sales taxes	$510,900	0.07 x A
d.) Freight	$365,000	0.05 x A
Total Purchased equipment cost, (PEC)	$8,905,050	B = 1.22 x A
2.) Direct installation costs		
a.) Foundations and supports	$712,400	0.08 x B
b.) Handling and erection	$1,246,700	0.14 x B
c.) Electrical	$356,200	0.04 x B
d.) Piping	$178,100	0.02 x B
e.) Insulation for ductwork	$89,100	0.01 x B
f.) Painting	$89,100	0.01 x B
Total direct installation cost	$2,671,600	0.30 x B
3.) Site preparation, SP	NA	NA
4.) Enclosure, Bldg.	NA	NA
Total Direct Cost, DC	$11,576,600	1.30B + SP + Bldg.
Indirect Costs (Installation)		
5.) Engineering	$890,500	0.10 x B
6.) Construction and field expenses	$445,300	0.05 x B
7.) Contractor fees	$890,500	0.10 x B
8.) Start-up	$178,100	0.02 x B
9.) Performance test	$89,100	0.01 x B
10.) Contingencies	$890,500	0.10 x B
11.) Simple Interest During Construction	$311,676.75	PEC x 7% x 0.5 years
Total Indirect Cost, IC	$3,695,677	0.31B + Other
Total Capital Investment (TCI) = DC + IC	**$15,272,300**	**1.61B + Bldg. + Other**

TABLE D-6
SCONOx COSTS

Annual Costs

Item	Value	Basis	Source
1) Electricity			
Press. Drop (in. W.C.)	2.0	ressure drop - catalyst bed with dilution ai	Vendor, estimate
Power Output of Turbine (CTG only) (kW)	170,405		Vendor
Power Loss Due to Pressure Drop (%)	0.20%	0.1% for every 1" pressure drop	Vendor
Power Loss Due to Pressure Drop (kW)	341		
Unit Cost ($/kWh)	$0.035	Estimated Market Value	Estimate
Cost of Heat Rate Loss ($/yr)	$104,490		
Total Cost ($/yr)	$104,490		
2) Operating Labor			
SCONOx Requirement (hr/yr)	1095	8,760 operating hours per year	Estimate
Catalyst Cleaning (hr/yr)	80.0	2 workers x 40 hours per year	
Unit Cost ($/hr)	$35.00	Facility Data	Estimate
Cost ($/yr)	$41,125		
3) Supervisory Labor			
Cost ($/yr)	$6,170	15% Operating Labor	OAQPS
4) Maintenance			
SCONOx Labor Req. (hr/yr)	547.5	1/2 hour per shift	OAQPS
Catalyst Replacement Labor Req. (hr/yr)	106.7	8 workers for 40 hours every 3 yrs	Estimate
Unit Cost ($/hr)	$35.00	Facility Data	Estimate
Labor Cost ($/yr)	$22,896		
Material Cost ($/yr)	$22,900	100% of Maintenance Labor	OAQPS
Total Cost ($/yr)	$45,800		
5) Catalyst Replacement			
Catalyst Cost ($)	$3,970,500	Catalyst modules	Vendor
Catalyst Disposal Cost ($)	$50,000	Disposal of catalyst modules	Estimate
Sales Tax ($)	$201,025	5% Sales Tax	as of 1/1/99
Power Output of CTG & Unfired HRSG (kW)	252,830		
Power Output of Fired HRSG (Peak) (kW)	36,745		
Base Load Power Loss During Replacement (kWh)	18,203,760	3 days shut down every three years	
Peak Load Power Loss During Replacement (kWh)	2,645,604		
Cost of Energy Loss During Catalyst Replacement ($)	$600,602		
Catalyst Life (yrs)	3	n	OAQPS
Interest Rate (%)	7	i	
CRF	0.38	Amortization of Catalyst	OAQPS
Annual Cost ($/yr)	$1,837,480	(Volume)(Unit Cost)(CRF)	
6) Other Annual Expenses			
Contingency ($/yr)	$1,157,660	10% of DC - Annual Contingency	Estimate
Annual Cost ($/yr)	$1,157,660		
7) Indirect Annual Costs			
Overhead	$55,860	60% of O&M Costs	OAQPS
Administration	$305,450	2% of Total Capital Investment	OAQPS
Property Tax	$152,720	1% of Total Capital Investment	OAQPS
Insurance	$152,720	1% of Total Capital Investment	OAQPS
Capital Life (yrs)	10	n	
Interest Rate (%)	7	i	
CRF	0.14	Amortization of Capital Costs	
Capital Recovery	$1,609,120	(Capital Cost)(CRF)	OAQPS
Total Indirect ($/yr)	$2,275,870		
Total Annualized Cost ($/yr)	**$5,468,600**		
Total NOx Controlled (tpy)	**230.2**		
Cost Effectiveness ($/ton)	**$23,800**		

TABLE D-7
OXIDATION CATALYST FOR CO CONTROL

Control Efficiency (%)	85

Facility Input Data

Item	Value
Operating Schedule	
Shifts per day	3
Hours per day	24
Days per week	7
Hours per year	8,760
Source(s) Controlled	Power Block, ~ 290 MW @ Average Ambient Conditions
Power Output of Turbine (CTG Only) (kW)	170,405
Power Output CTG & Unfired HRSG (kW)	252,830
Power Output CTG & Fired HRSG (kW)	289,575
Estimated Total Flowrate (acfm)	885,525
Estimated Temperature (F)	187
Total Flowrate (scfm)	722,654
CO From Source(s) (lb/hr)[1]	63.0
CO From Source(s) (tpy)[2]	276
Site Specific Enclosure (Building) Cost	NA
Site Specific Electricity Value (Base Load) ($/kWh)	0.035
Site Specific Electricity Value (Peak Load) ($/kWh)	0.065
Site Specific Operating Cost ($/kWh)	0.010
Site Specific Operating Labor Cost ($/hr)	35
Site Specific Maint. Labor Cost ($/hr)	35

Capital Costs

	Value	Basis
Direct Costs		
1.) Purchased Equipment Cost		
a.) Equipment cost + auxiliaries	$1,288,522	Engelhard quote plus auxiliaries, A
b.) Instrumentation	$128,900	0.10 x A
c.) Sales taxes	$64,400	0.05 x A
d.) Freight	$64,400	0.05 x A
Total Purchased equipment cost, (PEC)	$1,546,222	B = 1.22 x A
2.) Direct installation costs		
a.) Foundations and supports	$123,700	0.08 x B
b.) Handling and erection	$216,500	0.14 x B
c.) Electrical	$61,800	0.04 x B
d.) Piping	$30,900	0.02 x B
e.) Insulation for ductwork	$15,500	0.01 x B
f.) Painting	$15,500	0.01 x B
Total direct installation cost	$463,900	0.30 x B
3.) Site preparation, SP	NA	NA
4.) Enclosure, Bldg.	NA	NA
Total Direct Cost, DC	$2,010,100	1.30B + SP + Bldg.
Indirect Costs (installation)		
5.) Engineering	$154,600	0.10 x B
6.) Construction and field expenses	$77,300	0.05 x B
7.) Contractor fees	$154,600	0.10 x B
8.) Start-up	$30,900	0.02 x B
9.) Performance test	$15,500	0.01 x B
10.) Contingencies	$46,400	0.03 x B
11.) Simple Interest During Construction	$54,117.79	PEC x 7% x 0.5 years
Total Indirect Cost, IC	$533,418	0.31B + Other
Total Capital Investment (TCI) = DC + IC	**$2,543,500**	**1.61B + Bldg. + Other**

TABLE D-7
OXIDATION CATALYST FOR CO CONTROL

Annual Costs

Item	Value	Basis	Source
1) Electricity			
Press. Drop (in. W.C.)	3.0	ressure drop - catalyst bed with dilution ai	Vendor, estimate
Power Output of Turbine (kW)	170,405		Vendor
Power Loss Due to Pressure Drop (%)	0.30%	0.1% for every 1" pressure drop	Vendor
Power Loss Due to Pressure Drop (kW)	511		
Unit Cost ($/kWh)	$0.035	Estimated Market Value	Estimate
Cost of Heat Rate Loss ($/yr)	$156,740		
Total Cost ($/yr)	$156,740		
2) Operating Labor			
CO Catalyst Requirement (hr/yr)	1095	8,760 operating hours per year	Estimate
Catalyst Cleaning (hr/yr)	80.0	2 workers x 40 hours per year	
Unit Cost ($/hr)	$35.00	Facility Data	Estimate
Cost ($/yr)	$41,125		
3) Supervisory Labor			
Cost ($/yr)	$6,170	15% Operating Labor	OAQPS
4) Maintenance			
CO Catalyst Labor Req. (hr/yr)	547.5	1/2 hour per shift	OAQPS
Catalyst Replacement Labor Req. (hr/yr)	106.7	8 workers for 40 hours every 3 yrs	Estimate
Unit Cost ($/hr)	$35.00	Facility Data	Estimate
Labor Cost ($/yr)	$22,896		
Material Cost ($/yr)	$22,900	100% of Maintenance Labor	OAQPS
Total Cost ($/yr)	$45,800		
5) Catalyst Replacement			
Catalyst Cost ($)	$710,373	Catalyst modules	Vendor
Catalyst Disposal Cost ($)	$50,000	Disposal of catalyst modules	Estimate
Sales Tax ($)	$38,019	5% Sales Tax	as of 1/1/99
Power Output of CTG & Unfired HRSG (kW)	252,830		
Power Output of Fired HRSG (Peak) (kW)	36,745		
Base Load Power Loss During Replacement (kW	18,203,760	3 days shut down every three years	
Peak Load Power Loss During Replacement (kW	2,645,604		
Cost of Energy Loss During Catalyst Replaceme	$600,602		
Catalyst Life (yrs)	3	n	OAQPS
Interest Rate (%)	7	i	
CRF	0.38	Amortization of Catalyst	OAQPS
Annual Cost ($/yr)	$533,090	(Volume)(Unit Cost)(CRF)	
7) Indirect Annual Costs			
Overhead	$55,860	60% of O&M Costs	OAQPS
Administration	$50,870	2% of Total Capital Investment	OAQPS
Property Tax	$25,440	1% of Total Capital Investment	OAQPS
Insurance	$25,440	1% of Total Capital Investment	OAQPS
Capital Life (yrs)	10	n	
Interest Rate (%)	7	i	
CRF	0.14	Amortization of Capital Costs	
Capital Recovery	$261,000	(Capital Cost)(CRF)	OAQPS
Total Indirect ($/yr)	$418,610		
Total Annualized Cost ($/yr)	**$1,201,500**		
Total CO Controlled (tpy)	**234.4**		
Cost Effectiveness ($/ton)	**$5,100**		

TABLE D-8
OXIDATION CATALYST FOR VOC CONTROL

Control Efficiency (%)	44

Facility Input Data

Item	Value
Operating Schedule	
Shifts per day	3
Hours per day	24
Days per week	7
Hours per year	8,760
Source(s) Controlled	Power Block, ~ 290 MW @ Average Ambient Conditions
Power Output of Turbine (CTG Only) (kW)	170,405
Power Output CTG & Unfired HRSG (kW)	252,830
Power Output CTG & Fired HRSG (kW)	289,575
Estimated Total Flowrate (acfm)	885,525
Estimated Temperature (F)	187
Total Flowrate (scfm)	722,654
CO From Source(s) (lb/hr)[1]	9
CO From Source(s) (tpy)[2]	40
Site Specific Enclosure (Building) Cost	NA
Site Specific Electricity Value (Base Load) ($/kWh)	0.035
Site Specific Electricity Value (Peak Load) ($/kWh)	0.065
Site Specific Operating Cost ($/kWh)	0.010
Site Specific Operating Labor Cost ($/hr)	35
Site Specific Maint. Labor Cost ($/hr)	35

Capital Costs

	Value	Basis
Direct Costs		
1.) Purchased Equipment Cost		
a.) Equipment cost + auxiliaries	$1,288,522	Engelhard quote plus auxiliaries, A
b.) Instrumentation	$128,900	0.10 x A
c.) Sales taxes	$64,400	0.05 x A
d.) Freight	$64,400	0.05 x A
Total Purchased equipment cost, (PEC)	$1,546,222	B = 1.22 x A
2.) Direct installation costs		
a.) Foundations and supports	$123,700	0.08 x B
b.) Handling and erection	$216,500	0.14 x B
c.) Electrical	$61,800	0.04 x B
d.) Piping	$30,900	0.02 x B
e.) Insulation for ductwork	$15,500	0.01 x B
f.) Painting	$15,500	0.01 x B
Total direct installation cost	$463,900	0.30 x B
3.) Site preparation, SP	NA	NA
4.) Enclosure, Bldg.	NA	NA
Total Direct Cost, DC	$2,010,100	1.30B + SP + Bldg.
Indirect Costs (installation)		
5.) Engineering	$154,600	0.10 x B
6.) Construction and field expenses	$77,300	0.05 x B
7.) Contractor fees	$154,600	0.10 x B
8.) Start-up	$30,900	0.02 x B
9.) Performance test	$15,500	0.01 x B
10.) Contingencies	$46,400	0.03 x B
11.) Simple Interest During Construction	$54,117.79	PEC x 7% x 0.5 years
Total Indirect Cost, IC	$533,418	0.31B + Other
Total Capital Investment (TCI) = DC + IC	**$2,543,500**	**1.61B + Bldg. + Other**

TABLE D-8
OXIDATION CATALYST FOR VOC CONTROL

Annual Costs

Item	Value	Basis	Source
1) Electricity			
Press. Drop (in. W.C.)	3.0	ressure drop - catalyst bed with dilution ai	Vendor, estimate
Power Output of Turbine (kW)	170,405		Vendor
Power Loss Due to Pressure Drop (%)	0.30%	0.1% for every 1" pressure drop	Vendor
Power Loss Due to Pressure Drop (kW)	511		
Unit Cost ($/kWh)	$0.035	Estimated Market Value	Estimate
Cost of Heat Rate Loss ($/yr)	$156,740		
Total Cost ($/yr)	$156,740		
2) Operating Labor			
CO Catalyst Requirement (hr/yr)	1095	8,760 operating hours per year	Estimate
Catalyst Cleaning (hr/yr)	80.0	2 workers x 40 hours per year	
Unit Cost ($/hr)	$35.00	Facility Data	Estimate
Cost ($/yr)	$41,125		
3) Supervisory Labor			
Cost ($/yr)	$6,170	15% Operating Labor	OAQPS
4) Maintenance			
CO Catalyst Labor Req. (hr/yr)	547.5	1/2 hour per shift	OAQPS
Catalyst Replacement Labor Req. (hr/yr)	106.7	8 workers for 40 hours every 3 yrs	Estimate
Unit Cost ($/hr)	$35.00	Facility Data	Estimate
Labor Cost ($/yr)	$22,896		
Material Cost ($/yr)	$22,900	100% of Maintenance Labor	OAQPS
Total Cost ($/yr)	$45,800		
5) Catalyst Replacement			
Catalyst Cost ($)	$710,373	Catalyst modules	Vendor
Catalyst Disposal Cost ($)	$50,000	Disposal of catalyst modules	Estimate
Sales Tax ($)	$38,019	5% Sales Tax	as of 1/1/99
Power Output of CTG & Unfired HRSG (kW)	252,830		
Power Output of Fired HRSG (Peak) (kW)	36,745		
Base Load Power Loss During Replacement (kW	18,203,760	3 days shut down every three years	
Peak Load Power Loss During Replacement (kW	2,645,604		
Cost of Energy Loss During Catalyst Replaceme	$600,602		
Catalyst Life (yrs)	3	n	OAQPS
Interest Rate (%)	7	i	
CRF	0.38	Amortization of Catalyst	OAQPS
Annual Cost ($/yr)	$533,090	(Volume)(Unit Cost)(CRF)	
7) Indirect Annual Costs			
Overhead	$55,860	60% of O&M Costs	OAQPS
Administration	$50,870	2% of Total Capital Investment	OAQPS
Property Tax	$25,440	1% of Total Capital Investment	OAQPS
Insurance	$25,440	1% of Total Capital Investment	OAQPS
Capital Life (yrs)	10	n	
Interest Rate (%)	7	i	
CRF	0.14	Amortization of Capital Costs	
Capital Recovery	$261,000	(Capital Cost)(CRF)	OAQPS
Total Indirect ($/yr)	$418,610		
Total Annualized Cost ($/yr)	**$1,201,500**		
Total VOC Controlled (tpy)	**17.6**		
Cost Effectiveness ($/ton)	**$68,200**		

TABLE D-9
PRICE QUOTE ADJUSTMENTS

GOAL LINE SCONOX PRICE QUOTE ADJUSTMENT				
Original Price Quote:		$5,716,000		Goal Line Letter 12/19/97
Base Air Flow:		821,197	SCFM	Basis For Quote
Actual Air Flow:		722,654	SCFM	Estimated Air Flow From Turbine Emission Calculations
Adjusted Price Quote:	High Temp Catalyst	$5,294,000		See Note (a) below.

Note:
(a) Flow Adjusted Price Quote = [Original Price Quote] * [(Actual Air Flow/Base Air Flow)^0.6]

NOx SCONOx - Top Control Option
Combined Cycle GE 7FA

$5,294,000	Budgetary cost for SCONOx (without auxiliaries)
$1,323,500	Structure (assume 25% of base cost)
$3,970,500	Catalyst (assume 75% of base cost)
$5,294,000	Original Quote for 9 ppm inlet
$20,000	Crane = Crane to handle modules = 20k
	Fan = Dilution air fan, variable speed drive, ductwork, starter= 30k
$1,985,250	Spare Catalyst = 1 spare catalyst on site at all times for 2 turbines
$7,299,250	

TABLE D-9
PRICE QUOTE ADJUSTMENTS

ENGELHARD CO OXIDATION CATALYST STRUCTURE PRICE QUOTE ADJUSTMENT				
Original Price Quote:		$200,000		Engelhard Letter 02/22/1999
Base Air Flow:		705,153	SCFM	Basis For Quote
Actual Air Flow:		722,654	SCFM	Estimated Air Flow From Turbine Emission Calculations
Adjusted Price Quote:	High Temp Catalyst	$202,964		See Note (a) below.

ENGELHARD CO OXIDATION CATALYST PRICE QUOTE ADJUSTMENT				
Original Price Quote:		$700,000		Engelhard Letter 02/22/1999
Base Air Flow:		705,153	SCFM	Basis For Quote
Actual Air Flow:		722,654	SCFM	Estimated Air Flow From Turbine Emission Calculations
Adjusted Price Quote:	High Temp Catalyst	$710,373		See Note (a) below.

Note:
(a) Flow Adjusted Price Quote = [Original Price Quote] * [(Actual Air Flow/Base Air Flow)^0.6]

CO Catalyst

$913,336	Budgetary cost for CO Oxidation Catalyst (without auxiliaries)
$202,964	Catalyst Structure - Adjusted from Vendor Quote
$710,373	Oxidation Catalyst - Adjusted from Vendor Quote

$913,336	Budgetary cost for CO Oxidation Catalyst (without auxiliaries)
$20,000	Crane = Crane to handle modules = 20k
$355,186	Spare Catalyst = 1 spare catalyst on site at all times for 2 turbines
$1,288,522	

GOAL LINE
ENVIRONMENTAL TECHNOLOGIES

Budgetary Proposal to:

ENSR

Goal Line Proposal #044-97

Gas Turbine Plant Installation

of

The SCONOx™ Catalytic Absorption System

December 19, 1997

Details not included
"proprietary & confidential"

GOAL LINE
ENVIRONMENTAL TECHNOLOGIES

December 19, 1997

Mr. Jeff Holmes
ENSR
35 Nagog Park
Acton, MA 01720

Re: Budgetary SCONOx™ Proposal #044-97

Dear Jeff:

As you requested, I have prepared a budgetary proposal for a SCONOx™ system to be installed on a General Electric Frame 7FA gas turbine. This proposal has included with it the various operating parameters necessary to keep the system running properly as well as the capital cost of the system, which is approximately $5,716,000.

Note that this price is somewhat lower that the "Vendor Price" noted in the cost comparison for this engine that I sent you earlier this month. This is because your system does not require a separate regeneration gas unit, and the cost savings is reflected in the lower price. You can enter this lower price in the cost comparison program and see what effect is has on the final numbers.

I will be out of the office until January 5th, so if you have any questions between now and then please contact Tom Girdlestone at (213) 233-2224, and he will be able to answer them for you. Hope you have a happy holiday season!

Sincerely,

Robert J. MacDonald, P.E.
SCONOx Product Manager

enclosures

Goal Line Environmental Technologies LLC
P.O. Box 58324, 2045 East Vernon, Los Angeles, CA 90058

Tel (213) 233-2224
Fax (213) 233-7428

Abstract

In 1988, when Sunlaw Energy Corporation needed to retrofit their two natural gas fired power plants to meet new emission requirements that were soon to come into place, they looked at existing technologies and found them either economically or environmentally undesirable. With the help of General Electric they developed a program of water injection that was capable of reducing their NOx emissions to 25 ppm. This, however, was not low enough to meet coming regulations.

To install a selective catalytic reduction (SCR) system would have entailed cutting their HRSG in half and moving it 10 feet downstream to accommodate an SCR at the correct temperature location. This would have resulted in a capital cost of more than $2.8 million, not including downtime costs of $25,000 each day for two months.

Sunlaw concluded that the best option for pollution control was to invent their own system. A partnership was formed between Sunlaw and Advanced Catalyst Systems, a catalyst development and manufacturing firm. The result of their efforts was Goal Line Environmental Technologies and the SCONOx™ catalytic absorption system. The newest SCONOx™ system, commissioned at Sunlaw's Federal cogeneration plant in December 1996, treats the exhaust of a GE LM2500 gas turbine. Combined with water injection, it has reduced NOx emissions from 160 ppm down to 1-2 ppm. Carbon monoxide emissions are virtually eliminated, with stack readings less than ambient levels.

The SCONOx™ system uses a single catalyst for both CO & NOx control. It oxidizes CO to CO_2 and NO to NO_2, and the NO_2 is then absorbed onto the surface of the catalyst. Just as a sponge absorbs water and must be wrung out periodically, the SCONOx™ catalyst must be periodically regenerated. This is accomplished by passing a dilute hydrogen gas across the surface of the catalyst in the absence of oxygen. Nitrogen oxides are broken down into nitrogen and water, and this is exhausted up the stack instead of NOx.

The SCONOx™ system is a breakthrough in CO & NOx control technology that makes it possible to have clean air without the use of ammonia or other hazardous materials. It is truly an environmentally friendly NOx control system.

Introduction

Sunlaw Cogeneration Partners is an independent power producer that owns two 30 MW combined cycle power plants in Los Angeles. Electricity is sold to Southern California Edison, and each plant provides refrigeration to a cold storage warehouse that acts as a steam host, qualifying the plants as cogeneration facilities under PURPA regulations. Sunlaw's two plants, the Growers and Federal facilities, were both commissioned in 1986, and are virtually identical in terms of equipment, the only basic difference being the plant configurations.

The prime mover of each plant is a natural gas fired GE LM2500 gas turbine fitted with evaporative coolers and water injection capability for power enhancement. Waste heat (G.T. exhaust) is directed to a Vogt heat recovery steam generator (HRSG) designed to provide 70,000 lbs/hour of high pressure steam (600 psig/730°F) and 7,000 lbs/hour of low pressure steam (120 psig dry saturated) at base load. At the time of construction no provision was made for NOx or CO reduction except by water injection.

The high-pressure steam is taken to a single casing condensing Murray steam turbine, which incorporates an extraction belt at 120 psig. The HRSG low-pressure steam is dedicated to supply the refrigeration plant nearby (Federal Cold Storage and U.S. Growers Cold Storage) and is supplemented as necessary by extraction steam from the steam turbine.

Emissions Control Alternatives

In 1988 the engineers at Sunlaw studied the possibility of installing a Selective Catalytic Reduction system either into the inlet duct (high temperature SCR at 980°F) or midway down the HRSG at approximately 500°F. This of course would have necessitated cutting the HRSG and "rolling" the whole of the cold end approximately 15 feet away from the gas turbine package. In addition to the estimated capital cost of $2.8 million, each SCR installation would have incurred a loss in revenue of $25,000 for each day of plant downtime, which would have been at least two months. To operate an SCR system would have cost $120,000/year for ammonia for each plant. Facing costs like these, it was not difficult for Sunlaw to make the decision to seek alternative emission control systems for its plants.

In early 1990 Sunlaw carried out testing using ultra-high water injection rates with water/fuel ratios of 1.8 achieving NOx levels as low as 12 ppmv (corrected to 15% O_2) at the highest water/fuel ratios. This caused distress to the combustor, and it was decided to restrict the maximum water/fuel ratio to 1.15 at that time to prevent excess gas turbine damage during extended base load operations. Since that time General Electric and other users have carried out similar tests with identical results.

Further testing was carried out using heated NOx water (up to 340°F) to reduce gas turbine erosion and keep fuel consumption to a minimum. This system is in operation at the Growers facility at this time.

In 1992, Sunlaw teamed up with Advanced Catalyst Systems in Knoxville, Tennessee to form Goal Line Environmental Technologies with the intention of developing an emission control system for Sunlaw's power plants. Specification for any new system for the plants required that it work well in conjunction with water injection, since Sunlaw liked the power augmentation it provided.

As a consequence, one of the first developments of the new company was the ADCAT™ oxidation catalyst for the removal of carbon monoxide, the formation of which increases as a consequence of water injection. The strategy of reducing NOx with water injection and CO with an oxidation catalyst was employed in 1994 at Sunlaw's Growers plant with great success. Nitrogen oxide emissions were reduced from 160 ppm to 40 ppm, and carbon monoxide readings at the stack were lowered to well below 1 ppm. The CO catalyst was installed upstream of the HRSG at a temperature of approximately 980°F. It was in base load operation for approximately nine months before removal prior to the installation of the Mod I prototype SCONOx™ system, which made a separate CO catalyst unnecessary.

The Mod I system, commissioned on May 14, 1995, was based on a moving hood design that proved the SCONOx™ concept and was used as a test installation to accumulate design and operating data. Enough information was obtained so that the prototype unit could be decommissioned in June 1996 and the catalyst removed for use in the Mod II system at the Federal plant.

With the wealth of design and operating data accumulated from SCONOx™ Mod I at the Growers plant, Mod II was commissioned on December 20, 1996 at the Federal facility, and has been running continuously in base load operation since that date with highly successful results. On July 2, 1997, the U.S. Environmental Protection Agency set its Lowest Achievable Emissions Rate (LAER) for gas turbines at 3.5 ppm NOx based on results from the Federal SCONOx™ system. This paper will summarize these results and describe the principle behind the operation of the system.

Description of Operation

The SCONOx™ system utilizes a single catalyst for the removal of both carbon monoxide and nitrogen oxide emissions. It uses no ammonia or other hazardous materials in its process and requires that no deliveries of chemicals be made in support of its operation. All utilities required to operate the system (natural gas, steam, water ambient air, and electricity) are typically already present at a natural gas fired power plant. The SCONOx™ system can operate effectively at temperatures ranging from 300°F to 700°F, making it well suited to retrofit applications.

The Mod II SCONOx™ system retrofitted to Sunlaw's Federal plant operates at the 'cold' end of the Heat Recovery Steam Generator (HRSG) at approximately 320°F. Because the HRSG did not have to be split in half to install the system, installation was completed with only eleven days of plant downtime.

The Oxidation/Absorption Cycle

The SCONOx™ catalyst works by simultaneously oxidizing CO to CO_2, NO to NO_2, and then absorbing NO_2 onto its surface through the use of a potassium carbonate absorber coating. These reactions are shown below, and are referred to as the "Oxidation/Absorption Cycle".

$$CO + \tfrac{1}{2}O_2 \rightarrow CO_2 \qquad (1)$$

$$NO + \tfrac{1}{2}O_2 \rightarrow NO_2 \qquad (2)$$

$$2NO_2 + K_2CO_3 \rightarrow CO_2 + KNO_2 + KNO_3 \qquad (3)$$

The CO_2 in reaction (1) & reaction (3) is exhausted up the stack. Note that during this cycle, the potassium carbonate coating reacts to form potassium nitrites and nitrates, which are then present on the surface of the catalyst. Just as a sponge absorbs water and must be wrung out before it can absorb any more, the SCONOx™ catalyst becomes saturated with NOx and must be regenerated. When all of the carbonate absorber coating on the surface of the catalyst has been reacted to nitrogen compounds, NOx will no longer be absorbed, and the catalyst must enter the regeneration cycle.

The Regeneration Cycle

The regeneration of the SCONOx™ catalyst, one of the features that makes the system so unique, is accomplished by passing a dilute hydrogen reducing gas across the surface of the catalyst in the absence of oxygen. The hydrogen in this gas reacts with the nitrites and nitrates to form water and elemental nitrogen. Carbon dioxide in the regeneration gas reacts with potassium nitrites and nitrates to form potassium carbonate, which is the absorber coating that was on the surface of the catalyst before the oxidation/absorption cycle began. This cycle is referred to as the "Regeneration Cycle", and the relevant reaction is shown below.

$$KNO_2 + KNO_3 + 4H_2 + CO_2 \rightarrow K_2CO_3 + 4H_2O_{(g)} + N_2 \qquad (4)$$

Water (as steam) and elemental nitrogen are exhausted up the stack instead of NOx, and potassium carbonate is once again present on the surface of the catalyst, allowing the oxidation/absorption cycle to begin again. There is no net gain or net loss of potassium carbonate after both the oxidation/absorption cycle and the regeneration cycle have been completed.

Because the regeneration cycle must take place in an oxygen free environment, a section of catalyst undergoing regeneration must be isolated from exhaust gases. This is accomplished using a set of louvers, one upstream of the section being regenerated and one downstream. During the regeneration cycle, these louvers close and valves allowing fresh regeneration gas into and spent regeneration gas out of the section open as shown in Figure 1 below. Stainless steel sealing strips on the isolation louvers provide a durable and effective barrier against leaks during operation. The Federal Mod II SCONOx™ system has twelve sections of catalyst, each of which is 10'6" wide, 2' high, and 3' deep. At any given time nine of these rows are in the oxidation/absorption cycle and three are in the regeneration cycle. Because the same number of rows is always in the regeneration cycle, the production of regeneration gas always proceeds at a constant rate. A regeneration cycle typically is set to last for three to five minutes, so each section is in the oxidation/absorption cycle for nine to fifteen minutes.

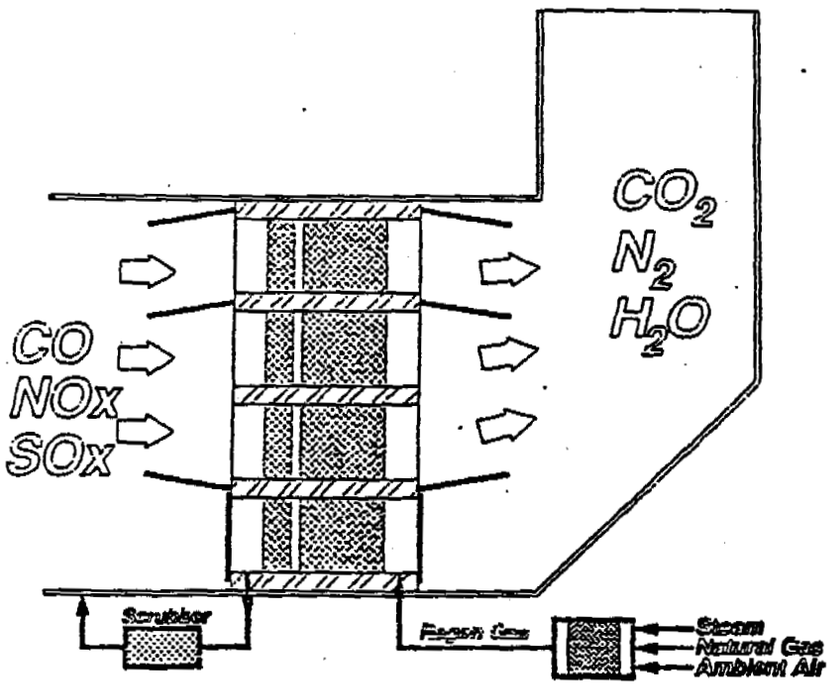


Figure 1: Flow diagram showing a thin layer of SCOSOx catalyst upstream of the SCONOx catalyst.

The SCONOx™ Control System

The heart of the SCONOx™ control system is an Allen-Bradley Programmable Logic Loop Controller (PLC). This controller has been programmed to control all essential SCONOx™ functions, including the opening and closing of louver doors and regen gas inlet and outlet valves, and the maintaining of regen gas flow to achieve positive pressure during the regeneration cycle.

A LabView™ program run on a Pentium® PC supervises the system. The LabView program monitors, records, and reports system performance. It sends notifications and warnings when appropriate, and it allows the user to control the system by changing set points, such as pressures, regeneration cycle times, and flows. The PLC can, however, operate independent of the LabView™ program--a PC crash or loss of power will not interrupt the operation of the system.

The Regeneration Gas Generator

Regeneration gas is produced by reacting natural gas with oxygen from ambient air. The technology for producing hydrogen from natural gas is well developed, and there are numerous reactions by which this can be accomplished. The Mod II SCONOx™ system uses a gas generator produced by Surface Combustion, a company that has made its name manufacturing similar units for the heat treat industry. This unit uses a two-stage process to produce hydrogen and carbon dioxide. In the first stage, natural gas and air are reacted across a partial oxidation catalyst at 1900°F to form carbon monoxide and hydrogen. Steam is added to the mixture, which is then passed across a low temperature shift catalyst, forming carbon dioxide and more hydrogen. This mixture is then diluted to under 4% hydrogen using steam, although another inert gas, such as nitrogen, can be used for this purpose. The appropriate reactions are listed below.

$$CH_4 + \tfrac{1}{2}O_2 + 1.88N_2 \rightarrow CO + 2H_2 + 1.88N_2 \qquad (5)$$
$$CO + 2H_2 + H_2O + 1.88N_2 \rightarrow CO_2 + 3H_2 + 1.88N_2 \qquad (6)$$

In addition, Goal Line has tested several methods for producing regeneration gas, including a one step method where steam, natural gas, and air are reacted at 900°F using an autothermal process. For SCONOx™ units installed in locations of the HRSG that operate above 550°F, a separate regeneration gas generator is not required. Regeneration gas is produced by introducing natural gas directly across the SCONOx™ catalyst, reforming the gas. Both of these processes will eliminate the conventional gas generator, reducing the cost of the system.

The SCOSOx™ Sulfur Removal System

The SCOSOx™ system works in conjunction with the SCONOx™ system and removes sulfur compounds from the exhaust stream. It utilizes an oxidation/absorption cycle and a regeneration cycle just as the SCONOx™ system does, but its absorption cycle

favors SO_3 instead of NOx. Chemical reactions for the SCOSOx™ system oxidation/absorption cycle are shown below.

$$CO + \frac{1}{2}O_2 \rightarrow CO_2 \quad (7)$$
$$SO_2 + \frac{1}{2}O_2 \rightarrow SO_3 \quad (8)$$

$$SO_3 + \text{SORBER} \rightarrow [SO_3 + \text{SORBER}] \quad (9)$$

The reaction for the regeneration cycle is also similar to that of the SCONOx™ catalyst:

$$[SO_3 + \text{SORBER}] + 4H_2 \rightarrow H_2S + 3H_2O \quad (10)$$

Note that the regeneration gas used for the both types of catalyst is the same (hydrogen), allowing them to be regenerated simultaneously. The SCOSOx™ catalyst is placed upstream of the SCONOx™ catalyst, and enhances the efficiency of NOx absorption as well as removing sulfur compounds. The SORBER is proprietary.

Equation (10) above is valid for SCONOx™ installations that operate at temperatures below 500°F. At higher temperatures, hydrogen sulfide does not come off during the regen process, as sulfur compounds come off as SO_2.

Results from the Federal System

The SCONOx™ system has achieved remarkably low CO and NOx emissions over the 10 months of operation that are complete as of this writing. The system has averaged less than 2 ppm NOx and under 1 ppm CO for this period, with initial start up NOx levels of 0.6 ppm having been recorded. These emissions levels make the Federal plant the cleanest fossil fuel fired power plant in the world—and without ammonia emissions.

The SCONOx™ system can achieve these low levels of NOx emissions partly due to the fact that emission levels into the catalyst system are kept at about 25 ppm NOx through the use of water injection, which also augments the power output of the plant. The SCONOx™ system was designed to work in conjunction with hydroaugmentation or Dry Low NOx technology. Because of the nature of the system, which relies on an absorber to remove the NOx, it is on this type of application that SCONOx™ is most effective.

Also, the Federal SCONOx™ system utilizes a scrubber to remove sulfur compounds from the natural gas before it is combusted in the gas turbine. This prevents absorption of the sulfur on the SCONOx™ catalyst, which would over time reduce the number of sites available for NOx absorption and cause an increase in emissions. This scrubber was installed on the Federal plant in late May 1997, and its effect can clearly be seen in Figure 2, where NOx emissions level off at approximately 1 ppm after five months of "saw-tooth" operation.

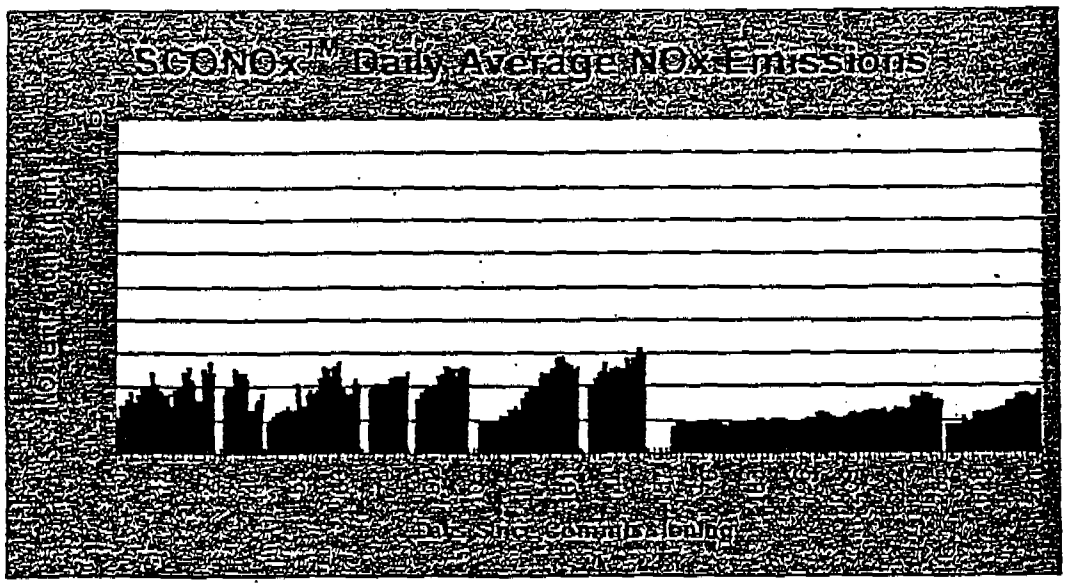


Figure 2: Average Daily NOx Emissions-December 20, 1996 to September 30, 1997.

This leveling off of the NOx readings was noted by the United States Environmental Protection Agency in its letter that sets the Lowest Achievable Emissions Rate for gas turbines based on results from the Federal SCONOx™ system. The LAER determination of 3.5 ppm by the EPA indicates that had the Federal plant been permitted at that level of NOx emissions, it would not have been out of compliance during the six-month period on which that determination was based. However, in their letter of July 2, 1997 to Goal Line's Robert Danziger, EPA indicated that *"...the SCONOx™ control system has typically been achieving average NOx emissions of approximately 2 ppmv (and less than 1 ppmv during the most recent month)."* EPA further stated *"If SCONOx™ continues to achieve these impressive results for an additional five months, EPA would be able to make a revised determination to reflect the emission rate achieved over that period."* Goal Line expects this revised determination to be made at 2 ppmv or less by the end of 1997.

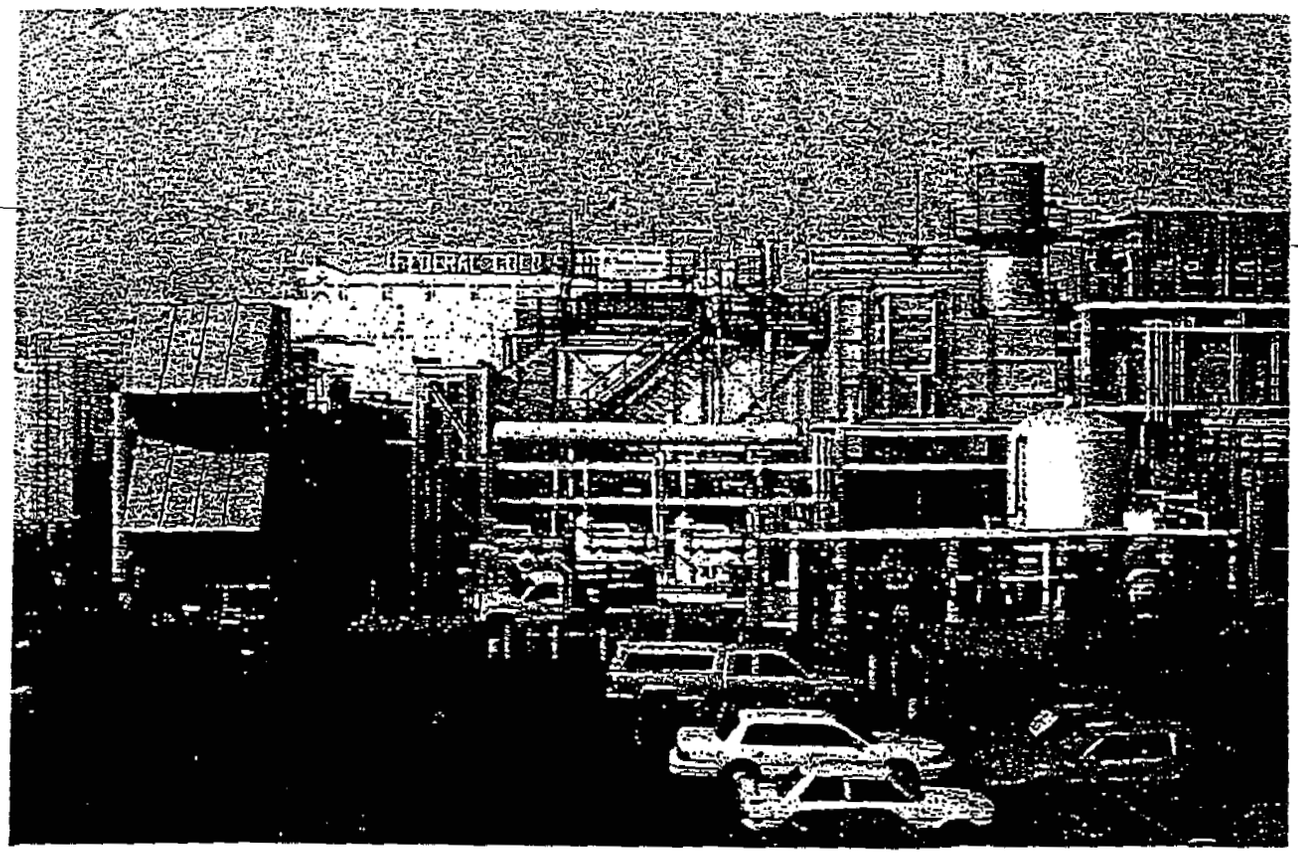


Figure 3: Sunlaw's Federal plant showing the SCONOx modules just to the left of the stack.

Because of the composition of the SCONOx™ catalyst, which is basically an oxidation catalyst with Goal Line's special absorber coating applied to it, the system oxidizes CO, VOC, and HAPs emissions as well as removing NOx. CO oxidation is typically about 95%, even at temperatures as low as 320°F, the temperature at which the Federal system operates. VOC destruction is greater than 80% for non-methane hydrocarbons, and destruction of HAPs such as formaldehyde and acetaldehyde have been measured

at 97% and 94% respectively at 300°F. The percentage destruction is expected to rise at higher temperatures.

The mechanical portion of the SCONOx™ system has been extremely reliable over the ten months that the system has been in operation. No downtime has been incurred by the Federal plant from problems experienced by the SCONOx™ system. Because the Federal SCONOx™ system was designed with only the isolation louvers themselves exposed to the exhaust gas stream, maintenance of the system can be performed while the plant is on line. Should a louver actuator fail, the affected row would be placed in "maintenance mode" on the PLC system, which would then skip that row in the regen process. Louvers can be closed manually using a hand wheel if necessary, and this allows the repair of the system with only a small increase in NOx (perhaps 0.3 ppm) and back pressure (perhaps 0.5" H_2O). Once the affected section is placed on line again, NOx and back pressure levels return to normal.

The SCONOx™ system is completely automatic in its operation, and once placed on line requires only minimal attention from plant operators, such as would normally be given to other plant equipment while taking daily readings. Start up of the system is easily accomplished with a few clicks of the mouse to open control valves and the push button start of the Surface Combustion gas generator.

The two Sunlaw facilities are covered by a blanket air permit under the South Coast AQMD's RECLAIM program. Sunlaw easily meets these emissions requirements with the SCONOx™ system operating on its Federal plant, but it still plans to retrofit its Growers facility with the improved design in the near future.

Future Development and Applications

The LAER determination by the EPA has caused a great deal of interest to be generated in the SCONOx™ system. Much of this interest is from power generators who are looking for new ways to reduce NOx, CO, and SOx from applications other than natural gas fired turbines. Although Goal Line does not currently offer the SCONOx™ system for direct fired boilers or reciprocating engines and it is not available for use with coal fired plants, laboratory work has been performed using gas compositions typical of these applications. This work has led to the development of the SCOSOx™ Sulfur Removal System.

The SCOSOx™ Sulfur Removal System is scheduled to be installed at Sunlaw's Federal plant in early 1998. The full-scale installation of this system will bring the SCONOx™ system into consideration as a candidate for providing NOx and CO control for applications using higher sulfur fuels, such as #2 diesel oil or coal. The ultimate development of the SCOSOx™ system will see it used on its own for the removal of large amounts of sulfur from various combustion applications. There is much interest in the SCOSOx™ system in Asian markets where coal fired plants play a large role in the generation of power.

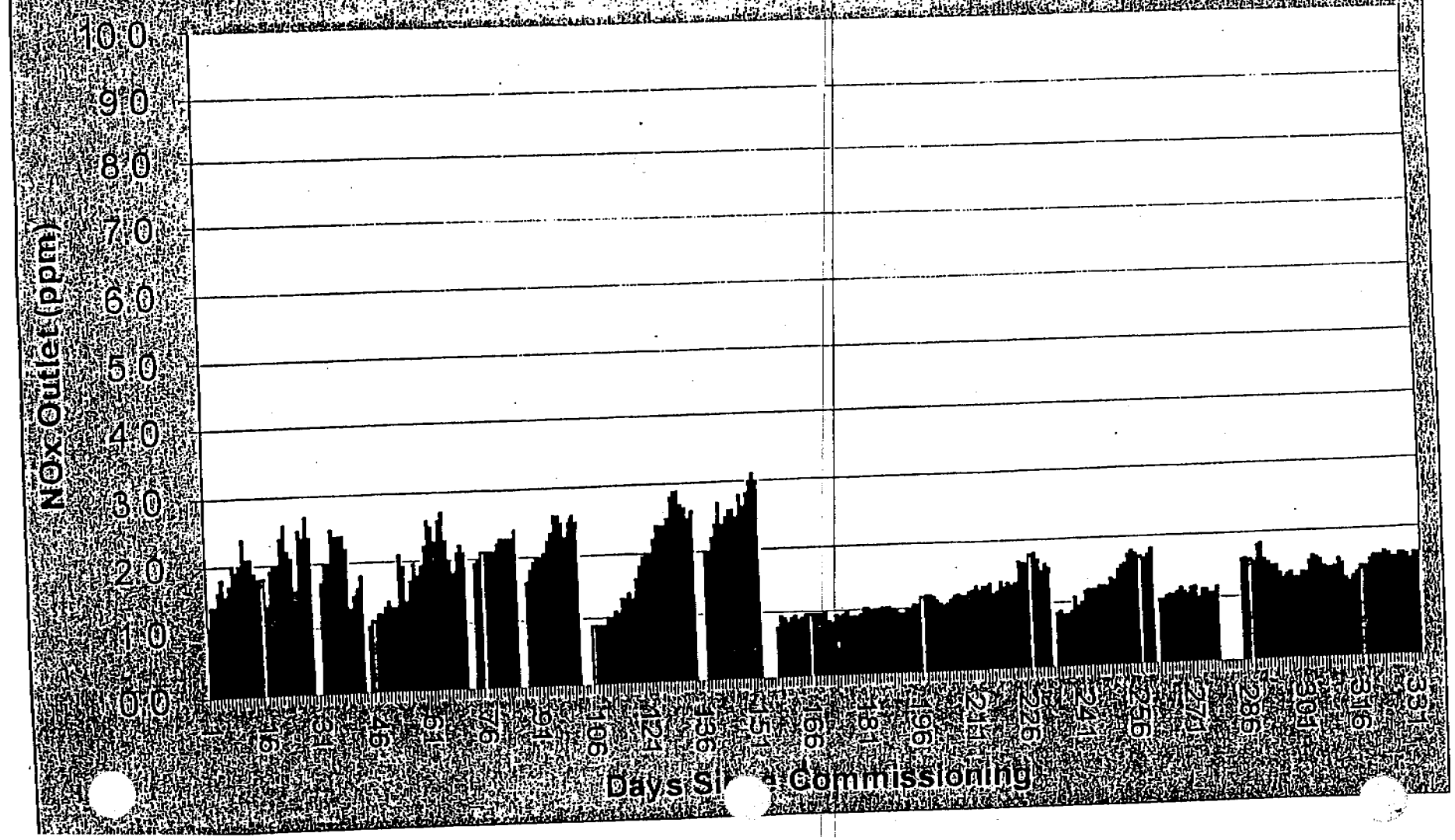
Conclusions

As pollution regulations continue to tighten, the challenge of finding a cost effective pollution control system that can meet low emission targets is growing. The SCONOx™ system offers an alternative to the more prevalent emission control systems that use costly ammonia and produce PM-2.5 emissions such as ammonium nitrate and ammonium sulfate. This practice of trading one pollutant for another will not stand much longer, as the EPA has proposed new ozone and PM-2.5 standards that will prevent the use of ammonia in non-attainment areas for NO_2 and ozone. Unfortunately for power generators entering the new deregulated markets, the non-attainment areas are all located in populated areas that consume the most power.

So the choice with which power companies are being faced is whether to build a plant in the desert away from load centers to get around stricter emission regulations (thereby creating huge costs for gas and electricity transmission), or to build a plant in or near the load center with a state-of-the-art emission control system. SCONOx™ makes the latter option possible, and builders of the new generation of merchant plants are coming to the realization that clean power is not only good for the environment, but is also good for their bottom line.

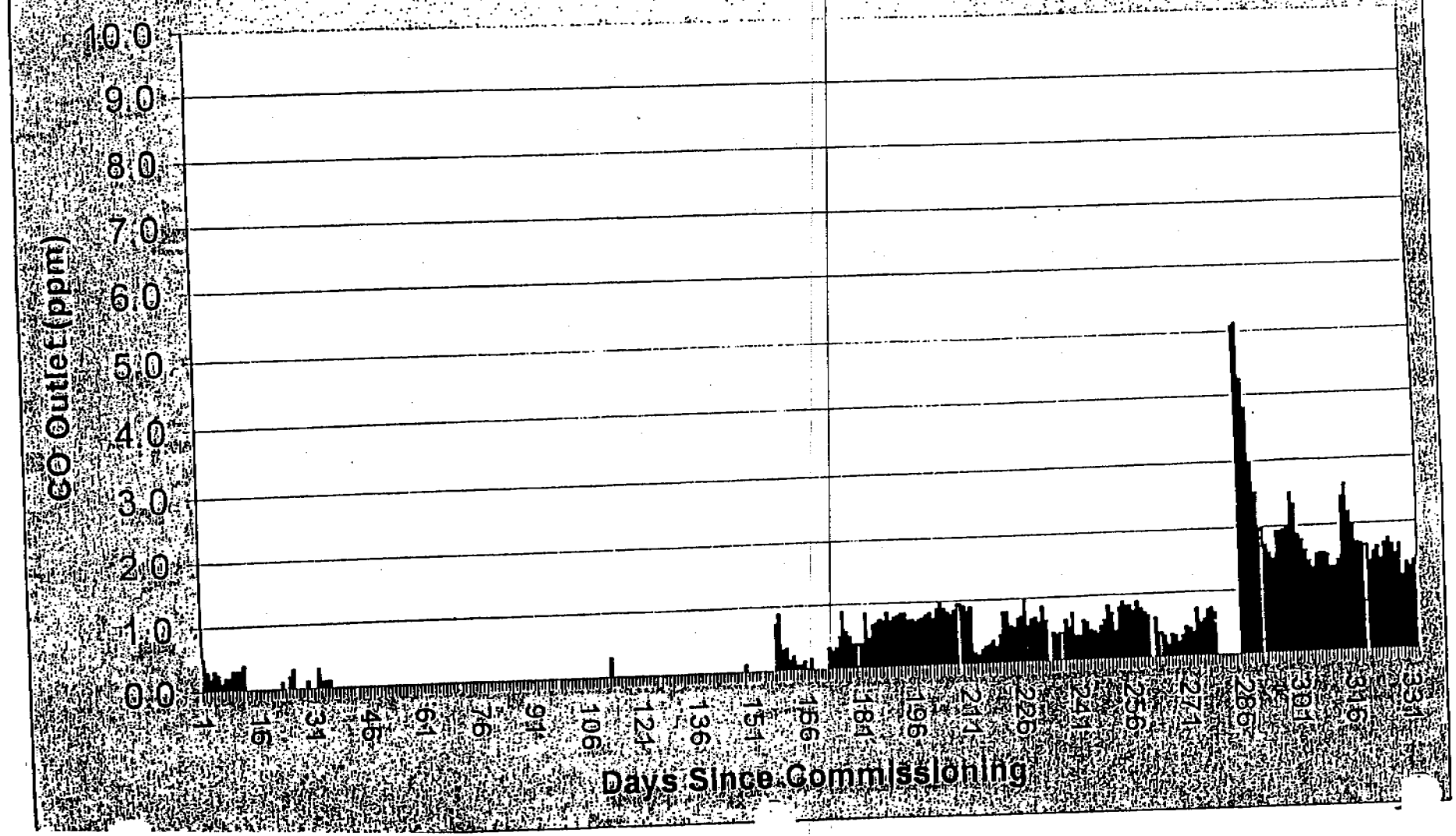
GOAL LINE
ENVIRONMENTAL TECHNOLOGIES

SCONOx Average Daily NOx Readings



GOAL LINE
ENVIRONMENTAL TECHNOLOGIES

SCONOx Average Daily CO Readings



XONON
FLAMELESS COMBUSTION

September 27, 1997

Re: Ultra-low NOx solution for Gas Turbines

Catalytica Combustion Systems has developed the XONON Flameless Combustion System, the ultimate NOx control technology for gas turbines. XONON has reduced NOx emissions to 3 ppm in numerous rig tests at Catalytica and at several gas turbine manufacturer's test facilities. The XONON (pronounced ZO-NON) results were accomplished without water injection, steam injection or SCR. This is possible because XONON is a breakthrough, flameless combustion process, that controls the temperature of combustion below the temperature that allows NOx to form. XONON will be demonstrated in a gas turbine engine later this year.

The XONON Information series was developed for the gas turbine user. It is designed to familiarize users with the relevant air quality regulations and how various NOx control technologies, including XONON can be used to generate value by reducing NOx emissions below the levels required by regulations.

Enclosed is your copy of the XONON Information Series. This series will introduce you to this breakthrough technology, and allow you to compare XONON to other NOx control technologies. We believe the enclosed spreadsheet, Financial analysis of NOx Control Options will also assist you in evaluating BACT/LAER determinations and other analysis.

If a colleague would like their own copy of the information series, or you have any questions please contact us at any time.

Catalytica Combustion Systems, Inc.
430 Ferguson Drive
Mountain View, CA 94043
Tel: (415) 960-3000
Fax: (415) 960-0127

Catalytica Overview

Catalytica, Inc. is developing and offering advanced products that use the Company's proprietary catalytic technologies to yield economic and environmental benefits by lowering manufacturing costs and reducing hazardous byproducts.

Corporation

The parent company, Catalytica, Inc., has three subsidiaries focused on the markets served by the Company's core technologies: Catalytica Combustion Systems, Catalytica Fine Chemicals and Catalytica Advanced Technologies.

Catalytica Combustion Systems, Inc.

Gas turbines are expected to meet a majority of the growing demand for power generation and the processing and transportation of natural gas. Combustion of natural gas, however, creates significant emissions of air pollutants. To address this issue, Catalytica Combustion Systems has developed its proprietary XONON Flameless Combustion™ system for use by the turbine manufacturers. The XONON system reduces or eliminates the nitrogen oxide, carbon monoxide and unburned hydrocarbon emissions produced by gas turbines. Catalytica Combustion Systems is currently working with leading turbine manufacturers, including General Electric Co., Allison Engine Co. (a Rolls-Royce Inc. subsidiary), and Solar Turbines Inc. (a Caterpillar Inc. subsidiary), to commercialize the XONON system.

The XONON Information Series will describe this product in more detail.

Catalytica Combustion Systems' subsidiary **Advanced Sensor Devices** develops and manufactures environmental air pollution monitoring devices, including the new CEMcat™ continuous emissions monitor: Industry is finding the rugged, accurate, easy to install CEMcat monitor to be the cost effective solution for emissions monitoring of gas turbines.

Corporate Background

Catalytica became publicly traded in February 1993 with the sale of 3 million shares of common stock, which raised approximately $28 million. On November 3, 1995, the Company completed an additional public offering of 4 million shares of common stock, which resulted in net proceeds of approximately $14.7 million. The stock trades on the Nasdaq National Market under the symbol CTAL.

Catalytica is a registered trademark of Catalytica, Inc.
ASD, Advanced Sensor Devices, CEMcat, XONON and XONON Flameless Combustion are trademarks of Catalytica, Inc.

ENGELHARD

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PHONE 410-569-0297
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E-Mail Fred_Booth@ENGELHARD.COM

DATE:	May 5, 1999	NO. PAGES	3	(INCLUDING COVER)
TO:	ENSR ATTN: Michael Griffin	FAX 978-635-9180		
	ENGELHARD ATTN: Nancy Ellison			
FROM:	Fred Booth	Ph 410-569-0297 // FAX 410-569-1841		

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RE: ENSR FAX of May 5, 1999
NOxCAT™ VNX™ SCR Catalyst Systems
Engelhard Budgetary Proposal EPB99406

We provide Engelhard Budgetary Proposal EPB99406 for Engelhard NOxCAT™ VNX™ SCR Catalyst systems per your FAXed request on May 5, 1999.

Our Proposal is based on:

- Data for GE Fr7FA Gas Turbine;
- SCR Catalyst for NOx reductions from 9 ppmvd @ 15% O_2 to 3.5 and 2.5 ppmvd @ 15% O_2 with ammonia slips of 10 ppmvd @ 15% O_2 and 5 ppmvd @ 15% O_2 – Natural Gas fuel;
- Assumed gas temperature at the SCR catalyst of 650°F;
- Scope is assumed to be normal scope to HRSG supplier:
  - SCR System - internal support frame and VNX modules - both installed inside HRSG internally insulated casing and ammonia delivery system components – assumed 28% aqueous ammonia to skid
- Assumed HRSG cross section of 33'-0" W x 57'-0" H;

We request the opportunity to work with you on this project.

Sincerely yours,

ENGELHARD CORPORATION

Frederick A. Booth
Senior Sales Engineer

cc: Nancy Ellison - Proposal Administrator

ENGELHARD

ENGELHARD CORPORATION
NOxCAT™ VNX™ SCR NOx ABATEMENT CATALYST SYSTEM

Engelhard Corporation ("Engelhard") offers to supply to Buyer the NOxCAT™ VNX™ ceramic substrate SCR system summarized per the technical data and site conditions provided.

Scope of Supply: The equipment supplied is installed by others in accordance with Engelhard design and installation instructions.

- Engelhard NOxCAT™ VNX™ SCR catalyst in modules;
- Internal support frames for catalyst modules - installed inside internally insulated HRSG casing;
- Ammonia Delivery System Components: 28% Aqueous Ammonia to skid
  - Ammonia Injection Grid (AIG);
  - AIG manifold with flow control valves ;
  - NH_3 Vaporization / Air dilution skid: Pre-piped & wired (including all valves and fittings)
    - Two (2) dilution air fans, one for back-up purposes
    - Panel mounted system controls for:
    - Blowers (on/off/flow indicators)
    - Air/ammonia flow indicator and controller
    - System pressure indicators
    - Main power disconnect switch

Excluded from Scope of Supply:
Ammonia storage and pumping
HRSG Duct / Catalyst Casing
Any interconnecting field piping or wiring
Electrical grounding equipment
Utilities
Foundations
All Monitors
All other items not specifically listed in Scope of Supply

BUDGET PRICES:	See Performance Data Section
WARRANTY AND GUARANTEE:	
Mechanical Warranty:	One year of operation* or 1.5 years after catalyst delivery, whichever occurs first.
Performance Guarantee:	Three (3) years of operation* or 3.5 years after catalyst delivery, whichever occurs first. Catalyst warranty is prorated over the guaranteed life
Expected Life:	5 - 7 Years

SCR SYSTEM DESIGN BASIS:	
Gas Flow from:	GE Fr7F Gas Turbine
Gas Flow:	Assumed Horizontal
Fuel:	Natural Gas
Gas Flow Rate (At catalyst face):	See Performance data - Designed for Gas Velocities within ±15% at the reactor inlet
Temperature (At catalyst face):	Designed for Gas Temperatures within range ±20°F at the reactor inlet
NOx Inlet (At catalyst face):	9 ppmvd @ 15% O_2
NOx Outlet(At catalyst face):	3.5 and 2.5 ppmvd @ 15% O_2 – Firing NG
NH_3 Slip:	10 and 5 ppmvd @ 15% O_2
HRSG Cross Section:	57'-0" H x 33'-0" W – inside liner sheets

ENGELHARD

ENSR
NOxCAT™ VNX™ SCR Systems
Engelhard Budgetary Proposal EPB99406
May 5, 1999

Performance Data

TURBINE EXHAUST FLOW, lb/hr	3,488,000	3,488,000	3,488,000	3,488,000
TURBINE EXHAUST GAS ANALYSIS, % VOL. - N_2	74.42	74.42	74.42	74.42
O_2	12.38	12.38	12.38	12.38
CO_2	3.90	3.90	3.90	3.90
H_2O	8.41	8.41	8.41	8.41
Ar	0.89	0.89	0.89	0.89
TURBINE NOx, ppmvd @ 15% O_2	9	9	9	9
TURBINE NOx, lb/hr	58.3	58.3	58.3	58.3
CALCULATED GAS MOL. WT.	28.39	28.39	28.39	28.39
FLUE GAS TEMP. @ SCR CATALYST, °F (+/-20)	650	650	650	650
DESIGN REQUIREMENTS NOx OUT, ppmvd @ 15% O_2	3.5	3.5	2.5	2.5
NH_3 SLIP, ppmvd @ 15% O_2	10	5	10	5
GUAR. PERFORMANCE DATA NOx CONVERSION, % - Min.	61.1%	61.1%	72.2%	72.2%
NOx OUT, ppmvd @ 15% O_2 - Max.	3.5	3.5	2.5	2.5
NOx OUT, lb/hr	22.7	22.7	16.2	16.2
EXPECTED AQUEOUS NH_3 (28% SOL.) FLOW, lb/hr	133	90	141	98
NH_3 SLIP, ppmvd @ 15% O_2 - Max.	10	5	10	5
SCR PRESSURE DROP, "WG - Max.	1.0	1.2	1.2	1.5
SCR SYSTEM COMPONENTS	$900,000	$1,050,000	$1,050,000	$1,150,000
REPLACEMENT SCR CATALYST MODULES	$500,000	$600,000	$650,000	$700,000

APPENDIX E
INPUT/OUTPUT FILES

94-98MET.ZIP	Meteorological Data Archive	
PVNGSxx.ASC	where xx = year (1994-1998)	
SILS_UPA.ZIP	Archive: Significant Impact Level simulations for SO2 and CO	
input files	AV_SOxx.IN	SO2 where xx = year (1994-1998)
input files	AV_COxx.IN	CO where xx = year (1994-1998)
output files	AV_SOxx.OUT	SO2 where xx = year (1994-1998)
output files	AV_COxx.OUT	CO where xx = year (1994-1998)
SILS_UPB.ZIP	Archive: Significant Impact Level simulations for PM10	
input files	AV_PMAxx.IN	PM10 where xx = year (1994-1998)
input file	AV_PMADD.IN	Peak Year 1996 run for PM10
output files	AV_PMAxx.OUT	PM10 where xx = year (1994-1998)
output file	AV_PMADD.OUT	Peak Year 1996 run for PM10
SILS_UPC.ZIP	Archive: Significant Impact Level simulations for NOx	
input files	AV_NOxx.IN	CO where xx = year (1994-1998)
output files	AV_NOxx.OUT	CO where xx = year (1994-1998)
CUM_UP.zip	Archive: Cumulative Impact Analysis for AVEP and APS (PM10)	
input files	C_PMxx.IN	PM10 where xx = year (1994-1998)
output files	C_PMxx.OUT	PM10 where xx = year (1994-1998)
C2_UP.zip	Archive: Class II Increment Impact Analysis (PM10)	
input files	C2_PMxxS.IN	PM10 where xx = year (1994-1998)
input file	C2UNITxx	unit emissions deposition analysis
input file	UNIT_98	unit emissions peak impact for air toxics
output files	C2_PMxxS.OUT	PM10 where xx = year (1994-1998)
output file	C2UNITxx	unit emissions deposition analysis
output file	UNIT_98	unit emissions peak impact for air toxics
Ann & 1hr Air Toxics.XLS		Excel spreadsheet with emission computations, air toxics analysis, and deposition analysis

APPENDIX F
METEOROLOGICAL ANALYSIS FOR LEVEL-2 VISIBILITY SCREENING

Arlington Valley Energy Project

Woolsey Peak Wilderness Area	
Meteorological Data	Palo Verde NGS 1994-1998
Wind Direction	N
Distance	16 km
Hours	01-06
Number of Hours	10956 hours
1% Cutoff	109 hours

Direction	Stability	Speed (m/sec)	Number of Hours	Travel Time (hours)	$\sigma_y\sigma_z u$ (m^3/sec)	Cumulative Number of Hours	Cumulative Frequency (%)
N	F	1.0	139	4.4	2.31E+04	139	1.28 *
N	F	2.0	139	2.2	4.61E+04	278	2.55 *
N	E	1.0	118	4.4	6.08E+04	396	3.63 *
N	F	3.0	63	1.5	6.92E+04	459	4.21 *
N	E	2.0	134	2.2	1.22E+05	593	5.44 *
N	D	1.0	33	4.4	1.45E+05	626	5.74 *
N	E	3.0	73	1.5	1.82E+05	699	6.41 *
N	E	4.0	32	1.1	2.43E+05	731	6.71 *
N	D	2.0	52	2.2	2.90E+05	783	7.18 *
N	E	5.0	13	0.9	3.04E+05	796	7.30 *
N	D	3.0	30	1.5	4.36E+05	826	7.58 *
N	D	4.0	26	1.1	5.81E+05	852	7.82 *
N	D	5.0	10	0.9	7.26E+05	862	7.91 *
N	D	6.0	13	0.7	8.71E+05	875	8.03 *
N	D	7.0	5	0.6	1.02E+06	880	8.07 *
N	D	8.0	17	0.6	1.16E+06	897	8.23 *

Note: Wind speed is the lower limit for the category. Categories are 1.0 m/s wide except for 8/ms which is a lower limit.

Arlington Valley Energy Project

Woolsey Peak Wilderness Area	
Meteorological Data	Palo Verde NGS 1994-1998
Wind Direction	N
Distance	16 km
Hours	07-12
Number of Hours	10956 hours
1% Cutoff	109 hours

Direction	Stability	Speed (m/sec)	Number of Hours	Travel Time (hours)	$\sigma_y\sigma_z u$ (m^3/sec)	Cumulative Number of Hours	Cumulative Frequency (%)
N	F	1.0	17	4.4	2.31E+04	17	0.16
N	F	2.0	8	2.2	4.61E+04	25	0.23
N	E	1.0	32	4.4	6.08E+04	57	0.52
N	F	3.0	5	1.5	6.92E+04	62	0.57
N	E	2.0	22	2.2	1.22E+05	84	0.77
N	D	1.0	80	4.4	1.45E+05	164	1.50 *
N	E	3.0	3	1.5	1.82E+05	167	1.53 *
N	E	4.0	7	1.1	2.43E+05	174	1.60 *
N	D	2.0	58	2.2	2.90E+05	232	2.13 *
N	E	5.0	1	0.9	3.04E+05	233	2.14 *
N	D	3.0	14	1.5	4.36E+05	247	2.27 *
N	D	4.0	15	1.1	5.81E+05	262	2.40 *
N	D	5.0	10	0.9	7.26E+05	272	2.50 *
N	D	6.0	8	0.7	8.71E+05	280	2.57 *
N	D	7.0	7	0.6	1.02E+06	287	2.63 *
N	D	8.0	9	0.6	1.16E+06	296	2.72 *

Note: Wind speed is the lower limit for the category. Categories are 1.0 m/s wide except for 8/ms which is a lower limit.

Arlington Valley Energy Project

Woolsey Peak Wilderness Area	
Meteorological Data	Palo Verde NGS 1994-1998
Wind Direction	N
Distance	16 km
Hours	13-18
Number of Hours	10956 hours
1% Cutoff	109 hours

Direction	Stability	Speed (m/sec)	Number of Hours	Travel Time (hours)	$\sigma_y\sigma_z u$ (m^3/sec)	Cumulative Number of Hours	Cumulative Frequency (%)
N	F	1.0	1	4.4	2.31E+04	1	0.01
N	F	2.0	0	2.2	4.61E+04	1	0.01
N	E	1.0	3	4.4	6.08E+04	4	0.04
N	F	3.0	0	1.5	6.92E+04	4	0.04
N	E	2.0	4	2.2	1.22E+05	8	0.07
N	D	1.0	7	4.4	1.45E+05	15	0.14
N	E	3.0	0	1.5	1.82E+05	15	0.14
N	E	4.0	3	1.1	2.43E+05	18	0.17
N	D	2.0	3	2.2	2.90E+05	21	0.19
N	E	5.0	0	0.9	3.04E+05	21	0.19
N	D	3.0	8	1.5	4.36E+05	29	0.27
N	D	4.0	5	1.1	5.81E+05	34	0.31
N	D	5.0	4	0.9	7.26E+05	38	0.35
N	D	6.0	1	0.7	8.71E+05	39	0.36
N	D	7.0	2	0.6	1.02E+06	41	0.38
N	D	8.0	5	0.6	1.16E+06	46	0.42

Note: Wind speed is the lower limit for the category. Categories are 1.0 m/s wide except for 8/ms which is a lower limit.

Arlington Valley Energy Project

Woolsey Peak Wilderness Area	
Meteorological Data	Palo Verde NGS 1994-1998
Wind Direction	N
Distance	16 km
Hours	19-24
Number of Hours	10956 hours
1% Cutoff	109 hours

Direction	Stability	Speed (m/sec)	Number of Hours	Travel Time (hours)	$\sigma_y\sigma_z u$ (m^3/sec)	Cumulative Number of Hours	Cumulative Frequency (%)
N	F	1.0	43	4.4	2.31E+04	43	0.39
N	F	2.0	48	2.2	4.61E+04	91	0.83
N	E	1.0	61	4.4	6.08E+04	152	1.39 *
N	F	3.0	15	1.5	6.92E+04	167	1.53 *
N	E	2.0	77	2.2	1.22E+05	244	2.24 *
N	D	1.0	32	4.4	1.45E+05	276	2.53 *
N	E	3.0	68	1.5	1.82E+05	344	3.16 *
N	E	4.0	48	1.1	2.43E+05	392	3.60 *
N	D	2.0	51	2.2	2.90E+05	443	4.06 *
N	E	5.0	30	0.9	3.04E+05	473	4.34 *
N	D	3.0	40	1.5	4.36E+05	513	4.71 *
N	D	4.0	35	1.1	5.81E+05	548	5.03 *
N	D	5.0	23	0.9	7.26E+05	571	5.24 *
N	D	6.0	19	0.7	8.71E+05	590	5.41 *
N	D	7.0	13	0.6	1.02E+06	603	5.53 *
N	D	8.0	12	0.6	1.16E+06	615	5.64 *

Note: Wind speed is the lower limit for the category. Categories are 1.0 m/s wide except for 8/ms which is a lower limit.

Arlington Valley Visibility Screening

Signal Mountain Wilderness	
Meteorological Data	Palo Verde NGS 1994-1998
Wind Direction	NNE
Distance	16 km
Hours	01-06
Number of Hours	10956 hours
1% Cutoff	109 hours

Direction	Stability	Speed (m/sec)	Number of Hours	Travel Time (hours)	$\sigma_y\sigma_z u$ (m^3/sec)	Cumulative Number of Hours	Cumulative Frequency (%)
NNE	F	1.0	132	4.4	2.31E+04	132	1.21 *
NNE	F	2.0	200	2.2	4.61E+04	332	3.05 *
NNE	E	1.0	86	4.4	6.08E+04	418	3.83 *
NNE	F	3.0	177	1.5	6.92E+04	595	5.46 *
NNE	E	2.0	146	2.2	1.22E+05	741	6.80 *
NNE	D	1.0	42	4.4	1.45E+05	783	7.18 *
NNE	E	3.0	112	1.5	1.82E+05	895	8.21 *
NNE	E	4.0	63	1.1	2.43E+05	958	8.79 *
NNE	D	2.0	48	2.2	2.90E+05	1006	9.23 *
NNE	E	5.0	30	0.9	3.04E+05	1036	9.50 *
NNE	D	3.0	46	1.5	4.36E+05	1082	9.93 *
NNE	D	4.0	46	1.1	5.81E+05	1128	10.35 *
NNE	D	5.0	41	0.9	7.26E+05	1169	10.72 *
NNE	D	6.0	19	0.7	8.71E+05	1188	10.90 *
NNE	D	7.0	15	0.6	1.02E+06	1203	11.04 *
NNE	D	8.0	33	0.6	1.16E+06	1236	11.34 *

Note: Wind speed is the lower limit for the category. Categories are 1.0 m/s wide except for 8/ms which is a lower limit.

Arlington Valley Visibility Screening

Signal Mountain Wilderness	
Meteorological Data	Palo Verde NGS 1994-1998
Wind Direction	NNE
Distance	16 km
Hours	07-12
Number of Hours	10956 hours
1% Cutoff	109 hours

Direction	Stability	Speed (m/sec)	Number of Hours	Travel Time (hours)	$\sigma_y\sigma_z u$ (m^3/sec)	Cumulative Number of Hours	Cumulative Frequency (%)
NNE	F	1.0	16	4.4	2.31E+04	16	0.15
NNE	F	2.0	16	2.2	4.61E+04	32	0.29
NNE	E	1.0	42	4.4	6.08E+04	74	0.68
NNE	F	3.0	19	1.5	6.92E+04	93	0.85
NNE	E	2.0	56	2.2	1.22E+05	149	1.37 *
NNE	D	1.0	76	4.4	1.45E+05	225	2.06 *
NNE	E	3.0	33	1.5	1.82E+05	258	2.37 *
NNE	E	4.0	2	1.1	2.43E+05	260	2.39 *
NNE	D	2.0	70	2.2	2.90E+05	330	3.03 *
NNE	E	5.0	2	0.9	3.04E+05	332	3.05 *
NNE	D	3.0	67	1.5	4.36E+05	399	3.66 *
NNE	D	4.0	32	1.1	5.81E+05	431	3.95 *
NNE	D	5.0	18	0.9	7.26E+05	449	4.12 *
NNE	D	6.0	11	0.7	8.71E+05	460	4.22 *
NNE	D	7.0	9	0.6	1.02E+06	469	4.30 *
NNE	D	8.0	5	0.6	1.16E+06	474	4.35 *

Note: Wind speed is the lower limit for the category. Categories are 1.0 m/s wide except for 8/ms which is a lower limit.

Arlington Valley Visibility Screening

Signal Mountain Wilderness	
Meteorological Data	Palo Verde NGS 1994-1998
Wind Direction	NNE
Distance	16 km
Hours	13-18
Number of Hours	10956 hours
1% Cutoff	109 hours

Direction	Stability	Speed (m/sec)	Number of Hours	Travel Time (hours)	$\sigma_y\sigma_z u$ (m^3/sec)	Cumulative Number of Hours	Cumulative Frequency (%)
NNE	F	1.0	1	4.4	2.31E+04	1	0.01
NNE	F	2.0	0	2.2	4.61E+04	1	0.01
NNE	E	1.0	3	4.4	6.08E+04	4	0.04
NNE	F	3.0	0	1.5	6.92E+04	4	0.04
NNE	E	2.0	4	2.2	1.22E+05	8	0.07
NNE	D	1.0	9	4.4	1.45E+05	17	0.16
NNE	E	3.0	1	1.5	1.82E+05	18	0.17
NNE	E	4.0	1	1.1	2.43E+05	19	0.17
NNE	D	2.0	8	2.2	2.90E+05	27	0.25
NNE	E	5.0	0	0.9	3.04E+05	27	0.25
NNE	D	3.0	5	1.5	4.36E+05	32	0.29
NNE	D	4.0	4	1.1	5.81E+05	36	0.33
NNE	D	5.0	3	0.9	7.26E+05	39	0.36
NNE	D	6.0	4	0.7	8.71E+05	43	0.39
NNE	D	7.0	1	0.6	1.02E+06	44	0.40
NNE	D	8.0	2	0.6	1.16E+06	46	0.42

Note: Wind speed is the lower limit for the category. Categories are 1.0 m/s wide except for 8/ms which is a lower limit.

Arlington Valley Visibility Screening

Signal Mountain Wilderness	
Meteorological Data	Palo Verde NGS 1994-1998
Wind Direction	NNE
Distance	16 km
Hours	19-24
Number of Hours	10956 hours
1% Cutoff	109 hours

Direction	Stability	Speed (m/sec)	Number of Hours	Travel Time (hours)	$\sigma_y\sigma_z u$ (m^3/sec)	Cumulative Number of Hours	Cumulative Frequency (%)
NNE	F	1.0	35	4.4	2.31E+04	35	0.32
NNE	F	2.0	43	2.2	4.61E+04	78	0.72
NNE	E	1.0	43	4.4	6.08E+04	121	1.11 *
NNE	F	3.0	33	1.5	6.92E+04	154	1.41 *
NNE	E	2.0	51	2.2	1.22E+05	205	1.88 *
NNE	D	1.0	22	4.4	1.45E+05	227	2.08 *
NNE	E	3.0	57	1.5	1.82E+05	284	2.61 *
NNE	E	4.0	45	1.1	2.43E+05	329	3.02 *
NNE	D	2.0	27	2.2	2.90E+05	356	3.27 *
NNE	E	5.0	28	0.9	3.04E+05	384	3.52 *
NNE	D	3.0	27	1.5	4.36E+05	411	3.77 *
NNE	D	4.0	34	1.1	5.81E+05	445	4.08 *
NNE	D	5.0	28	0.9	7.26E+05	473	4.34 *
NNE	D	6.0	16	0.7	8.71E+05	489	4.49 *
NNE	D	7.0	17	0.6	1.02E+06	506	4.64 *
NNE	D	8.0	37	0.6	1.16E+06	543	4.98 *

Note: Wind speed is the lower limit for the category. Categories are 1.0 m/s wide except for 8/ms which is a lower limit.

APPENDIX G

ACID DEPOSITION SCREENING ANALYSIS

TABLE G-1
Acid Deposition

Arlington Valley Energy

Unit Annual Concentrations (ug/m3)/(lb/hr)		
Location	**NO_2**	**SO_2**
Peak Sensitive Class II Area	0.00313	0.00313

Annual Emission Rates (tons/yr)	**NO_x**	**SO_2**
Turbines (2)	220	38.5
Boiler	1.60	0.02

Assumptions		
Species	**NO_x**	**SO_2**
Deposition Velocity (m/s)	0.05	0.005
MW Ratio R	0.30	0.50
Annual Frequency Factor F	1.0	1.0

Estimated Total Class II Concentration and Deposition		
Location	**Nitrogen**	**Sulfur**
Peak Concentrations (ug/m3)	0.158	0.028
Peak Depositon (kg/ha-yr)	0.007	0.0002

Dry Dep (kg/ha-yr) = Conc ($\mu g/m^3$) • V_d (m/s) * F • R * 86,400 sec/day • 365 day/yr • 10^{-9} kg/µg • 10^4 m^2/ha
Total Deposition assumed to be twice dry deposition

ISCST3 Simulations	
Peak Unit Concentration	C2UNIT95.OUT

EXHIBIT B-2

GROUNDWATER ASSESSMENT

Water Resource Impact Assessment

Arlington Valley Energy Project
Arlington Valley, Arizona

ARCADIS
GERAGHTY & MILLER

21 December 1999

PREPARED FOR

Duke Energy North America

ARCADIS GERAGHTY & MILLER

Water Resource Impact Assessment

Arlington Valley Energy Project
Arlington Valley, Arizona

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Appendices

A Aquifer Test Data, Description of Methodology, and Analysis

B Application of a Numerical Groundwater Model (Quickflow) to the Region Surrounding the Proposed Duke Energy Power Plant

available to the proposed project through the conversion of Irrigation Grandfathered Rights (IGRs) that have been obtained by Duke, as discussed in the next section.

3.2 Elements of Supply Methodology

Water demand for the proposed project will be supplied fully through groundwater pumpage. Duke has obtained six IGRs from approximately 2,400 acres of contiguous, irrigated land located in the vicinity of the proposed project. The 1999 irrigation allotment of these rights is approximately 11,200 acre-feet per year, which is based on the application of varying water duties to approximately 2,300 water duty acres. Duke will convert the existing IGRs to Type 1 Non-Irrigation Grandfathered Rights (Type 1 Rights). For the purposes of this study, it is estimated that the conversion will occur using a water duty of approximately 3 acre-feet per acre, resulting in a total estimated Type 1 Right of approximately 6,816 acre-feet per year. Details of the water rights obtained by Duke and the Type 1 Right conversion are summarized in Table 1.

For the purposes of this study, all water is expected to be withdrawn from four existing production wells located within 1 mile of the proposed project.

3.3 Elements of Adequacy Methodology

Several methods were used to determine the adequacy of water supply for the proposed project and to determine the impacts to groundwater levels expected from groundwater extraction to meet the project water supply. These methods include the development of an analytical model based on historical response of groundwater levels to agricultural pumpage, and the use of a two-dimensional analytical groundwater flow modeling software package.

Historically, water use in the study area has been largely related to agricultural irrigation, beginning approximately in the early 1940's and continuing to present. As a result, water levels in the area have decreased significantly since the 1940's, although they began to rebound beginning in the early 1980's as agricultural pumpage decreased. Based on annual groundwater pumpage as reported to ADWR since 1986 and available aerial photographs for the area, an estimated amount of groundwater extracted over the last 40 years has been developed. By comparing this estimate to known declines in water levels over this time period, a simple analytical model of regional groundwater level response to pumpage has been developed. This model has been used to estimate the expected impact regionally due to pumpage by Duke over the lifetime of the proposed project.

1. Introduction

Duke Energy North America (Duke) retained ARCADIS Geraghty & Miller, Inc. (ARCADIS Geraghty & Miller) to conduct a hydrologic analysis for a proposed combined-cycle natural gas power plant to be built in Arlington Valley, in western Maricopa County, Arizona. This report summarizes the results of the hydrologic analysis conducted by ARCADIS Geraghty & Miller, and provides conclusions as to the physical availability of a water supply over the lifetime of the proposed project and the expected impact of groundwater pumping on groundwater levels in the area. The proposed project (also known as the Arlington Valley Energy Project) will occupy approximately 40 acres located in Township 1 South (T1S), Range 6 West (R6W), on part of Section 17, approximately 1.5 miles south of the Palo Verde Nuclear Generating Station (PVNGS). The location of the proposed project is shown on Figure 1. This property is located within the Lower Hassayampa sub-basin of the Phoenix Active Management Area (Phoenix AMA).

2. Purpose and Scope of Analysis

This hydrologic assessment has been conducted to support an Application for a Certificate of Environmental Compatibility to be submitted to the Power Plant and Transmission Line Siting Committee of the Arizona Corporation Commission (ACC). The specific purpose of this report is to demonstrate the physical availability of a water supply over the expected lifetime of the proposed project, and to assess the impact of groundwater extraction on groundwater levels in the Arlington Valley area.

Specific statutory or regulatory guidelines for this hydrologic analysis do not exist. However, the scope of this analysis was modeled after guidelines developed by the Arizona Department of Water Resources (ADWR) for hydrologic studies for assured and adequate water supplies (ADWR, 1995).

3. Methods of Analysis

3.1 Elements of Demand Methodology

Preliminary estimates of expected water demand were obtained from Duke, and vary based on the expected operational parameters of the proposed project, including methods of pre-treatment, use of duct-firing for greater efficiency, expected cycles of concentration of cooling water, and disposal options for blowdown water. Final estimates of water demand have not yet been completed. For the purposes of this hydrologic analysis, the water demand is assumed to be the maximum amount of water

In addition to the analytical model based on historic data, the expected impact from the four production wells was modeled using Quickflow™, an analytical two-dimensional groundwater flow modeling software package developed by ARCADIS Geraghty & Miller. The transient modeling analysis used by Quickflow™ solves for the Theis equation. The model assumes a uniform, isotropic, homogeneous aquifer with an infinite lateral extent. No recharge or leakage was applied to the model for this analysis. The groundwater flow model was used to calculate the amount of drawdown over the 30-year expected lifetime of the proposed project that can be attributed to withdrawals from the Duke supply wells.

4. Elements of Demand

A review of aerial photos and the pumpage data reported to ADWR indicate that the withdrawals from the wells associated with the IGRs for the subject parcels has decreased since the 1980's as noted for the area in general. Based on quantity of groundwater available under the IGRs, irrigation pumpage for the Duke parcels could be as high as approximately 11,200 acre-feet/year. Conversion of the IGRs to Type I Rights will reduce the allowable pumpage from the subject parcels to approximately 6,816 acre-feet/year, as shown in Table 1. Since approximately 1988, irrigation has continued on two of the Duke parcels (Shepard and Hardison properties) under the associated IGRs, averaging approximately 3,300 acre-feet/year over the past three years, as shown in Table 2. The proposed pumpage for the project is expected to increase over the current irrigation withdrawal, but to no more than the converted Type I Rights. Thus, proposed pumpage (6,816 acre-feet/year) for the project represents a 3,500 acre-feet/year increase over the current irrigation pumpage of 3,300 acre-feet/year. To summarize, the proposed project represents a 4,400 acre-feet/year decrease from the potential groundwater pumpage on the Duke properties, and a 3,500 acre-feet/year increase over the actual groundwater pumpage on the Duke properties.

For the purposes of evaluating the estimated impacts, the adequacy evaluation made use of the maximum pumpage allowed under the converted Type I Right of 6,816 acre-feet per year.

5. Elements of Supply

5.1 Hydrogeologic Setting

5.1.1 Geology

The Lower Hassayampa sub-basin of the Phoenix AMA is an alluvial plain bounded by the White Tank Mountains on the east, on the south by the Buckeye Hills and the Gila Bend Mountains, and on the west by the Palo Verde Hills.

Bedrock in the Lower Hassayampa area consists of granitic and metamorphic rocks (basement complex), and locally of interbedded volcanic and sedimentary deposits that overlie the basement complex. The main water-bearing unit in the area consists of the basin-fill sediments, comprised of gravel, sand, silt and clay (Sanger and Appel, 1980). These sediments range from a few tens of feet thick near the mountains to more than 1,000 feet thick near the center of the plain.

Basin-fill sediments in the area are divided into three major units and include the upper, middle and lower alluvium (U.S. Bureau of Reclamation, 1976). The upper alluvium ranges from 30 to 60 feet thick and consists of silty-sands and gravelly-sands with discontinuous lenses of clay and silty clay (Long, 1983). Caliche may be present in the upper 50 feet of the upper alluvium. The middle alluvium ranges from 230 to 300 feet thick and is comprised of clay and silty clay interbedded with discontinuous lenses of clayey silt, clayey sand, and silty sand. It includes the Palo Verde clay that varies north of the project site from 80 to 130 feet thick. The middle alluvium is intermittent within the bounds of the project site, disappearing entirely in the northwest corner. However, further southeast, the middle alluvium appears in driller's logs to be over 200 feet thick. The lower alluvium consists of less than 100 to greater than 1,000 feet of unconsolidated silty sand, sand, and gravelly sand (Long, 1983).

5.1.2 Hydrology

5.1.2.1 Groundwater Resources

Groundwater occurs predominantly in the basin-fill sediments of the three alluvial layers. The upper alluvium is unsaturated in most of the Lower Hassayampa area. The middle alluvium consists of two fine-grained layers. Agricultural irrigation water has percolated through the permeable upper alluvium over time and now forms a local perched water table on top of the relatively impermeable upper layer of the middle alluvium (Long, 1983). Studies of the perched aquifer indicate that it probably formed

between 1950 and 1975, and contained very little water prior to that time-interval (Palo Verde APP, 1997). Groundwater in this perched zone flows radially outward from the center of the groundwater mound. The areal size of the mound has stabilized at a size which allows downward percolation to equal or exceed recharge rates. The approximate location of the perched groundwater is shown on Figure 3.

The lower alluvium is typically saturated throughout the region. Most productive wells in the area are completed in the lower alluvium.

5.1.2.2 Water Levels

Regionally, groundwater flows from northeast to southwest. In the general vicinity of the proposed project, groundwater converges around a cone of depression that formed due to the long-term pumping for agricultural activity in the basin (Palo Verde APP, 1997). The cone of depression appears centered near the western-most edge of the Duke property, with a radius of about 5 miles in 1992. Since approximately 1980 agricultural pumping has decreased substantially and water levels are rebounding. Regional water level contours are shown in Figure 3, and primarily represent water levels in the lower alluvium. Representative hydrographs of the area are included as Figures 4 and 5. Available data indicate that water levels decreased as much almost as much as 100 feet in response to agricultural pumpage in the area, and have recovered as much approximately 50 feet as pumpage began to decease in the early 1980's.

5.1.2.3 Hydraulic Parameters

Hydraulic parameters for the area were derived from several sources, including site specific aquifer tests and published sources. The ADWR Salt River Valley (SRV) model does not extend far enough west to include the study area; the western boundary of the SRV model is located approximately 8 miles east of the proposed project. However, ADWR SRV estimates of hydraulic conductivity were obtained for comparison because of their use in other Applications for a Certificate of Environmental Compatibility submitted to the ACC (Pinnacle West, 1999). The nearest model cell for the ADWR SRV model uses a value of hydraulic conductivity for the lower alluvial unit of 10 feet per day (ft/day) (Corell and Corkhill, 1994).

Pump test data collected from one irrigation well, (B-01-06 34ABB) resulted in a calculated transmissivity of 100,000 gallons per day per foot (gpd/ft), which corresponds to 11.5 ft/day (Palo Verde APP, 1997).

ARCADIS Geraghty & Miller also performed site-specific aquifer tests for two of the existing Duke production wells located near the proposed project (Wells 4-1 and 4-2). The aquifer tests were performed using the existing pumps in each well. Pumping tests were performed on each well for a period of approximately 24 hours, followed by recovery tests for a period of approximately 12 hours. A complete description of the aquifer tests is included as Appendix A. Based on these tests, hydraulic conductivity ranges from 13.2 to 18.7 ft/day.

A complete summary of estimates of aquifer parameters obtained from various sources is included in Table 3.

5.2 Well Inventory and Water Supply Wells

A well inventory for the immediate vicinity of the proposed project (Township 1 South, Range 6 West) is included as Table 4. The well inventory was derived from several databases maintained by ADWR, including the Well Registry database (also known as the "55-files") and the Groundwater Site Inventory (GWSI) database. Based on these sources there are approximately 160 wells located within the above township. Due to overlap and uncertainty between the two databases, there are likely to be less than 160 wells in actuality. Duplicates have been removed from Table 4 where possible.

With the acquisition of the property needed to obtain the Type 1 Rights, Duke also acquired nine wells that have been used in the past to supply irrigation demands for the subject properties. These wells are indicated on Table 4. Of the remaining wells, approximately 100 are monitoring wells associated with PVNGS. All wells in the immediate vicinity of the proposed project are shown on Figure 6.

5.3 Water Quality

Detailed site-specific groundwater samples were obtained from four of the Duke production wells in October 1999. Laboratory analytical results for these samples are summarized in Table 5. Groundwater quality is adequate to meet the needs of the project water supply.

6. Elements of Adequacy

6.1 Historical Analytical Model of Regional Groundwater Usage

All known water rights in Arlington Valley and the approximate irrigated acreage for each are summarized in Table 6. Adequate information exists from aerial photographs and records of groundwater use as reported to ADWR to determine the approximate water use per acre for the area. Details of these calculations are shown in Table 6.

Based on this information, an estimate of the approximate annual groundwater use prior to 1980 was calculated as approximately 25,700 acre-feet/year for the period from the early 1940's to 1980, as shown in Table 6. From existing hydrographs, this magnitude of pumpage caused a long-term groundwater decline in the area of approximately 80 feet, or approximately 3.1 feet per 1,000 acre-feet/year of groundwater pumpage. This value was used to extrapolate the expected regional groundwater response to Duke pumpage over the 30-year lifetime of the proposed project.

To the extent that the past can be used to predict the future, the estimated pumpage for the proposed project would have contributed approximately a 21-foot decline in regional water levels over the period. This is about a quarter of the observed water level declines over a similar historic period (the period prior to 1980 is about the same as the projected lifetime of the plant). However, water levels have increased since the 1980's and are continuing to rise in the Arlington Valley area under the current reduced rate of agricultural pumpage. Impacts of the conversion of rights and future project pumpage can be expected to be offset to an extent.

Application of the historical analytical model is meant only as an informal examination of proposed project impacts relative to previous impacts to Arlington Valley and expected future recovery of water levels. More reliable specific impacts due to project production wells were developed using a numerical groundwater flow model, as discussed in the next section.

6.2 Theis Hydrologic Impact Analysis

The transient numerical model employed by ARCADIS Geraghty & Miller utilizes values of hydraulic conductivity, pumpage, and storativity to produce expected groundwater levels at a specific time in the future resulting from the projected pumpage. The model illustrates the impacts of the projected pumpage only, and no attempt was made to model groundwater recharge or inflows that are the cause of the

ongoing increases in groundwater levels. The model results therefore predict the changes in water levels due to the projected pumpage, and should be combined with ongoing water level trends to project future depths to groundwater and water levels. A complete description of the modeling effort employed by ARCADIS Geraghty & Miller is included as Appendix B.

Conservative estimates of all parameters were used in the model. The pumpage amount used was also conservative, as the maximum possible water demand of 6,816 acre-feet/year was used, rather than the increase over current pumpage on the parcels. Pumpage by well was determined by dividing this demand between four modeled production wells.

All estimates of hydraulic conductivity compiled were similar in magnitude; however, the site-specific pumping and recovery tests were assumed to be the best estimate of the actual aquifer conditions likely to be encountered by the project production wells. Both the lowest value and the highest value of hydraulic conductivity obtained from the site-specific tests were used in the modeling runs, in order to obtain a range of possible results. No site-specific values of storativity were available, so the value obtained from the ADWR Salt River Valley model was used.

Two model runs were made to assess the project water supply. In order to assess the likely expected groundwater conditions at the end of the project's expected lifetime, impacts to water levels were modeled for a 30-year period. As mentioned previously, each time period was modeled using both low and high values of hydraulic conductivity. Results of modeling for these two time periods are summarized in Table 7.

At the end of 30 years, drawdown does not exceed approximately 25 feet at any location during either of the modeling analyses. Declines of water levels up to 10 feet extend a distance of 1.2 to 1.9 miles radially from the production wells. Water level declines for the worst case scenario (low value of hydraulic conductivity) are shown on Figure 7.

7. Conclusions

Based on the information presented in this report, the following conclusions are warranted:

1. Water supply for the proposed proposed project will be met completely through the use of groundwater. Approximately 11,200 acre-feet/year of Irrigation

Grandfathered Rights will be converted to Type 1 Non-Irrigation Grandfathered Rights to provide a water supply of approximately 6,816 acre-feet/year. Current pumpage under the rights to be converted is about 3,300 acre-feet/year.

2. Historically, the Arlington Valley area as experienced approximately 80 feet of groundwater decline due to agricultural pumpage. Water levels have recovered approximately 50 feet in the area since approximately 1980 and are continuing to recover. Impacts of future pumpage can be expected to be offset by this recovery.

3. Adequate information is available for the vicinity of the proposed project to obtain a reliable estimate of changes in groundwater levels due to the groundwater pumpage for the proposed project. This includes the analysis of site-specific pumping and recovery tests.

4. Water quality is adequate to meet the water supply of the proposed project.

5. Modelings over the 30 year expected lifetime of the proposed project indicate that sufficient water is physically available to supply the project water demands. Projected groundwater pumpage does not cause excessive impact to the area. Based on groundwater flow modeling, projected water level changes due to withdrawals of the full Type I Right declines do not exceed approximately 25 feet at any location, and minimal water level changes (up to 10 feet of decline) are projected within 2 miles of the project production wells. Based on an analytical model of historical response to groundwater pumpage, water levels are estimated to change no more than 21 feet over the lifetime of the proposed project. Future water level changes will be offset by the ongoing recovery of water levels in the area.

6. Sufficient water is available to supply the proposed project needs. The proposed withdrawal of this water will have minimal impact on the aquifer.

8. References

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U.S. Bureau of Reclamation, 1976. Central Arizona Project—Geology and Ground-Water Resources Report, Maricopa and Pinal Counties, Arizona, December 1976.

Tables

Table 1. Details of Water Rights Obtained by Duke Energy North America
Arlington Valley Energy Project, Arlington Valley, Arizona

Parcel Identification		Current Allotment (1999)	Irrigation Acres	Water Duty (Acre-feet/acre)			Calculated Water Duty Acres	Type I Conversion @ 3 a-f/a
Parcel No.	Irrigation Grandfathered Right	(acre-feet/year)	(acres)	1992-1994	1995-1999	2000-	(acres)	(acre-feet/year)
1	58-105414.0000	3,352	740	5.98	4.70	3.87	713	2,139
2	58-104995.0000	3,467	618	7.09	5.74	5.29	604	1,812
3	58-130196.0000	144	34	5.31	4.37	3.75	33	99
4	58-102369.0000	1,617	395	5.35	4.20	3.46	385	1,155
7	58-101121.0001	1,297	320	5.78	4.54	3.74	286	857
8	58-100902.0003	1,343	284	6.80	5.34	4.40	252	755
Totals		11,219	2,390				2,272	

Total Type 1 Non-Irrigation Grandfathered Right = 6,816

Table 2. Annual Groundwater Withdrawals Reported to ADWR for Duke Parcels
Arlington Valley Energy Project, Arlington Valley, Arizona

Parcel No.	Right No.	Pumped From Well	Annual Withdrawals Reported to ADWR (Acre-feet)												
			1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	58-105414.000	624677	1069.29	656.7	0	0	0	0	-	-	-	-	-	0	-
		624678	67.67	826.4	0	0	55.7	0	-	-	-	-	-	0	-
2	58-104995.000	611935	-	1426.6	1345.76	997.74	953.46	1019.29	870.82	1164.09	1105.44	1257.92	1453.14	1149.78	863.38
		611936	-	0	0	0	0	0	0	0	0	1107.1	1196.75	1443.4	0
		611937	-	1278.4	1094.3	1092.92	908.59	969.23	831.1	1083.7	1130.96	0	0	0	1499.58
3	58-130196.000	None specified	0	0	0	0	0	0	0	-	-	-	-	0	-
4	58-102369.000	602601	379	698.3	450.94	293.57	301.79	0.81	2.49	1.9	27.62	16.24	455	303.75	159
		602602	594	583.23	416.79	563.98	445.32	0	0.67	0	160.38	173.45	367	257.67	335
7	58-101121.000	610922	-	-	-	-	-	-	-	-	-	-	369.91	0	-
8	58-100902.000	627971	-	-	-	-	-	-	-	-	-	-	0	0	0
	Annual Total Groundwater Usage for Duke Parcels		2,110	5,470	3,308	2,948	2,665	1,989	1,705	2,250	2,424	2,555	3,842	3,155	2,857

- No annual withdrawal report on file with ADWR

Table 4. Complete Inventory of Wells Township 1 South, Range 6 West
Arlington Valley Energy Project, Arlington Valley, Arizona

Category	Duke Parcel	Duke Well ID	Cadastral Location	Registration Number	Water Use	Site Use	Owner	Depth (feet)	Diameter (inches)	Perforated Interval (feet)	Year Constructed	Source
Duke Wells	Parcel 1	Well 1-1	C-01-06 26DAD	624677	Irrigation	Withdrawal	W PERRY; B YOUNGKER	1135	20	126-1135	1948	Registry; GWSI
	Parcel 1	Well 1-2	C-01-06 35ADA	624678	Irrigation	Withdrawal	W PERRY	1000	20		1974	Registry; GWSI
	Parcel 2	Well 2-1	C-01-06 28ACC2	611937	Irrigation	Withdrawal	LEON HARDISON	337	15	124-337	1961	Registry; GWSI
	Parcel 2	Well 2-2	C-01-06 27BBC	611935	Irrigation	Withdrawal	HARDISON	1090	20		1947	Registry; GWSI
	Parcel 2	Well 2-3*	C-01-06 28ACC1	611936	Stock	Withdrawal	LEON HARDISON	0				Registry; GWSI
	Parcel 4	Well 4-1	C-01-06 21CBB2	602602	Irrigation	Withdrawal	SHEPPARD	1012	20		1958	Registry; GWSI
	Parcel 4	Well 4-2	C-01-06 21BCB	602601	Irrigation	Withdrawal	ROBERT SHEPPARD	1001	20	350-980	1980	Registry; GWSI
	Parcel 7	Well 7-1	C-01-06 17ABB	610922	Irrigation	Withdrawal	E SHEPARD; BETTY MARTIN	1219	20	260-1219	1960	Registry; GWSI
	Parcel 8	Well 8-1	C-01-06 20AAB2	627971	Irrigation	Withdrawal	SHIRLEY DESHETLER	1110	20	508-1110	1968	GWSI
Non-Palo Verde Wells			C-01-06 03BBB1		Unused	Unused		1085	20		1948	GWSI
			C-01-06 04CBA	556600	Domestic	Withdrawal	BERRYMAN, MICHAEL	320	8		1996	Registry
			C-01-06 07AAD	610921	Irrigation	Withdrawal	JOHN HALL ASSOCIATES; J HODGES; JAMES BIRMINGHAM	819	16	120-819	1979	Registry; GWSI
			C-01-06 07BBB	610923	Irrigation	Withdrawal	J HODGES; JAMES BIRMINGHAM	605	20	20-605	1979	Registry; GWSI
			C-01-06 07BCC	610924	Irrigation	Withdrawal	JOHN HALL ASSOCIATES; J HODGES; JAMES BIRMINGHAM	936	16	264-936	1979	Registry; GWSI
			C-01-06 08ACC1	628079	Irrigation	Withdrawal	L MARTIN; PETE POPOFF	936	18		1977	Registry; GWSI
			C-01-06 08ACC2		Domestic	Withdrawal	L MARTIN	300	8		1979	GWSI
			C-01-06 08DCA	501390	Domestic	Withdrawal	GAVETTE	325	8		1981	Registry
			C-01-06 09ABC		Unused	Unused		176	4			GWSI
			C-01-06 10DDD	609047	Irrigation	Withdrawal	PAUL GARBER	322	8	240-320	1974	Registry; GWSI
			C-01-06 12BBC		Unused	Unused		1000	20		1951	GWSI

Table 4. Complete Inventory of Wells for Township 1 South, Range 6 West
Arlington Valley Energy Project, Arlington Valley, Arizona

Category	Duke Parcel	Duke Well ID	Cadastral Location	Registration Number	Water Use	Site Use	Owner	Depth (feet)	Diameter (inches)	Perforated Interval (feet)	Year Constructed	Source
Non-Palo Verde Wells			C-01-06 13	802026	Irrigation	Withdrawal	BECK WAYNE E	1100	8			Registry
			C-01-06 13CAB		Irrigation	Withdrawal		1200	20			GWSI
			C-01-06 14AAA	608004			JACKSON	700	18		1967	Registry; GWSI
			C-01-06 14ADB	608003	Unused	Unused	J JACKSON	1000	18	325-1000	1967	Registry; GWSI
			C-01-06 14CBB	623232	Irrigation	Withdrawal	GLADDEN BROTHERS; GLADDEN BROTHERS; WILLIAM MCMURTRY	1140	20	375-1126	1978	Registry; GWSI
			C-01-06 14DBB	623227	Irrigation	Withdrawal	BEN YOUNGKER; WILLIAM MCMURTRY	1114	20	190-1114	1948	Registry; GWSI
			C-01-06 15BAB	514110	Domestic	Withdrawal	SICHI, MIKE	595	8		1986	Registry
			C-01-06 18ABC	627864	Irrigation	Withdrawal	GARY CACCIOGUIDE; OLIVIA DALTON	500	10	235-495	1973	Registry; GWSI
			C-01-06 18BBB	629645	Irrigation	Withdrawal	VANOSDELL	1333	20		1953	Registry; GWSI
			C-01-06 19ABB	629644	Irrigation	Withdrawal	CAMPILLO	1045			1959	Registry; GWSI
			C-01-06 19BAA	535718	Domestic	Withdrawal	CAMPILLO, CELEDONIO	360	6		1992	Registry
			C-01-06 19BBB		Irrigation	Withdrawal	RONALD HARPER	940	20	225-940	1976	GWSI
			C-01-06 19BBB	628647	Irrigation	Withdrawal	CAMPILLO	980	18		1975	Registry
			C-01-06 19BBB	629650	Irrigation	Withdrawal	VANOSDELL, CHARLES	0	0		1975	Registry
			C-01-06 19BBC	628645	Irrigation	Withdrawal	CAMPILLO	822	18		1954	Registry
			C-01-06 19CBB	629651	Irrigation	Withdrawal	VANOSDELL, CHARLES	0	0			Registry
			C-01-06 20AAB1		Unused	Unused	DE SHETLER FARMS	340	20	150-340	1930	GWSI
			C-01-06 20ABA					280	8		1968	GWSI
			C-01-06 20ACD	614947			AZ STATE LAND DEPT	0	0			Registry

Table 4. Complete Inventory of Wel Township 1 South, Range 6 West
Arlington Valley Energy Project, Arlington Valley, Arizona

Category	Duke Parcel	Duke Well ID	Cadastral Location	Registration Number	Water Use	Site Use	Owner	Depth (feet)	Diameter (inches)	Perforated Interval (feet)	Year Constructed	Source
Non-Palo Verde Wells			C-01-06 20BCA	614948	Stock	Withdrawal	AZ STATE LAND DEPT	200	9		1973	Registry
			C-01-06 21AAB	86398	Irrigation	Withdrawal	YOUNGKER	0	0			Registry
			C-01-06 21AAB	501579	Irrigation	Withdrawal	YOUNGKER	0	0			Registry
			C-01-06 21AAB	504407	Irrigation	Withdrawal	YOUNGKER	0	0			Registry
			C-01-06 21ABB	633945	Domestic	Withdrawal	TERRELL	350	8		1977	Registry
			C-01-06 21CBB1	602600	Irrigation	Withdrawal	SHEPPARD	408	20			Registry; GWSI
			C-01-06 22DDD	555667	Domestic	Withdrawal	MCCOLLUM, PATRICK	230	7		1997	Registry
			C-01-06 23ADB	623230	Irrigation	Withdrawal	JG LAND AND CATTLE; WILLIAM MCMURTRY	1158	20	140-930	1948	Registry; GWSI
			C-01-06 23BA	803973	Domestic	Withdrawal	WOODMANSEE, PERRY	302	10		1986	Registry
			C-01-06 23BAB	623228	Irrigation	Withdrawal	JG LAND AND CATTLE; B YOUNGKER FARMS; WILLIAM MCMURTRY	1010	20	355-1010	1950	Registry; GWSI
			C-01-06 23CAA	623229	Irrigation	Withdrawal	JG LAND AND CATTLE; BEN YOUNGKER JR; WILLIAM MCMURTRY	1157	20	380-1157	1959	Registry; GWSI
			C-01-06 26ABA	623231	Irrigation	Withdrawal	B YOUNGKER; WILLIAM MCMURTRY	1130	20	200-1130	1948	Registry; GWSI
			C-01-06 27ACC	611938	Domestic	Withdrawal	HARDISON & HARDISON	0	0			Registry
			C-01-06 29ABB	620365	Irrigation	Withdrawal	GARY ACCOMAZZO; OLIVER HARPER	960	18	300-490	1970	Registry; GWSI

Table 4. Complete Inventory of Wells for Township 1 South, Range 6 West
Arlington Valley Energy Project, Arlington Valley, Arizona

Category	Duke Parcel	Duke Well ID	Cadastral Location	Registration Number	Water Use	Site Use	Owner	Depth (feet)	Diameter (inches)	Perforated Interval (feet)	Year Constructed	Source
Non-Palo Verde Wells			C-01-06 30AAA	629647	Irrigation	Withdrawal	PAUL HARPER; CAMPILLO	800	18	150-800	1976	Registry; GWSI
			C-01-06 30ABB	629646	Irrigation	Withdrawal	PAUL HARPER; CAMPILLO	980	18	225-480	1975	Registry; GWSI
			C-01-06 30CDD	541428	None	Cathodic	ALL AMERICAN PIPELN	400	10		1993	Registry
			C-01-06 31ADB	626716	Stock	Withdrawal	SOUTHERN PACIFIC TRN	315	5		1926	Registry; GWSI
			C-01-06 31DAC	559905	Domestic	Withdrawal	DERESH, ROBERT	0	0			Registry
			C-01-06 34CAB	614949			AZ STATE LAND DEPT	0	0			Registry
			C-01-06 34CAB	614950	Stock	Withdrawal	AZ STATE LAND DEPT	0	0			Registry
Palo Verde Wells			C-01-06 02BBB	86025	Monitoring	Observation	AZ NUCLEAR POWER	58	0		1980	Registry
			C-01-06 02BBB	86036	Monitoring	Observation	AZ NUCLEAR POWER	28	4		1980	Registry
			C-01-06 02BBB	502303	Monitoring	Observation	AZ NUCLEAR POWER	64	4		1982	Registry
			C-01-06 02BBB	502304	Monitoring	Observation	AZ NUCLEAR POWER	62	4		1982	Registry
			C-01-06 02BBB	502305	Monitoring	Observation	AZ NUCLEAR POWER	0	0			Registry
			C-01-06 02BCC	502318	Monitoring	Observation	AZ NUCLEAR POWER	100	4		1982	Registry
			C-01-06 02BCC	502319	Monitoring	Observation	AZ NUCLEAR POWER	100	4		1982	Registry
			C-01-06 03ACA	519356	Test	Piezometer	AZ PUBLIC SERVICE	35	6		1987	Registry
			C-01-06 03ACA	519371	Test	Piezometer	AZ PUBLIC SERVICE	15	6		1987	Registry
			C-01-06 03ACC	502306	Monitoring	Abandoned	AZ NUCLEAR POWER	47	4		1982	Registry
			C-01-06 03ADA	519357	Test	Piezometer	AZ PUBLIC SERVICE	36	6		1987	Registry

Table 4. Complete Inventory of Wel Township 1 South, Range 6 West
Arlington Valley Energy Project, Arlington Valley, Arizona

Category	Duke Parcel	Duke Well ID	Cadastral Location	Registration Number	Water Use	Site Use	Owner	Depth (feet)	Diameter (inches)	Perforated Interval (feet)	Year Constructed	Source
Palo Verde Wells			C-01-06 03ADA	519372	Test	Piezometer	AZ PUBLIC SERVICE	15	6		1987	Registry
			C-01-06 03BAD	613281	Monitoring	Observation	AZ PUBLIC SERVICE	45	2		1977	Registry
			C-01-06 03BBA	502327	Monitoring	Observation	AZ NUCLEAR POWER	75	7		1982	Registry
			C-01-06 03BBA	613277	Monitoring	Observation	AZ PUBLIC SERVICE	41	2		1977	Registry
			C-01-06 03BBB	613276	Monitoring	Observation	AZ PUBLIC SERVICE	48	2		1977	Registry
			C-01-06 03BBB2	613251	Unused	Observation	APS	75	4	30 - 75	1976	GWSI; Registry
			C-01-06 03BBB3	613273	Unused	Observation	APS	49	2	37 - 49	1977	GWSI
			C-01-06 03BBC	613280	Monitoring	Observation	AZ PUBLIC SERVICE	30	2		1977	Registry
			C-01-06 03BBC		Unused	Observation	APS	44		22 - 42	1978	GWSI
			C-01-06 03BBD	502329	Monitoring	Observation	AZ NUCLEAR POWER	60	4		1982	Registry
			C-01-06 03BBD	613274	Monitoring	Observation	AZ PUBLIC SERVICE	41	2		1977	Registry
			C-01-06 03BBD	613282	Monitoring	Observation	AZ PUBLIC SERVICE	45	2		1977	Registry
			C-01-06 03BBD	613283	Monitoring	Observation	AZ PUBLIC SERVICE	44	8		1978	Registry
			C-01-06 03BBD	613284	Monitoring	Observation	AZ PUBLIC SERVICE	41	3		1978	Registry
			C-01-06 03BBD	613285	Monitoring	Observation	AZ PUBLIC SERVICE	47	3		1978	Registry
			C-01-06 03BBD	613286	Monitoring	Observation	AZ PUBLIC SERVICE	44	3		1978	Registry
			C-01-06 03BBD	613287	Monitoring	Observation	AZ PUBLIC SERVICE	41	3		1978	Registry
			C-01-06 03BBD	613288	Monitoring	Observation	AZ PUBLIC SERVICE	44	3		1978	Registry
			C-01-06 03BBD	613289	Monitoring	Observation	AZ PUBLIC SERVICE	41	3		1978	Registry
			C-01-06 03BCB	502177	Monitoring	Observation	ANPP	0	0			Registry
			C-01-06 03BCD	502169	Monitoring	Observation	ANPP	0	0			Registry
			C-01-06 03BDA	613278	Monitoring	Observation	AZ PUBLIC SERVICE	61	2		1977	Registry
			C-01-06 03BDA	613279	Monitoring	Observation	AZ PUBLIC SERVICE	44	2		1977	Registry
			C-01-06 03BDA	613290	Monitoring	Observation	AZ PUBLIC SERVICE	44	3		1978	Registry
			C-01-06 03BDB	519348	Monitoring	Observation	AZ PUBLIC SERVICE	70	6		1987	Registry
			C-01-06 03BDB	519355	Test	Piezometer	AZ PUBLIC SERVICE	25	6		1987	Registry
			C-01-06 03BDB	519364	Monitoring	Observation	AZ PUBLIC SERVICE	70	6		1987	Registry
			C-01-06 03BDB	519370	Test	Piezometer	AZ PUBLIC SERVICE	15	6		1987	Registry
			C-01-06 03BDD		Unused	Observation	PVNGS	50		20 - 50	1973	GWSI
			C-01-06 03CAC	519351	Monitoring	Observation	AZ PUBLIC SERVICE	130	6		1987	Registry
			C-01-06 03CAC	519367	Monitoring	Observation	AZ PUBLIC SERVICE	130	6		1987	Registry

Table 4. Complete Inventory of Wells for Township 1 South, Range 6 West
Arlington Valley Energy Project, Arlington Valley, Arizona

Category	Duke Parcel	Duke Well ID	Cadastral Location	Registration Number	Water Use	Site Use	Owner	Depth (feet)	Diameter (inches)	Perforated Interval (feet)	Year Constructed	Source
Palo Verde Wells			C-01-06 03CBD	502170	Monitoring	Observation	ANPP	0	0			Registry
			C-01-06 03CCA	502167	Monitoring	Observation	ANPP	0	0			Registry
			C-01-06 03CCC	502307	Monitoring	Observation	AZ NUCLEAR POWER	62	4		1982	Registry
			C-01-06 03CCD	502171	Monitoring	Observation	ANPP	0	0			Registry
			C-01-06 03CDC	519362	Test	Piezometer	AZ PUBLIC SERVICE	40	6		1987	Registry
			C-01-06 03CDC	519375	Test	Piezometer	AZ PUBLIC SERVICE	15	6		1987	Registry
			C-01-06 03DAA	519358	Test	Piezometer	AZ PUBLIC SERVICE	31	6		1987	Registry
			C-01-06 03DAA	519373	Test	Piezometer	AZ PUBLIC SERVICE	15	6		1987	Registry
			C-01-06 03DAC	519359	Test	Piezometer	AZ PUBLIC SERVICE	45	6		1987	Registry
			C-01-06 03DAC	519374	Test	Piezometer	AZ PUBLIC SERVICE	15	6		1987	Registry
			C-01-06 03DCC	519350	Monitoring	Observation	AZ PUBLIC SERVICE	100	6		1987	Registry
			C-01-06 03DCC	519361	Test	Piezometer	AZ PUBLIC SERVICE	50	6		1987	Registry
			C-01-06 03DCC	519366	Monitoring	Observation	AZ PUBLIC SERVICE	85	6		1987	Registry
			C-01-06 03DCC	519376	Test	Piezometer	AZ PUBLIC SERVICE	15	6		1987	Registry
			C-01-06 03DDB	86024	Monitoring	Abandoned	ANPP	24	4		1980	Registry
			C-01-06 03DDB	86037	Monitoring	Abandoned	ANPP	45	4		1980	Registry
			C-01-06 03DDB	519349	Monitoring	Observation	AZ PUBLIC SERVICE	110	6		1987	Registry
			C-01-06 03DDB	519365	Monitoring	Observation	AZ PUBLIC SERVICE	80	6		1987	Registry
			C-01-06 03DDC	519360	Test	Piezometer	AZ PUBLIC SERVICE	49	6		1987	Registry
			C-01-06 03DDC	519377	Test	Piezometer	AZ PUBLIC SERVICE	15	6		1987	Registry
			C-01-06 03DDD	86030	Monitoring	Observation	ANPP	65	4		1980	Registry
			C-01-06 03DDD	86031	Monitoring	Observation	ANPP	27	4		1980	Registry
			C-01-06 03DDD	502172	Monitoring	Observation	ANPP	0	0			Registry
			C-01-06 03DDD	502301	Monitoring	Observation	AZ NUCLEAR POWER	82	4		1982	Registry
			C-01-06 03DDD		Unused	Observation	PVNGS	50		20 - 50	1973	GWSI
			C-01-06 04AAD	613263	Unused	Observation	APS	41	3	23 - 41	1978	GWSI; Registry
			C-01-06 04AAD	613272	Monitoring	Observation	AZ PUBLIC SERVICE	36	2		1977	Registry
			C-01-06 04AAD	613275	Monitoring	Observation	AZ PUBLIC SERVICE	41	2		1977	Registry
			C-01-06 04ACC	502175	Monitoring	Observation	ANPP	0	0			Registry
			C-01-06 04ACC	502310	Monitoring	Observation	AZ NUCLEAR POWER	63	4		1982	Registry

Table 4. Complete Inventory of Wel... r Township 1 South, Range 6 West
Arlington Valley Energy Project, Arlington Valley, Arizona

Category	Duke Parcel	Duke Well ID	Cadastral Location	Registration Number	Water Use	Site Use	Owner	Depth (feet)	Diameter (inches)	Perforated Interval (feet)	Year Constructed	Source
Palo Verde Wells			C-01-06 04ACC	502311	Monitoring	Observation	AZ NUCLEAR POWER	65	4		1982	Registry
			C-01-06 04ADA	613264	Monitoring	Observation	AZ PUBLIC SERVICE	42	3		1978	Registry
			C-01-06 04ADB	502176	Monitoring	Observation	ANPP	0	0			Registry
			C-01-06 04ADB	502316	Monitoring	Abandoned	AZ NUCLEAR POWER	130	4		1982	Registry
			C-01-06 04ADB	502317	Monitoring	Abandoned	AZ NUCLEAR POWER	130	4		1982	Registry
			C-01-06 04ADB	502325	Monitoring	Observation	AZ NUCLEAR POWER	80	4		1982	Registry
			C-01-06 04BDB	502324	Monitoring	Observation	AZ NUCLEAR POWER	80	4		1982	Registry
			C-01-06 04BDC	502314	Monitoring	Observation	AZ NUCLEAR POWER	100	4		1982	Registry
			C-01-06 04BDC	502315	Monitoring	Observation	AZ NUCLEAR POWER	100	4		1982	Registry
			C-01-06 04CBB	502312	Monitoring	Observation	AZ NUCLEAR POWER	100	4		1982	Registry
			C-01-06 04CBB	502313	Monitoring	Observation	AZ NUCLEAR POWER	100	4		1982	Registry
			C-01-06 04DBC	502174	Monitoring	Observation	ANPP	0	0			Registry
			C-01-06 04DCC	502173	Monitoring	Observation	ANPP	0	0			Registry
			C-01-06 04DCC	613252	Monitoring	Observation	AZ PUBLIC SERVICE	94	4		1976	Registry
			C-01-06 09DDD	523299	Monitoring	Monitor	AZ PUBLIC SERVICE	270	8		1989	Registry
			C-01-06 10ACC	502322	Monitoring	Observation	AZ NUCLEAR POWER	102	4		1982	Registry
			C-01-06 10ACC	502323	Monitoring	Observation	AZ NUCLEAR POWER	102	4		1982	Registry
			C-01-06 10ADB	519352	Monitoring	Observation	AZ PUBLIC SERVICE	110	6		1987	Registry
			C-01-06 10ADB	519368	Monitoring	Observation	AZ PUBLIC SERVICE	110	6		1987	Registry
			C-01-06 10BAA	86022	Monitoring	Observation	ANPP	27	4		1980	Registry
			C-01-06 10BAA	86039	Monitoring	Observation	ANPP	47	4		1980	Registry

Table 4. Complete Inventory of Wells for Township 1 South, Range 6 West
Arlington Valley Energy Project, Arlington Valley, Arizona

Category	Duke Parcel	Duke Well ID	Cadastral Location	Registration Number	Water Use	Site Use	Owner	Depth (feet)	Diameter (inches)	Perforated Interval (feet)	Year Constructed	Source
Palo Verde Wells			C-01-06 10BAA	502308	Monitoring	Observation	AZ NUCLEAR POWER	67	4		1982	Registry
			C-01-06 10BAA		Unused	Observation	APS	50		20 - 50	1973	GWSI
			C-01-06 10BBB	86023	Monitoring	Observation	ANPP	58	4		1980	Registry
			C-01-06 10BBB	86038	Monitoring	Observation	ANPP	20	4		1980	Registry
			C-01-06 10BBB		Unused	Observation	APS	50		20 - 50	1973	GWSI
			C-01-06 10BCB	502320	Monitoring	Observation	AZ NUCLEAR POWER	102	4		1982	Registry
			C-01-06 10BCB	502321	Monitoring	Observation	AZ NUCLEAR POWER	102	4		1982	Registry

Table 3. Estimates of Aquifer Hydraulic Parameters
Arlington Valley Energy Project, Arlington Valley, Arizona

Source of Data	Method of Estimation	Location	Estimated Hydraulic Conductivity (feet/day)	Estimated Storativity	Comments
ADWR Salt River Valley Model	Nearest model cells, lower alluvial unit	Approximately 8 miles east of Plant	10	0.1	
Palo Verde APP Application	Aquifer test on irrigation well 55-613124	Approximately 3 miles northeast of Plant	11.5	None	Reported transmissivity value of 100,000 gpd/ft. Converted to feet/day assuming a saturated interval of 1163 feet (from GWSI).
DENA Aquifer Test	Well 4-1 Pumping	Less than 1 mile from Plant	18.7	None	
DENA Aquifer Test	Well 4-1 Recovery	Less than 1 mile from Plant	13.2	None	Value used for modeling effort
DENA Aquifer Test	Well 4-2 Pumping	Less than 1 mile from Plant	14.7	None	
DENA Aquifer Test	Well 4-2 Recovery	Less than 1 mile from Plant	16.5	None	

Table 5. Groundwater Analytical Results for Duke Energy Production Wells
Arlington Valley Energy Project, Arlington Valley, Arizona

	Analyte	Units	Reporting Limit	Well ID Date Sampled	4-1 10-21-99	4-2 10-21-99	2-1 10-21-99	2-2 10-21-99
Field Data	Temperature	° F			104	100.8	82.2	89.9
	pH	-			7.67	7.82	8.07	8.18
	Conductivity	uS			3020	3090	4010	2160
Metals	Antimony	mg/L	0.050		<0.05	<0.05	<0.05	<0.05
	Arsenic	mg/L	0.050		0.054	<0.054	<0.054	<0.054
	Barium	mg/L	0.010		0.018	0.018	0.028	0.015
	Beryllium	mg/L	0.0050		<0.0050	<0.0050	<0.0050	<0.0050
	Cadmium	mg/L	0.0050		<0.0050	<0.0050	<0.0050	<0.0050
	Calcium	mg/L	2.0		95	55	67	29
	Chromium	mg/L	0.010		0.025	0.018	0.03	0.034
	Iron	mg/L	0.50		<0.50	<0.50	<0.50	<0.50
	Lead	mg/L	0.050		<0.050	<0.050	<0.050	<0.050
	Magnesium	mg/L	0.50		16	11	26	14
	Nickel	mg/L	0.050		<0.050	<0.050	<0.050	<0.050
	Potassium	mg/L	10		<10	<10	<10	<10
	Selenium	mg/L	0.060		<0.060	<0.060	<0.060	<0.060
	Sodium	mg/L	25		480	560	700	430
	Thallium	mg/L	0.050		<0.050	<0.050	<0.050	<0.050
	Mercury	mg/L	0.00020		<0.00020	<0.00020	<0.00020	<0.00020
Inorganics	Total Alkalinity	mg/L	5.0		77	110	280	170
	Bicarbonate Alkalinity	mg/L	5.0		77	110	280	170
	Carbonate Alkalinity	mg/L	5.0		<5.0	<5.0	<5.0	<5.0
	Chloride	mg/L	50		600	620	670	350
	Fluoride	mg/L	0.10		6	6.7	5.1	6.5
	Hydroxide Alkalinity	mg/L	5.0		<5.0	<5.0	<5.0	<5.0
	Nitrate	mg/L as N	0.10		7.1	14	18	5.1
	Sulfate	mg/L	50		360	370	510	370
	TDS	mg/L	20		1700	1800	2300	1300
TOC	TOC	mg/L	1.0		1.2	<1.0	1.1	<1.0
Silica	Silica - Reactive	mg/L as SiO2			6.5	6.5	2.0	4.1
	Silica - Unreactive	mg/L as SiO3			11.4	8.6	8.0	7.4

Table 6. Historical Analytical Model of Regional Response to Groundwater Extraction
Arlington Valley Energy Project, Arlington Valley, Arizona

Right No.	Year Earliest Well Drilled	Approximate Irrigated Acreage*	Approximate Annual Water Use (acre-feet)**
100037.0001	1974	20	62
100105.0002	Unknown	60	186
100229.0002	Unknown	25	78
100291.0001	Unknown	20	62
100608.0000	Unknown	40	124
100902.0003	1980	260	806
101121.0001	1960	320	992
102369.0000	1958	380	1,178
103054.0001	Unknown	160	496
104995.0000	1947	650	2,015
105005.0000	1977	280	868
105414.0000	Unknown	650	2,015
106422.0001	Unknown	40	124
106422.0002	Unknown	40	124
106422.0003	Unknown	40	124
106422.0004	Unknown	40	124
106422.0005	Unknown	40	124
106422.0006	Unknown	40	124
106422.0007	Unknown	40	124
106422.0008	Unknown	40	124
106981.0001	1954	60	186
107182.0000	1947	110	341
107183.0000	Unknown	200	620
107804.0001	Unknown	1,750	5,425
107805.0001	1978	400	1,240
108354.0003	1974	360	1,116
109909.0001	1953	320	992
111348.0002	1954	880	2,728
112193.0000	1975	640	1,984
115649.0001	Unknown	20	62
116602.0001	1942	80	248
117240.0002	1973	80	248
130196.0000	Unknown	30	93
130197.0000	Unknown	50	155
130493.0000	Unknown	80	248
130754.0000	Unknown	40	124
130755.0000	Unknown	10	31

Approximate Annual Pumpage Prior to 1980 =	25,715	Acre-Feet
Amount of Regional Drawdown to 1980 =	80	Feet
Long-Term Regional Response to Groundwater Pumpage =	3.1	Feet
(Feet of Drawdown per 1,000 Acre-feet/year of Groundwater Extracted)		
Expected Long-Term Regional Response to Plant Pumpage (6,816 Acre-feet/year) =	21.2	Feet

Table 6. Historical Analytical Model of Regional Response to Groundwater Extraction
Arlington Valley Energy Project, Arlington Valley, Arizona

* Taken from 1986 and 1992 aerial photographs and ADWR maps of extent of groundwater rights

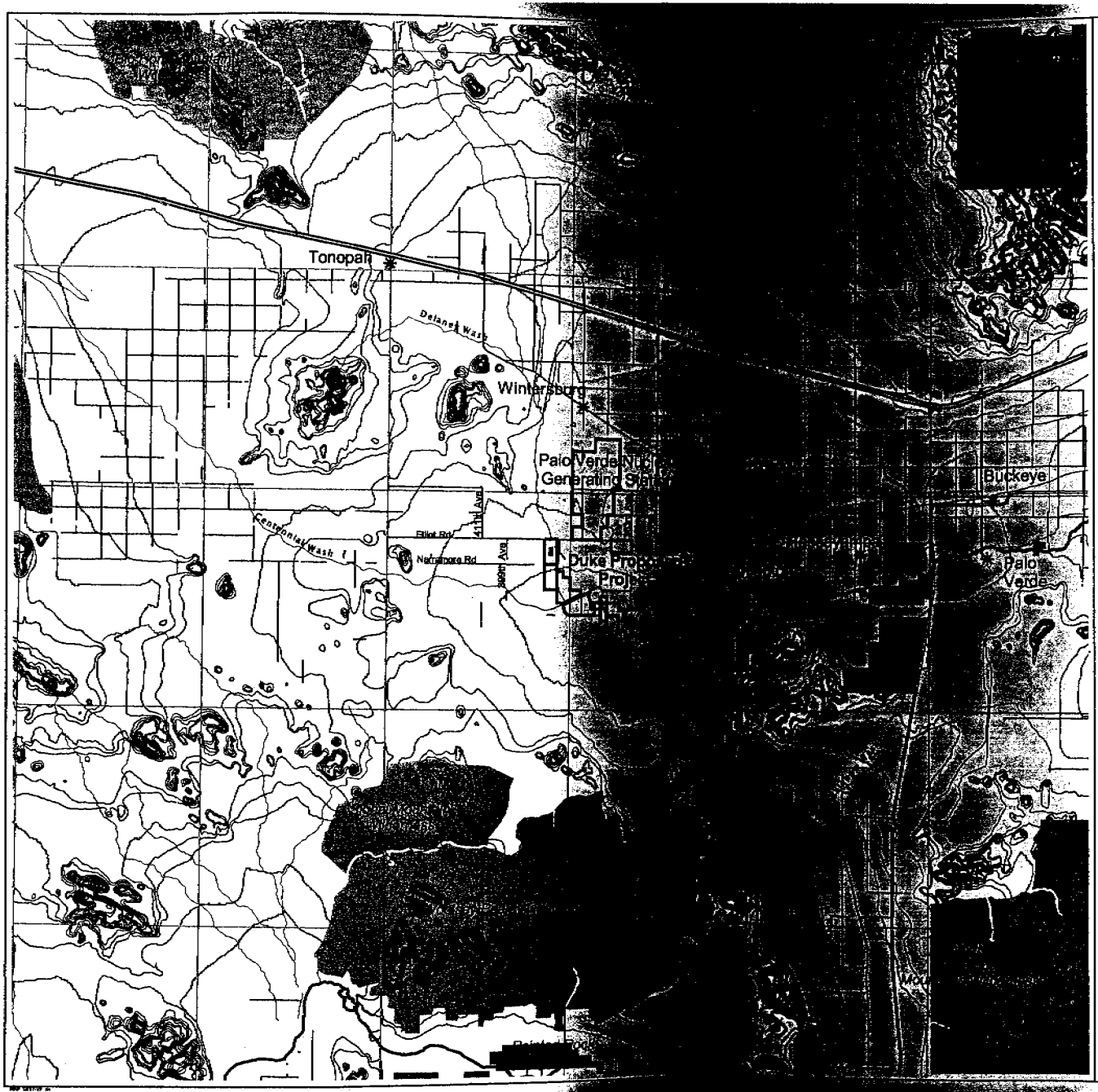
** Average water use per acre calculated as follows

Parcel No.	Irrigation Right	1986 Reported Groundwater Usage (acre-feet)	1986 Irrigated Acreage (from aerial photograph)	1992 Reported Groundwater Usage (acre-feet)	1992 Irrigated Acreage (from aerial photograph)	Calculated Water Use (acre-feet/acre)
1	8-105414.000	1137	504	-	-	2.3
2	8-104995.000	-	-	1702	471	3.6
4	8-102369.000	973	288	-	-	3.4
					Average Water Use Per Acre =	3.1

Figures

Table 7. Results of Groundwater Flow Modeling
Arlington Valley Energy Project, Arlington Valley, Arizona

Modeling Run	Pumpage Used (Acre-feet/year)	Hydraulic Conductivity Used (feet/day)	Duration of Transient Run (Years)	Maximum Drawdown (feet)	Approximate Radius of 10-Foot Drawdown (Miles from Parcel Boundary)
1	6,816	13.2	30	26.24	1.9
2	6,816	18.7	30	18.7	1.2



Figure

Site

Legend

Duke Proposed Project

Duke Properties

Palo Verde Nuclear Generating Station

Elevation Contours

Rivers and Washes

Cities and Towns

USGS 7.5' Quadrangles

Streets

BLM Wilderness Areas

Parks and Recreation

Game and Fish

Painted Rock Wildlife Area

0 1 2 3 4 5
Miles

Duke Energy

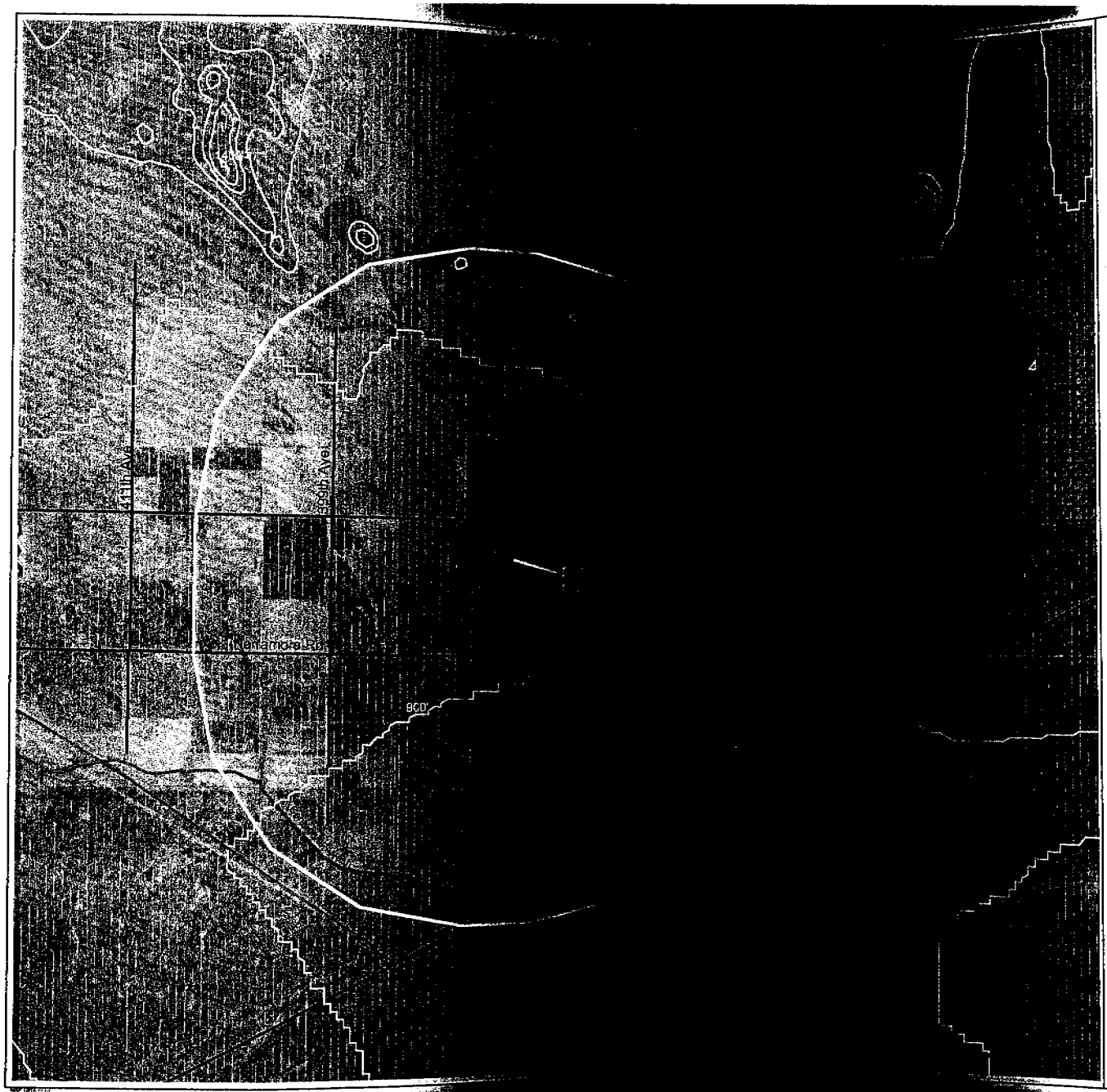


Figure 2:

Site Plan

Legend

- Duke Proposed Project
- Duke Properties
- Proposed Electric Power Transmission Lines
- Electric Power Transmission Lines
- Natural Gas Line
- Rivers and washes
- Streets
- Area within 2 Miles of Project
- Elevation Contours

Land Use

- Palo Verde Nuclear Generating Station
- Large Lot Residential

Land use for the remainder of the area is Rural.

0 0.5 1
Miles

Duke Energy.

411th Ave
700'
.089
399th Ave
Ellis Road
391st Ave
387th Ave
Perched Groundwater
Regional Water Level Contours and Extent of Perched Aquifer
Approximate Extent of Perched Groundwater
Groundwater Flow Direction
Perched Aquifer Monitoring Well
Shallow Monitoring Well
Regional Aquifer Monitoring Well
0
Miles

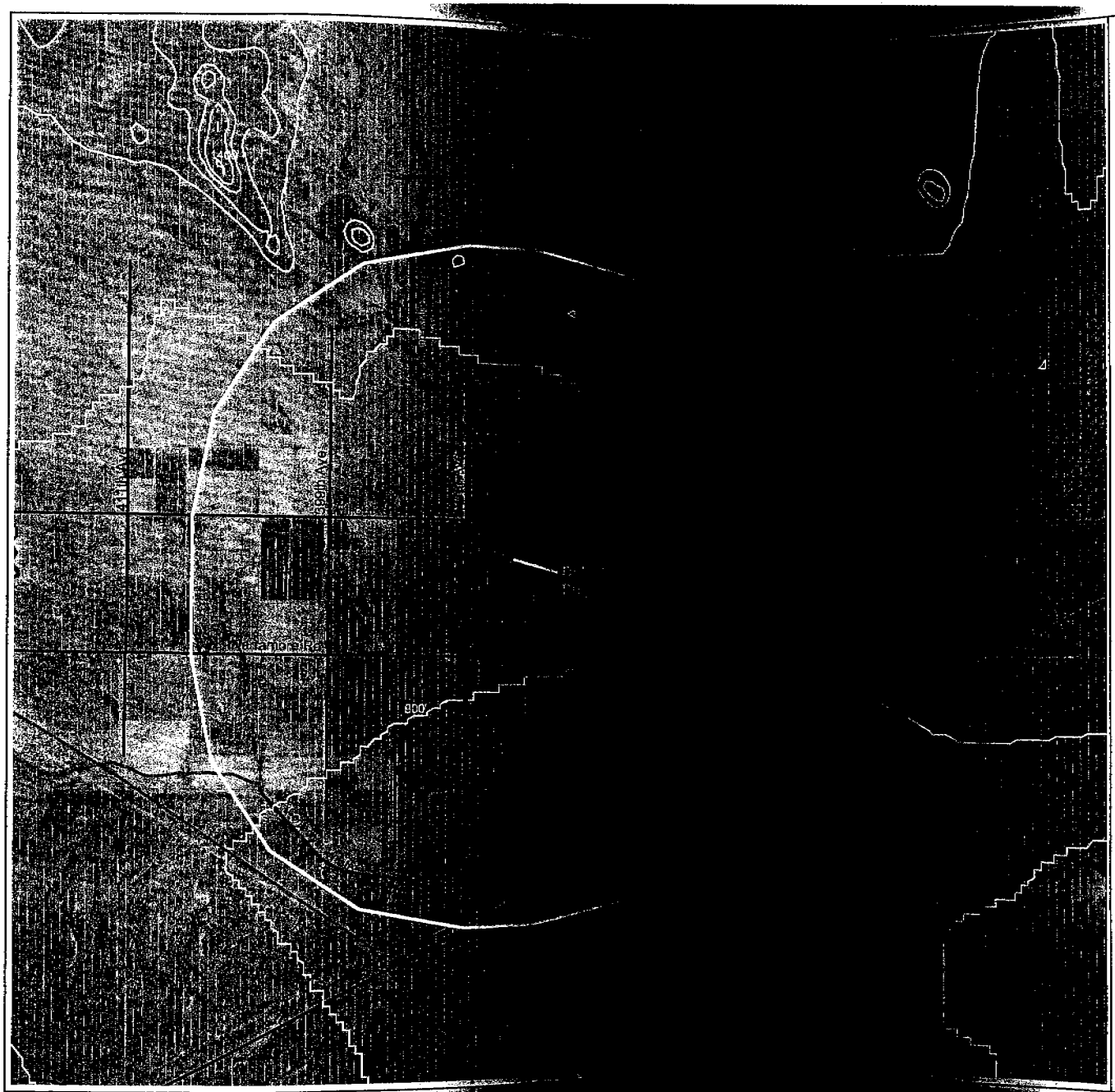


Figure 2:

Site Plan

Legend

- Duke Proposed Project
- Duke Properties
- Proposed Electric Power Transmission Lines
- Electric Power Transmission Lines
- Natural Gas Line
- Rivers and washes
- Streets
- Area within 2 Miles of Project
- Elevation Contours

Land Use

- Palo Verde Nuclear Generating Station
- Large Lot Residential

Land use for the remainder of the area is Rural.

0 0.5 1
Miles

Duke Energy.

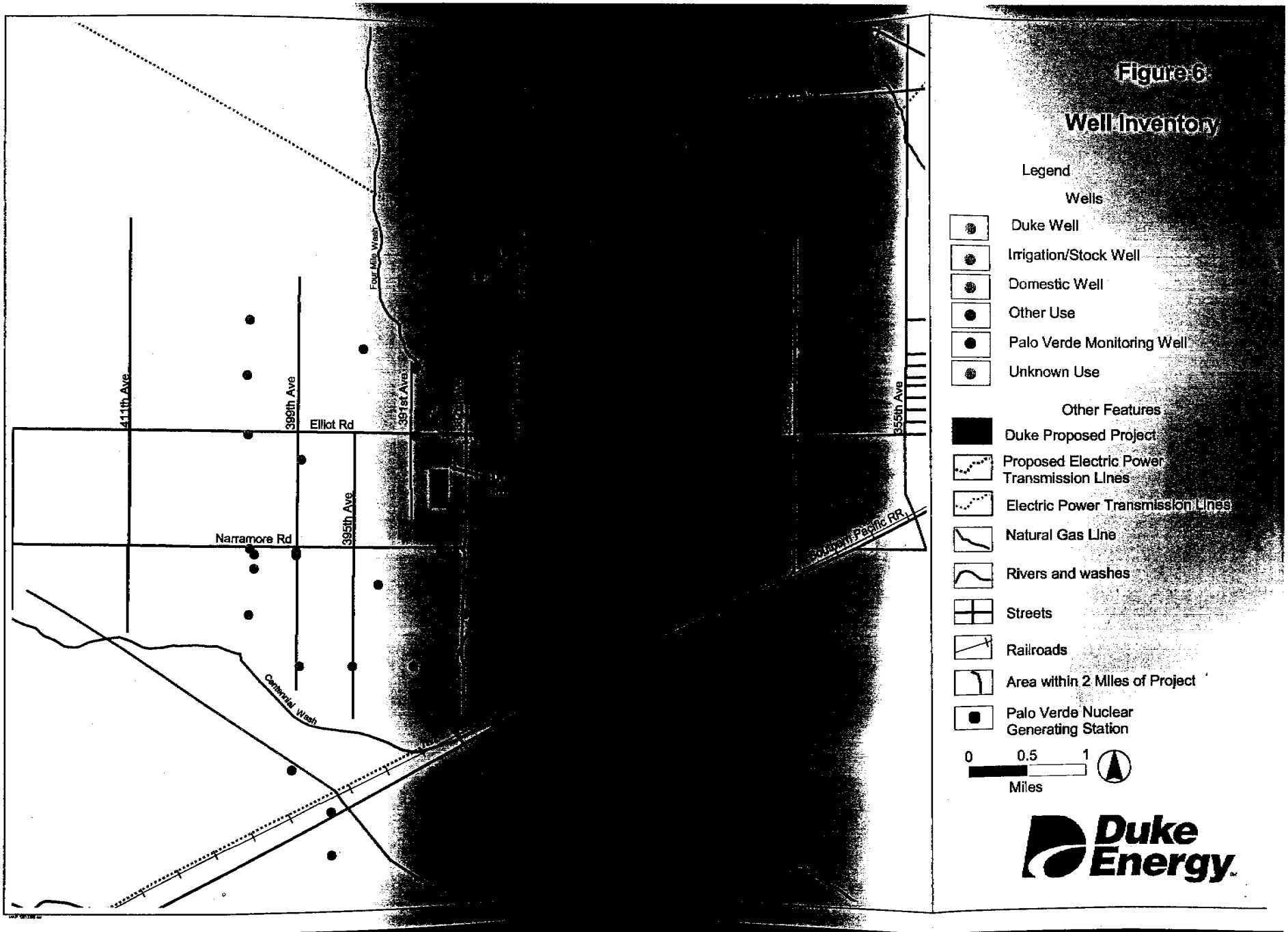
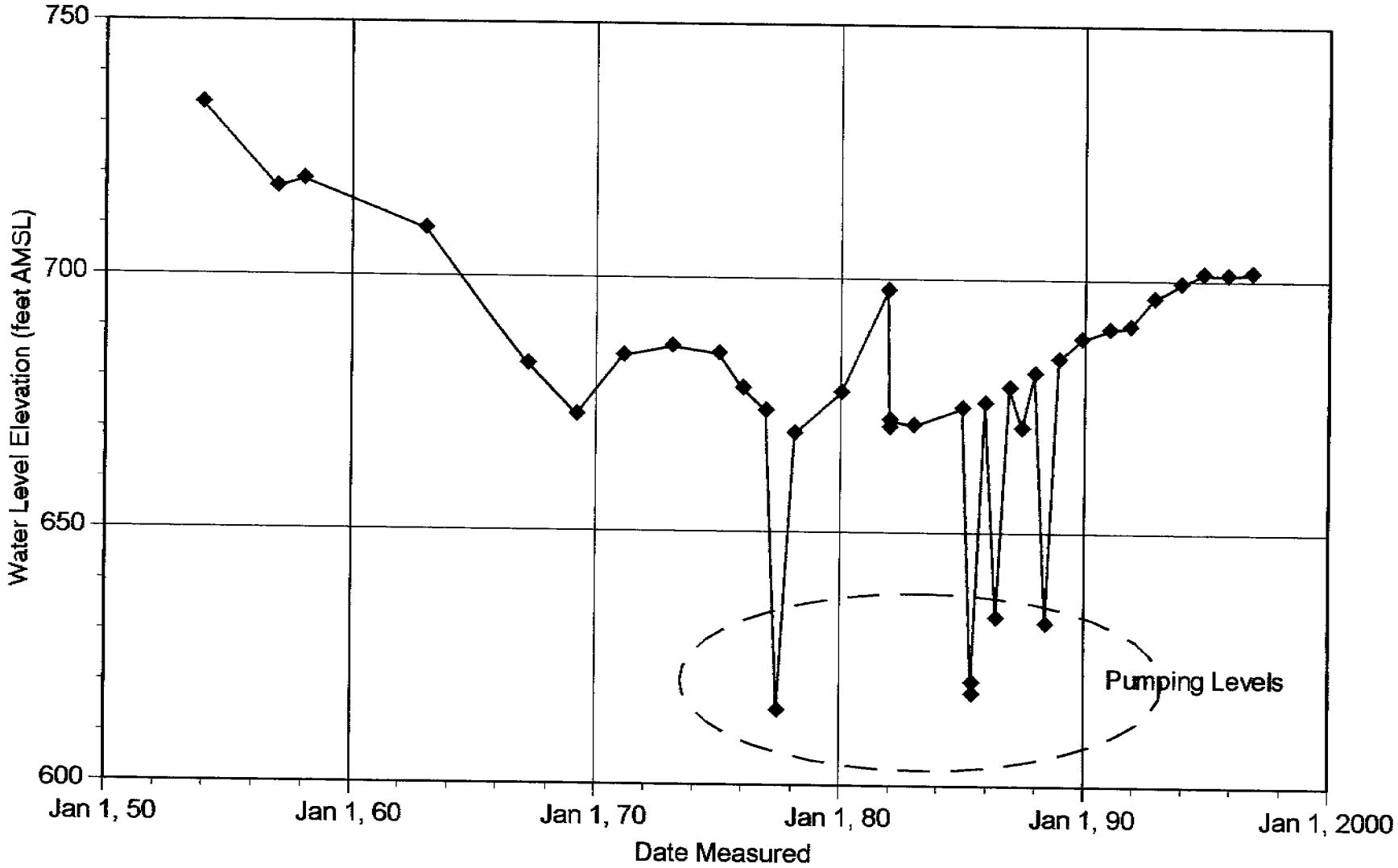


Figure 6
Well Inventory
Legend
Wells
Duke Well
Irrigation/Stock Well
Domestic Well
Other Use
Palo Verde Monitoring Well
Unknown Use
Other Features
Duke Proposed Project
Proposed Electric Power Transmission Lines
Electric Power Transmission Lines
Natural Gas Line
Rivers and washes
Streets
Railroads
Area within 2 Miles of Project
Palo Verde Nuclear Generating Station
0
0.5
1
Miles
Duke Energy
411th Ave
399th Ave
395th Ave
391st Ave
355th Ave
Elliot Rd
Narramore Rd
Four Mile Wash
Centennial Wash
Southern Pacific RR



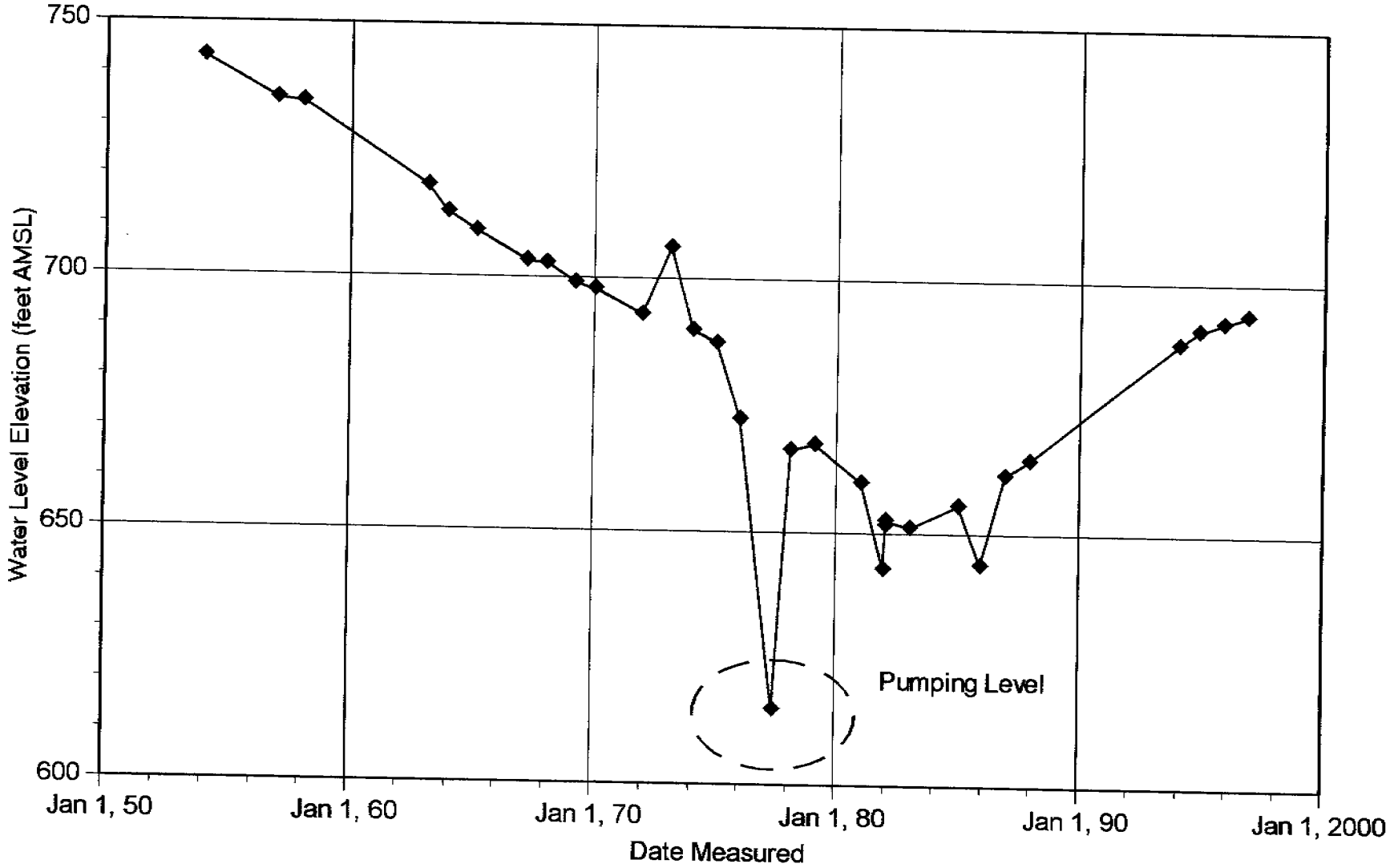
Duke Energy

GROUNDWATER ELEVATIONS FOR WELL C-01-06 14DBB

ARLINGTON VALLEY ENERGY PROJECT
ARLINGTON VALLEY, ARIZONA

FIGURE

4



Duke Energy

GROUNDWATER ELEVATIONS FOR WELL C-01-06 18BBB

ARLINGTON VALLEY ENERGY PROJECT
ARLINGTON VALLEY, ARIZONA

FIGURE

5

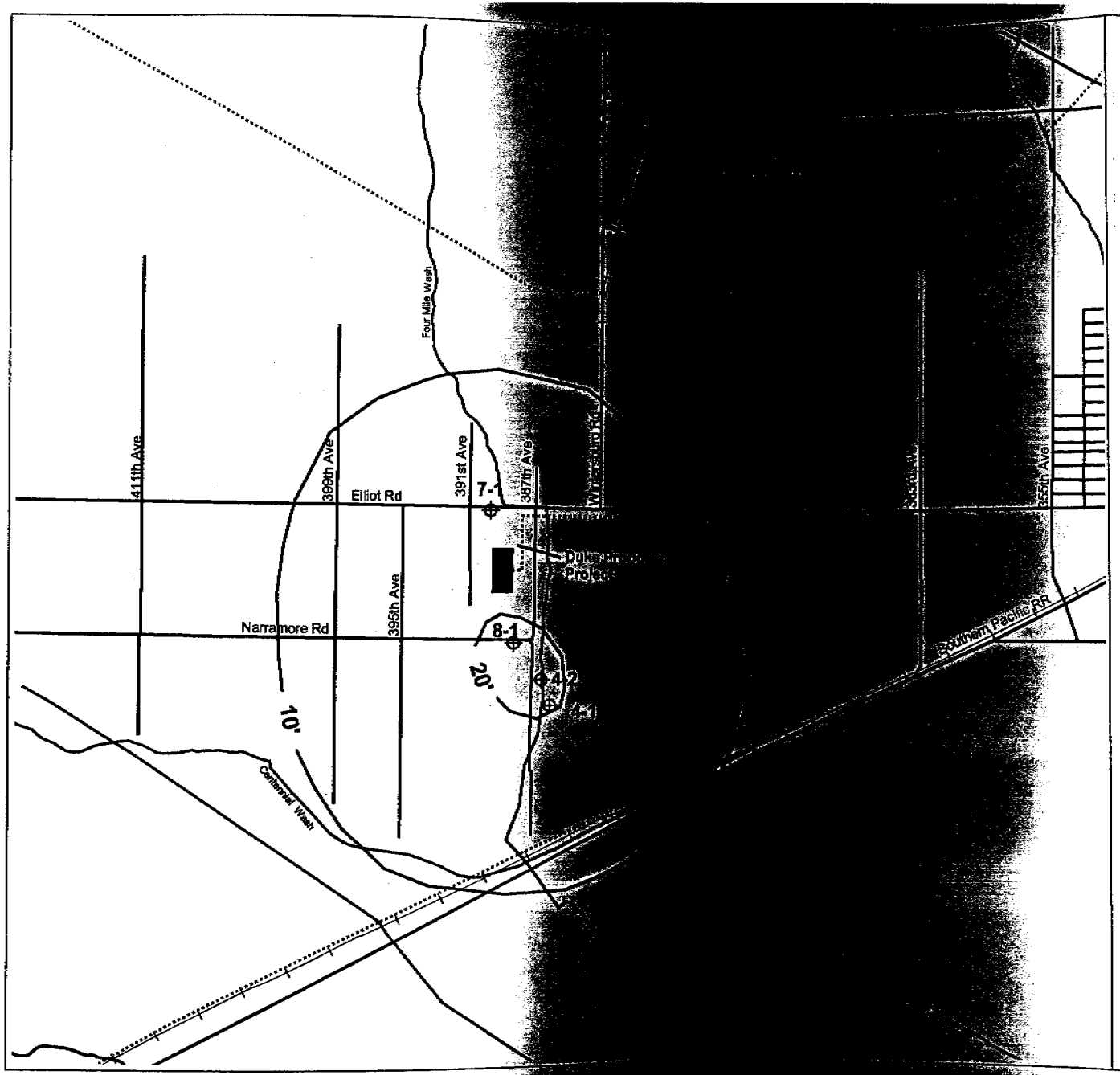


Figure 7:

Impact to Regional Groundwater Elevations (After 30 Years)

Legend

- Drawdown Contours

Modeled with Quickflow™ Version 1.19
Transient-state conditions at 30 years
Hydraulic Conductivity = 13.2 feet/day
Storage Coefficient = 0.1
Four existing wells pumping at 1,054 gpm each, for a total of 6,800 acre-feet/year

- Duke Production Wells
- Duke Proposed Project
- Proposed Electric Power Transmission Lines
- Electric Power Transmission Lines
- Natural Gas Line
- Rivers and washes
- Streets
- Railroads
- Palo Verde Nuclear Generating Station

0 0.5 1
Miles

Duke Energy.

ARCADIS GERAGHTY&MILLER

Appendix A

Aquifer Test Data,
Description of Methodology,
and Analysis

The purpose of conducting the aquifer tests was to develop reliable site-specific values of hydraulic conductivity necessary to support further hydrologic investigations. ARCADIS Geraghty & Miller conducted and analyzed pumping and recovery tests on Duke Energy Wells 4-1 and 4-2 on November 29th and 30th, 1999, and compiled available aquifer parameter information for the area from records maintained by ADWR. Plans for proposed aquifer tests on Duke Energy Wells 2-1 and 2-2 had to be abandoned due to problems with pump equipment at these locations.

Description of Field Work/Methodology

Duke Energy Wells 4-1 and 4-2 are constructed with annular open space between the outer well casing and the column pipe. This space permits down-well access for an electronic sounder to be lowered to the surface of the water within the well. During aquifer testing, depth-to-water measurements were conducted at regular intervals, concentrated toward the beginning of each event.

Two aquifer tests were conducted for each well, a pumping test and a recovery test. Tests for each well were conducted independently from the other well. No observation wells were available for use in collecting water level measurements for either of the Duke Energy wells.

Wells 4-1 and 4-2 are production wells historically used for agricultural irrigation purposes. Prior to each test, the well pump was shut down for the preceding week to allow recovery of water levels in the vicinity of the well. Water produced during aquifer tests was discharged to a system of irrigation canals that provide water to the local agricultural fields. Discharge rates were measured using a form of Pitot-tube flow meter and were relatively constant, dropping slowly as the depth to water increased. Each pumping test was conducted for approximately 24 hours. At the end of each pumping test, pumps were shut down and water levels were allowed to recover for approximately 12 hours. During recovery, water levels were regularly measured using the electric sounder.

Description of Analysis

Method of Analysis -- Pumping Tests

Data collected during the pumping tests were analyzed using the Cooper-Jacob method for drawdown data (Driscoll, 1986). For this method, pumping test data are plotted in a semi-logarithmic manner, with drawdown (in feet) plotted along the scalar y-axis, and elapsed time (in minutes) plotted along the logarithmic x-axis. Transmissivity is calculated using the following formula:

$$T=264 * Q / \Delta s$$

Where:

- T : coefficient of transmissivity, in gallons per day per foot (gpd/ft)
- Q: pumping rate, in gpm
- Δs: slope of the time-drawdown graph expressed as the change in drawdown between any two times on the log scale whose ratio is 10 (one log cycle).

The Cooper-Jacob method is derived from the Theis nonequilibrium well equation, and relies on the same assumptions:

1. The water-bearing formation is uniform in character and the hydraulic conductivity is the same in all directions.
2. The formation is uniform in thickness and infinite in areal extent.
3. The formation receives no recharge from any source.
4. The pumped well penetrates, and receives water from, the full thickness of the water-bearing formation.
5. The water removed from storage is discharged instantaneously when the head is lowered.
6. The pumping well is 100-percent efficient.
7. All water removed from the well comes from aquifer storage.
8. Laminar flow exists throughout the well and the aquifer.
9. The water table or potentiometric surface has no slope.

The effect of partial penetration of the aquifer is accounted for when calculating hydraulic conductivity from transmissivity:

$$K = 0.134 * T / b'$$

Where:

K = hydraulic conductivity, in feet/day

T = coefficient of transmissivity, in gpd/ft

b' = saturated thickness of perforated interval of well, in feet

Method of Analysis – Recovery Tests

Data collected during the recovery tests were analyzed using the Theis method for analyzing recovery data (Driscoll, 1986). For this method, recovery test data is plotted in a semi-logarithmic manner. Residual drawdown (in feet) is plotted along the scalar y-axis, and the ratio T/T' is plotted along the logarithmic x-axis, where T/T' is the ratio of time since the pump was started to time since the pump was stopped. Transmissivity is calculated using the following formula:

$$T = 264*Q/\Delta s'$$

Where:

T = coefficient of transmissivity, in gpd/ft

Q = pumping rate, in gpm

$\Delta s'$ = slope of the time-residual drawdown graph expressed as the change in residual drawdown between any two times on the log scale whose ratio is 10 (one log cycle)

The Theis recovery method relies on similar assumptions as the Cooper-Jacob method for analysis of pumping tests.

Summary of Aquifer Test Results

Pumping Tests

Duke Energy Well 4-1 Pumping Test Results

Detailed calculations of aquifer parameters for Well 4-1 are included in Table A1. All water-level measurements collected during the aquifer tests on Well 4-1 are summarized in Table A2 and shown on Figure A1. The time-drawdown plot used for the Cooper-Jacob method is shown in Figure A2.

There is one complicating factor in the analysis of pumping test data. Approximately 73 minutes after startup, the pump on Well 4-1 inexplicably shut off. A brief delay of 25 minutes occurred before the representative of Navajo Pump could restart it. During this time, water levels rebounded to approximately initial conditions at 170 ft bgs. Following restart of the pump, water levels again dropped at similar rates as they did during the initial hour of pumping and continued in a predictable manner from then on. Data from the second of these two initial pumping events was used for the Cooper-Jacob method for continuity.

The value of Δs obtained from the best-fit line to the Cooper-Jacob plot is 3.7 feet, resulting in a transmissivity estimate of 109,168 gpd/ft, and a hydraulic conductivity estimate of 18.7 feet/day.

Duke Energy Well 4-2 Pumping Test Results

Detailed calculations of aquifer parameters for Well 4-2 are included in Table A3. All water-level measurements collected during the aquifer tests on Well 4-2 are summarized in Table A4 and shown on Figure A3. The time-drawdown plot used for the Cooper-Jacob method is shown in Figure A4.

The value of Δs obtained from the best-fit line to the Cooper-Jacob plot is 6.5 feet, resulting in a transmissivity estimate of 62,142 gpd/ft, and a hydraulic conductivity estimate of 13.2 feet/day.

Recovery Tests

Duke Energy Well 4-1 Recovery Test Results

Detailed calculations of aquifer parameters for Well 4-1 are included in Table A1. The residual drawdown plot used for the Theis recovery method is shown in Figure A5.

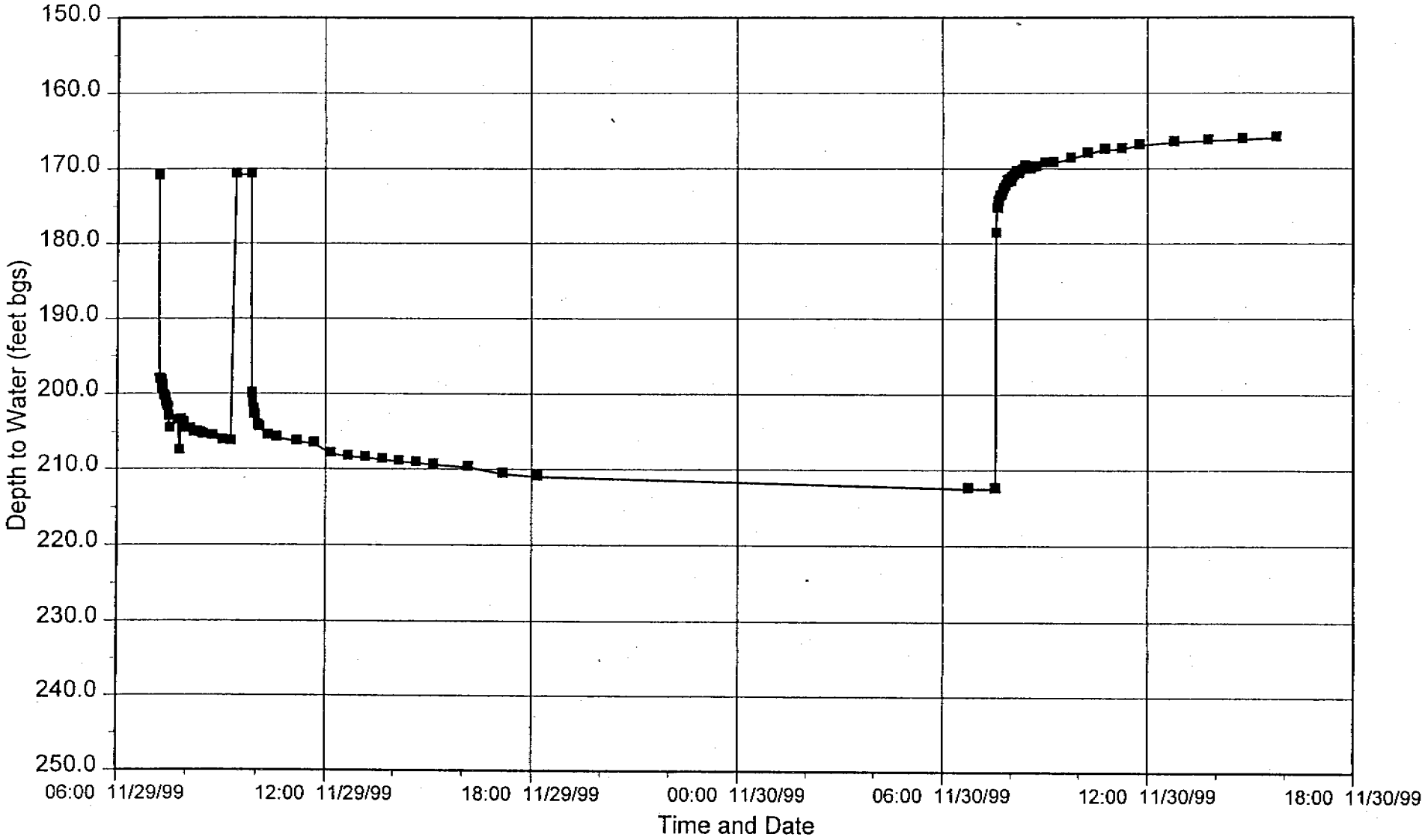
The value of $\Delta s'$ obtained from the best-fit line to the Cooper-Jacob plot is 4.7 feet, resulting in a transmissivity estimate of 85,940 gpd/ft, and a hydraulic conductivity estimate of 14.7 feet/day.

Duke Energy Well 4-2 Recovery Test Results

Detailed calculations of aquifer parameters for Well 4-2 are included in Table A3. The residual drawdown plot used for the Theis recovery method is shown in Figure A6.

The value of $\Delta s'$ obtained from the best-fit line to the Cooper-Jacob plot is 5.2 feet, resulting in a transmissivity estimate of 77,677 gpd/ft, and a hydraulic conductivity estimate of 16.5 feet/day.

Project No. AZ000771.0008	File: well4-1.dgr	Drafter: Gutmann	Checked: Garrett



ARCADIS
GERAGHTY&MILLER

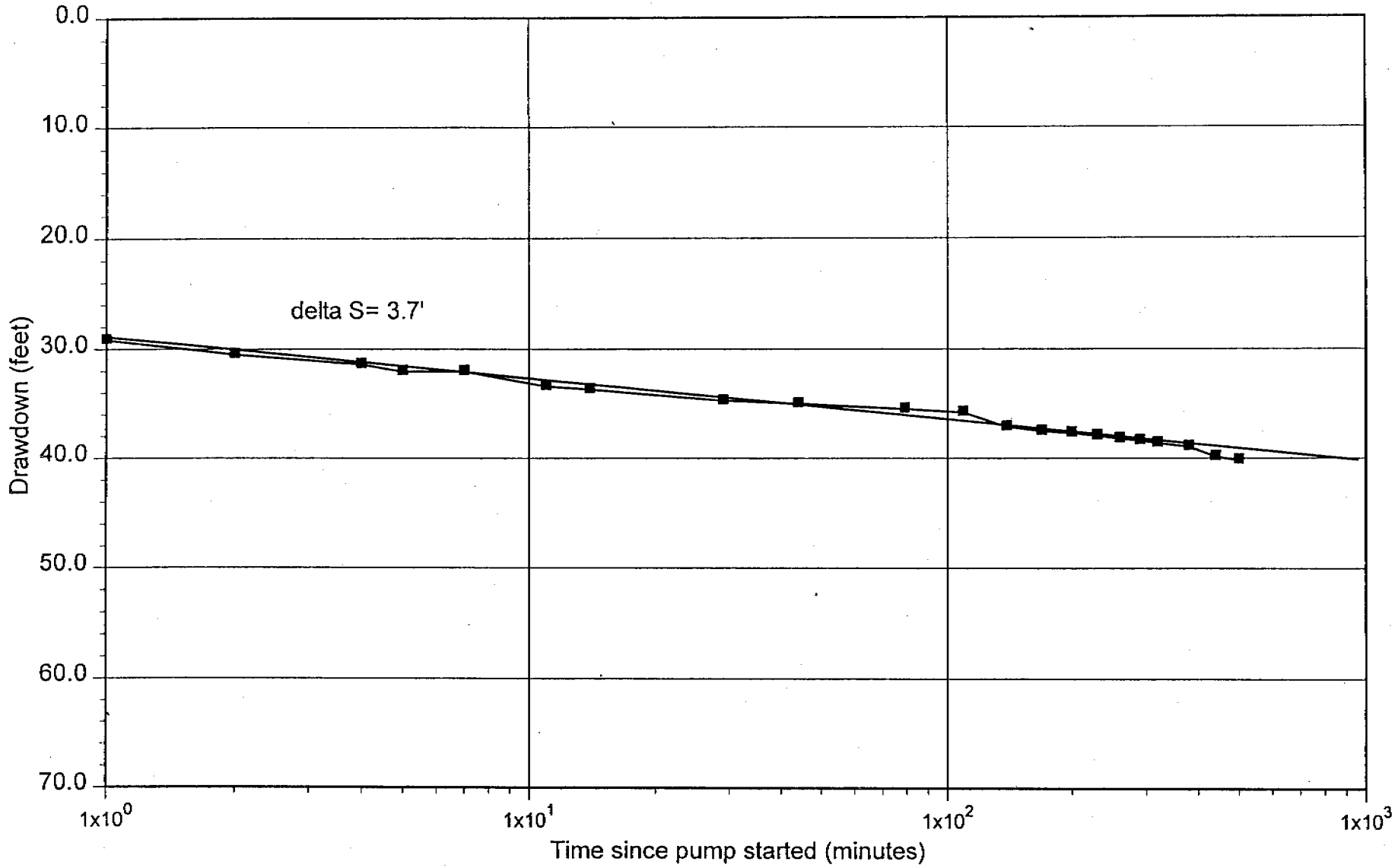
WATER LEVELS FOR AQUIFER TESTS FOR DUKE ENERGY WELL 4-1

ARLINGTON VALLEY ENERGY PROJECT
LINGTON VALLEY, ARIZONA

FIGURE

A1

Project No. AZ000771.0008	File: w4-1pump.dgr	Drafter: Gutmann	Checked: Garrett



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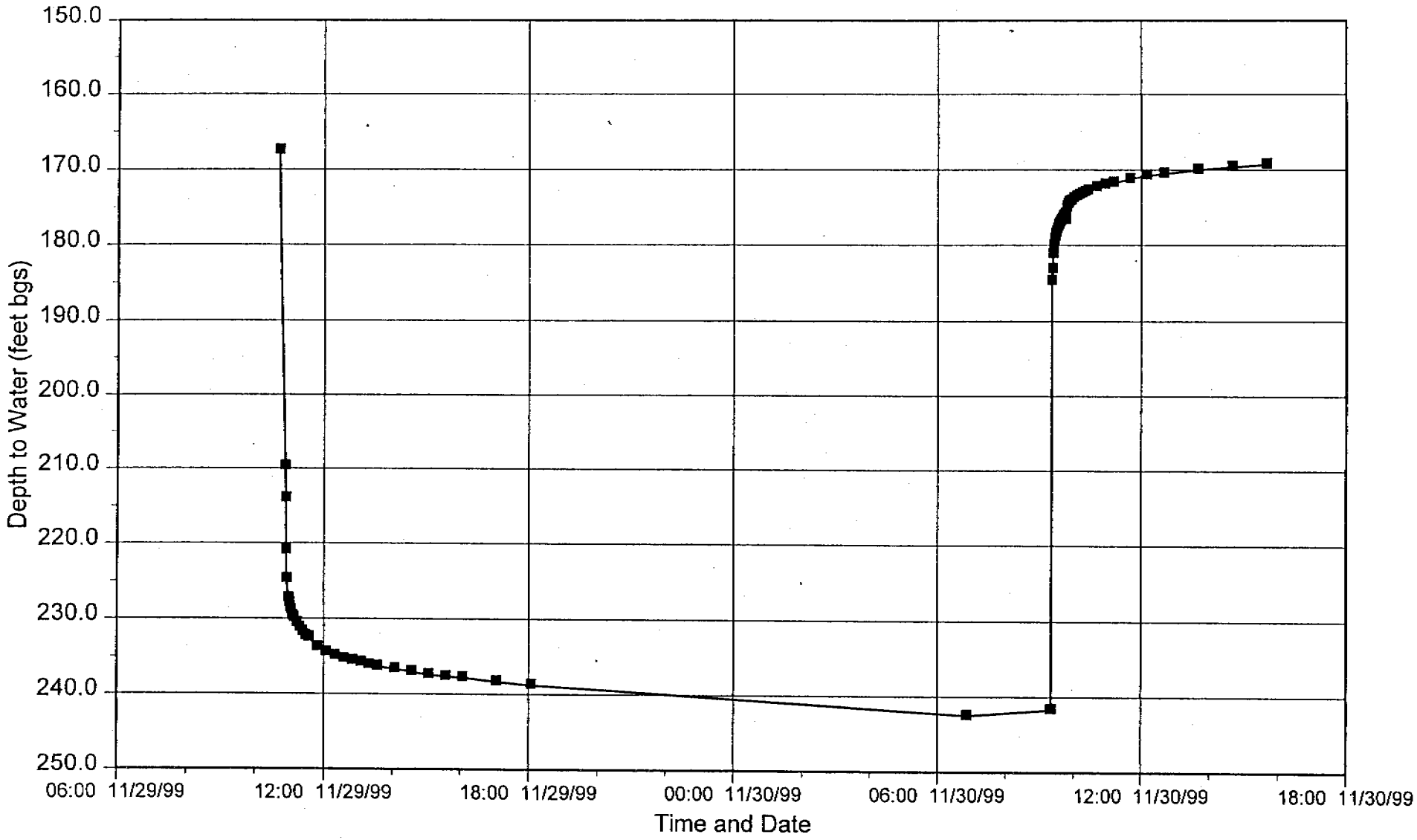
GERAGHTY & MILLER

PUMPING TEST ANALYSIS FOR DUKE ENERGY WELL 4-1

ARLINGTON VALLEY ENERGY PROJECT
ARLINGTON VALLEY, ARIZONA

FIGURE
A2

Project No. AZ000771.0008	File: well4-2.dgr	Drafter: Gutmann	Checked: Garrett



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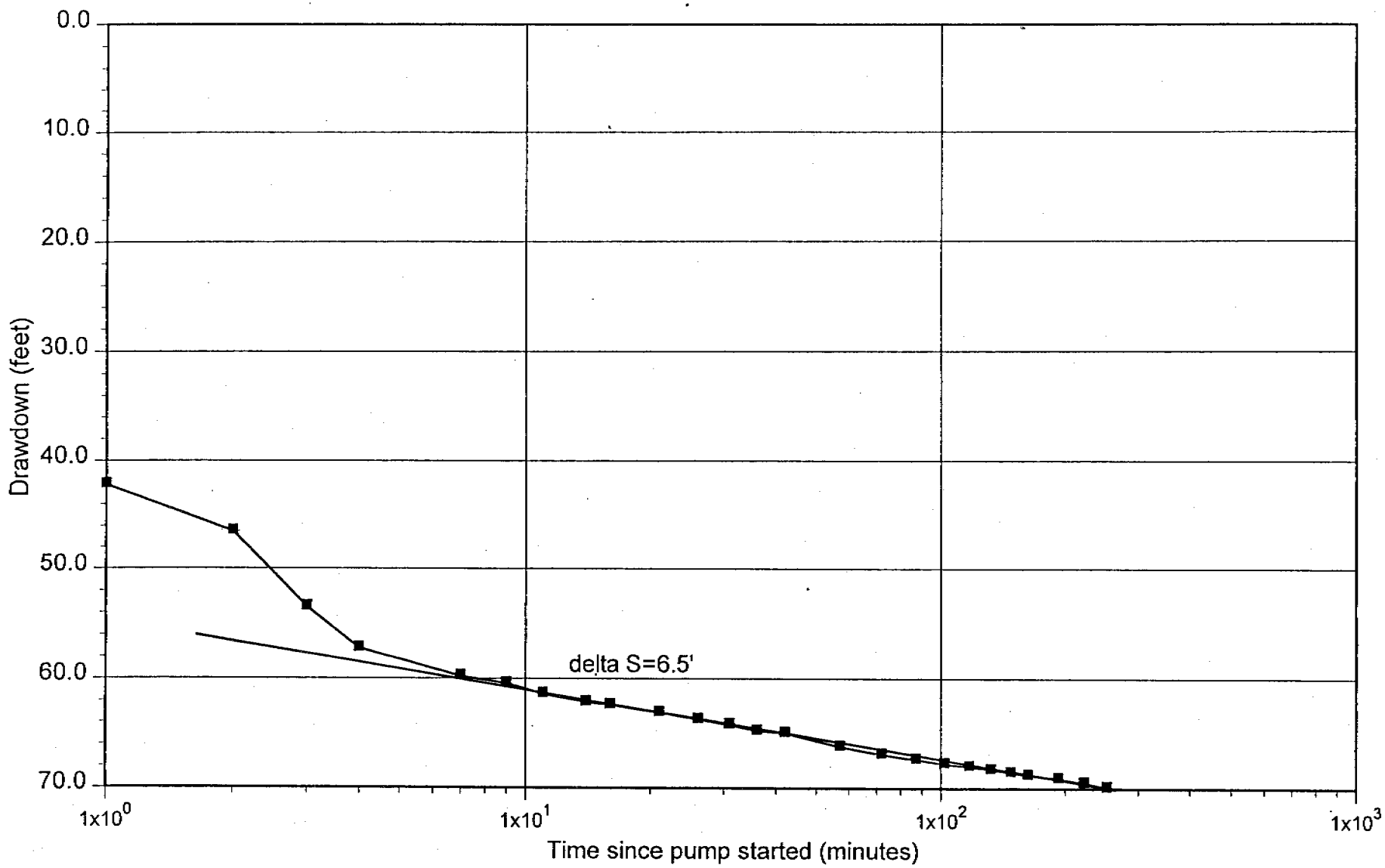
WATER LEVELS FOR AQUIFER TESTS FOR DUKE ENERGY WELL 4-2

ARLINGTON VALLEY ENERGY PROJECT
ARLINGTON VALLEY, ARIZONA

FIGURE
A3

Project No. AZ000771.0008	File: w4-2pump.dgr	Drafter: Gutmann	Checked: Garrett



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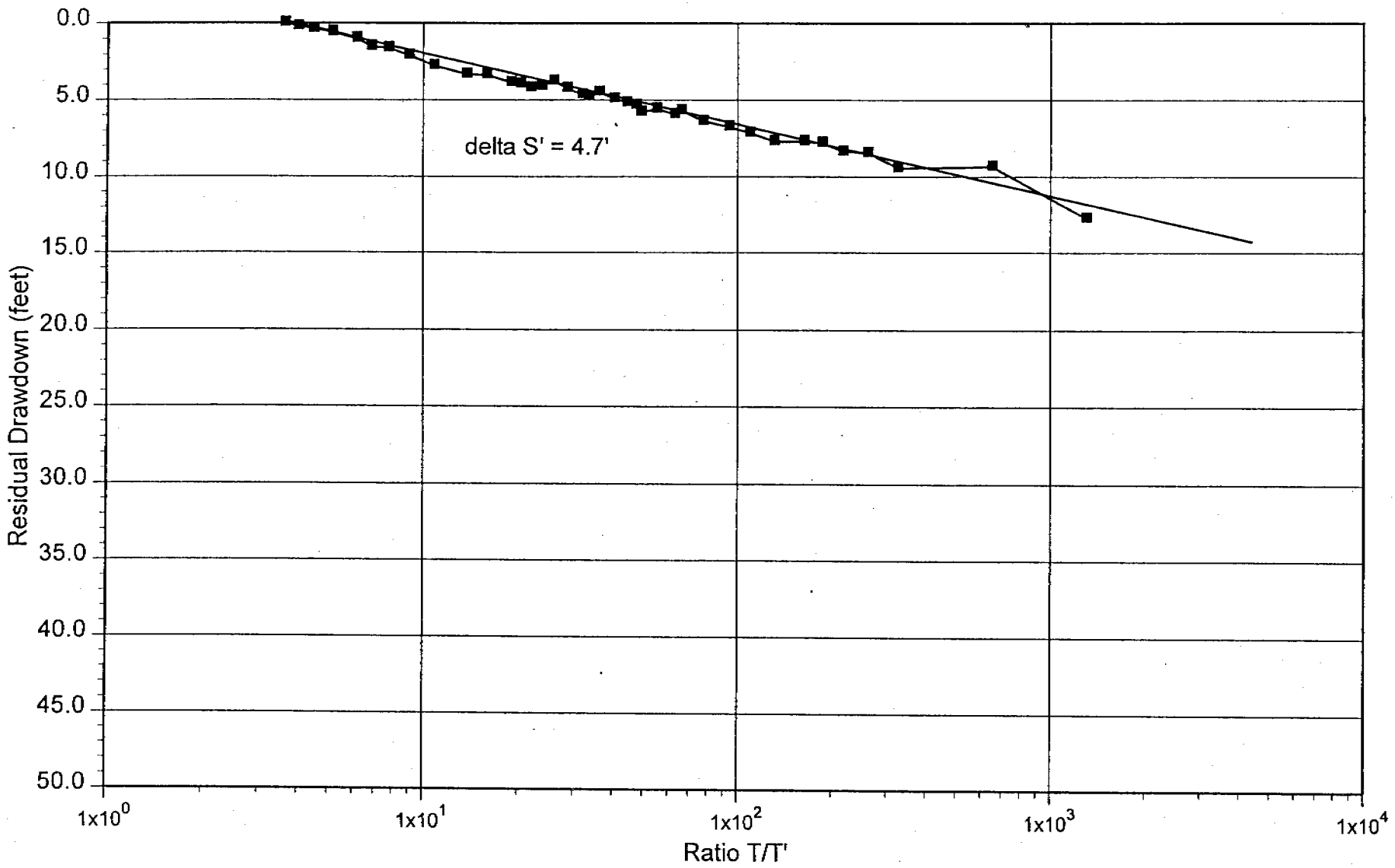
PUMPING TEST ANALYSIS FOR DUKE ENERGY WELL 4-2

ARLINGTON VALLEY ENERGY PROJECT
ARLINGTON VALLEY, ARIZONA

FIGURE
A4

Project No. AZ000771.0008	File: w4-1rec.dgr	Drafter: Gutmann	Checked: Garrett



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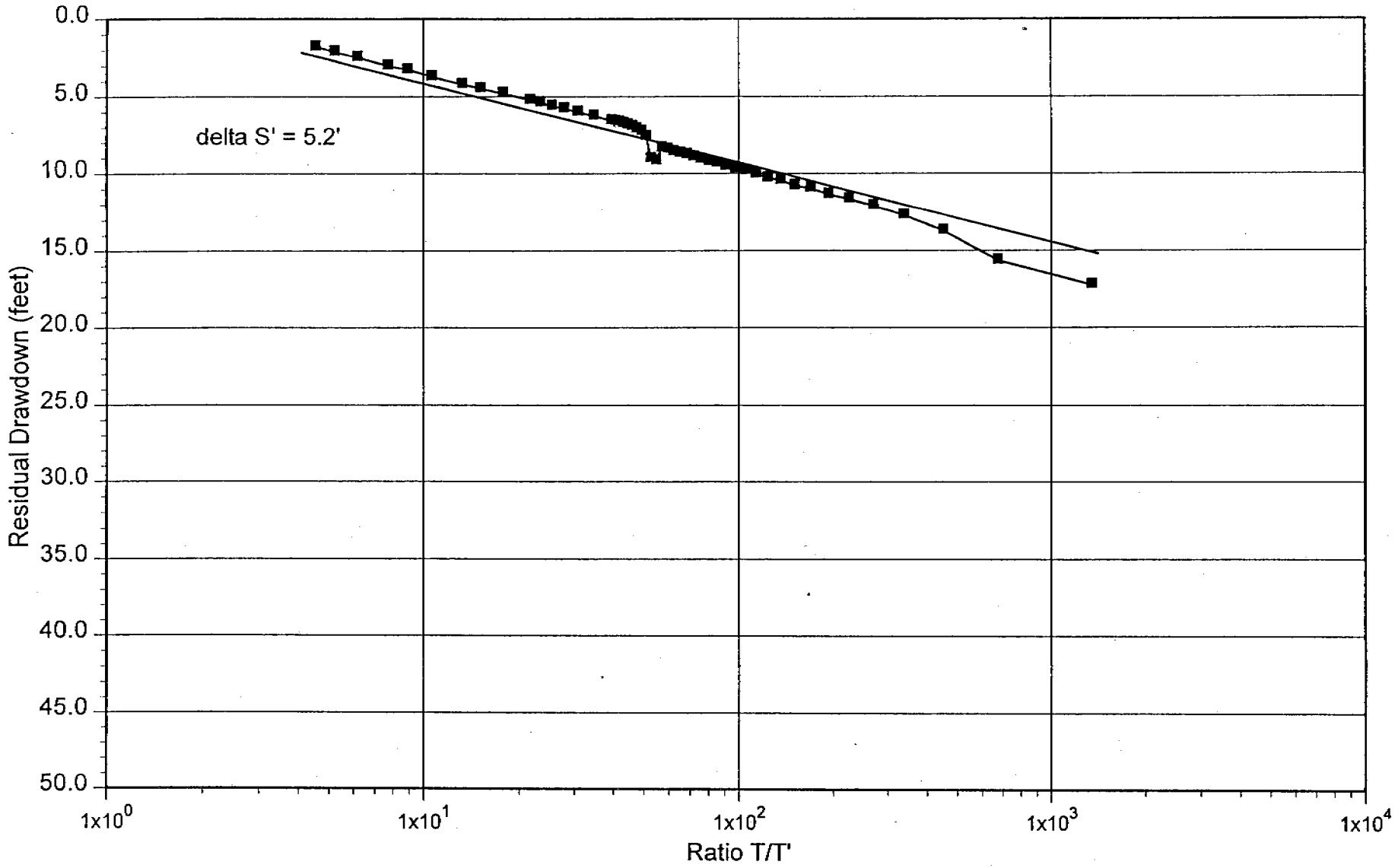
RECOVERY TEST ANALYSIS FOR DUKE ENERGY WELL 4-1

ARLINGTON VALLEY ENERGY PROJECT
ARLINGTON VALLEY, ARIZONA

FIGURE
A5

Project No. AZ000771.0008	File: w4-2rec.dgr	Drafter: Gutmann	Checked: Garrett



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RECOVERY TEST ANALYSIS FOR DUKE ENERGY WELL 4-2

ARLINGTON VALLEY ENERGY PROJECT
ARLINGTON VALLEY, ARIZONA

FIGURE
A6

Table A1. Calculations for Duke Energy Well 4-1

Estimate of Transmissivity and Hydraulic Conductivity from Pumping Test

$T = 264 * Q / \Delta s$

$K = 0.134 * T / b'$

$Q = 1530$ gpm

$\Delta s = 3.7$ feet

$b' = 783$ feet

$T = 264 * 1530 / 3.7 = 109{,}168$ gpd/ft

$K = 0.134 * 109{,}168 / 783 = 18.7$ ft/day $= 0.0130$ ft/min

Estimate of Transmissivity and Hydraulic Conductivity from Recovery Test

$T = 264 * Q / \Delta s'$

$K = 0.134 * T / b'$

$Q = 1530$ gpm

$\Delta s' = 4.7$ feet

$b' = 783$ feet

$T = 264 * 1530 / 4.7 = 85{,}940$ gpd/ft

$K = 0.134 * 85{,}940 / 783 = 14.7$ ft/day $= 0.0102$ ft/min

Estimate of Saturated Thickness of Perforated Interval of well (b')

Static water level = 170 ft.

Dynamic water level = 212.5 ft.

Perforated Interval = 229 to 1012 ft.

Saturated Thickness (b') = 783 ft.

Table A2. Aquifer Test for Duke Energy Well 4-1

				Pumping Test			Recovery Test		
Date	Time	Elapsed Time (min)	Depth to Water	Flow Velocity (ft/s)	Discharge (gpm)	Drawdown	Elapsed Time since pump stop	T/T'	Residual Drawdown
11/29/99	7:12	0	171.00	7.25	1775	0.00			
11/29/99	7:13	1	198.20	6.00	1469	27.20			
11/29/99	7:16	4	198.30			27.30			
11/29/99	7:17	5	199.40			28.40			
11/29/99	7:18	6	199.50			28.50			
11/29/99	7:19	7	199.00			28.00			
11/29/99	7:20	8	200.40			29.40			
11/29/99	7:22	10	200.45			29.45			
11/29/99	7:23	11	200.60			29.60			
11/29/99	7:24	12	201.15			30.15			
11/29/99	7:25	13	201.55			30.55			
11/29/99	7:26	14	201.65			30.65			
11/29/99	7:28	16	201.95			30.95			
11/29/99	7:29	17	203.10			32.10			
11/29/99	7:31	19	204.65			33.65			
11/29/99	7:45	33	203.65			32.65			
11/29/99	7:48	36	207.60			36.60			
11/29/99	7:50	38	203.50			32.50			
11/29/99	7:55	43	203.90			32.90			
11/29/99	8:00	48	204.70			33.70			
11/29/99	8:06	54	204.70			33.70			
11/29/99	8:13	61	205.20			34.20			
11/29/99	8:18	66	205.10			34.10			
11/29/99	8:23	71	205.25			34.25			
11/29/99	8:28	76	205.40			34.40			
11/29/99	8:45	93	205.60			34.60			
11/29/99	9:02	110	206.20			35.20			
11/29/99	9:16	124	206.30			35.30			
11/29/99	9:25	133	170.80			-0.20			
11/29/99	9:51	159	170.80			-0.20			
11/29/99	9:52	160	200.00			29.00			
11/29/99	9:53	161	201.30			30.30			
11/29/99	9:55	163	202.20			31.20			
11/29/99	9:56	164	202.85			31.85			
11/29/99	9:58	166	202.85			31.85			
11/29/99	10:02	170	204.20			33.20			
11/29/99	10:05	173	204.50			33.50			
11/29/99	10:20	188	205.55			34.55			
11/29/99	10:35	203	205.80			34.80			
11/29/99	11:10	238	206.30			35.30			
11/29/99	11:40	268	206.60			35.60			
11/29/99	12:10	298	207.95			36.95			
11/29/99	12:40	328	208.35			37.35			
11/29/99	13:10	358	208.50			37.50			
11/29/99	13:40	388	208.75			37.75			
11/29/99	14:10	418	209.00			38.00			
11/29/99	14:40	448	209.20	6.25	1530	38.20			

Table A2. Aquifer Test for Duke Energy Well 4-1

				Pumping Test			Recovery Test		
Date	Time	Elapsed Time (min)	Depth to Water	Flow Velocity (ft/s)	Discharge (gpm)	Drawdown	Elapsed Time since pump stop	T/T'	Residual Drawdc
11/29/99	15:10	478	209.40			38.40			
11/29/99	16:10	538	209.75	6.25	1530	38.75			
11/29/99	17:10	598	210.65	6.25	1530	39.65			
11/29/99	18:10	658	211.00	6.25	1530	40.00			
11/30/99	6:20	1388	213.00			42.00			
11/30/99	6:45	1413	212.50			41.50			
11/30/99	7:32	1460	212.50			41.50			
11/30/99	7:33	1461	212.50			41.50			
11/30/99	7:34	1462	178.75				1	1462.0	12.75
11/30/99	7:35	1463	175.35				2	731.5	9.35
11/30/99	7:37	1465	175.45				4	366.3	9.45
11/30/99	7:38	1466	174.45				5	293.2	8.45
11/30/99	7:39	1467	174.35				6	244.5	8.35
11/30/99	7:40	1468	173.80				7	209.7	7.80
11/30/99	7:41	1469	173.70				8	183.6	7.70
11/30/99	7:43	1471	173.70				10	147.1	7.70
11/30/99	7:45	1473	173.15				12	122.8	7.15
11/30/99	7:47	1475	172.75				14	105.4	6.75
11/30/99	7:50	1478	172.40				17	86.9	6.40
11/30/99	7:53	1481	171.70				20	74.1	5.70
11/30/99	7:54	1482	171.95				21	70.6	5.95
11/30/99	7:57	1485	171.60				24	61.9	5.60
11/30/99	8:00	1488	171.80				27	55.1	5.80
11/30/99	8:01	1489	171.35				28	53.2	5.35
11/30/99	8:03	1491	171.20				30	49.7	5.20
11/30/99	8:06	1494	170.95				33	45.3	4.95
11/30/99	8:10	1498	170.50				37	40.5	4.50
11/30/99	8:13	1501	170.80				40	37.5	4.80
11/30/99	8:15	1503	170.65				42	35.8	4.65
11/30/99	8:20	1508	170.25				47	32.1	4.25
11/30/99	8:25	1513	169.75				52	29.1	3.75
11/30/99	8:30	1518	170.10				57	26.6	4.10
11/30/99	8:35	1523	170.20				62	24.6	4.20
11/30/99	8:40	1528	169.95				67	22.8	3.95
11/30/99	8:45	1533	169.85				72	21.3	3.85
11/30/99	9:00	1548	169.35				87	17.8	3.35
11/30/99	9:15	1563	169.30				102	15.3	3.30
11/30/99	9:45	1593	168.75				132	12.1	2.75
11/30/99	10:15	1623	168.07				162	10.0	2.07
11/30/99	10:45	1653	167.60				192	8.6	1.60
11/30/99	11:15	1683	167.50				222	7.6	1.50
11/30/99	11:45	1713	167.00				252	6.8	1.00
11/30/99	12:45	1773	166.60				312	5.7	0.60
11/30/99	13:45	1833	166.39				372	4.9	0.39
11/30/99	14:45	1893	166.22				432	4.4	0.22
11/30/99	15:45	1953	166.00				492	4.0	0.00

Table A3. Calculations for Duke Energy Well 4-2

Estimate of Transmissivity and Hydraulic Conductivity from Pumping Test

$T = 264 * Q / \Delta s$

$K = 0.134 * T / b'$

$Q = 1530$ gpm

$\Delta s = 6.5$ feet

$b' = 630$ feet

$T = 264 * 1530 / 6.5 = 62{,}142$ gpd/ft

$K = 0.134 * 62{,}142 / 630 = 13.2$ ft/day $= 0.00918$ ft/min

Estimate of Transmissivity and Hydraulic Conductivity from Recovery Test

$T = 264 * Q / \Delta s'$

$K = 0.134 * T / b'$

$Q = 1530$ gpm

$\Delta s' = 5.2$ feet

$b' = 630$ feet

$T = 264 * 1530 / 5.2 = 77{,}677$ gpd/ft

$K = 0.134 * 77{,}677 / 630 = 16.5$ ft/day $= 0.0115$ ft/min

Estimate of Saturated Thickness of Perforated Interval of well (b')

Static water level = 167.55 ft.

Dynamic water level = 241.7 ft.

Perforated Interval = 350 to 980 ft.

Saturated Thickness (b') = 630 ft.

Table A4. Aquifer Tests for Duke Energy Well 4-2

				Pumping Test			Recovery Test		
Date	Time	Elapsed Time (min)	Depth to Water	Flow Velocity (ft/s)	Discharge (gpm)	Drawdown	Elapsed Time since pump stop	T/T'	Residual Drawdown
11/29/99	10:42		167.55			0.00			
11/29/99	10:52	0	167.55			0.00			
11/29/99	10:53	1	209.75			42.20			
11/29/99	10:54	2	214.05			46.50			
11/29/99	10:55	3	221.05			53.50			
11/29/99	10:56	4	224.80			57.25			
11/29/99	10:59	7	227.35			59.80			
11/29/99	11:01	9	228.00			60.45			
11/29/99	11:03	11	228.95			61.40			
11/29/99	11:06	14	229.70			62.15			
11/29/99	11:08	16	229.95			62.40			
11/29/99	11:13	21	230.65			63.10			
11/29/99	11:18	26	231.30			63.75			
11/29/99	11:23	31	231.80			64.25			
11/29/99	11:28	36	232.35			64.80			
11/29/99	11:34	42	232.55			65.00			
11/29/99	11:49	57	233.80			66.25			
11/29/99	12:04	72	234.50			66.95			
11/29/99	12:19	87	234.95			67.40			
11/29/99	12:34	102	235.35	6.50	1591	67.80			
11/29/99	12:49	117	235.60			68.05			
11/29/99	13:04	132	235.85	6.25	1530	68.30			
11/29/99	13:19	147	236.15			68.60			
11/29/99	13:34	162	236.35			68.80			
11/29/99	14:04	192	236.65			69.10			
11/29/99	14:34	222	237.05			69.50			
11/29/99	15:04	252	237.45			69.90			
11/29/99	15:34	282	237.68			70.13			
11/29/99	16:04	312	237.85			70.30			
11/29/99	17:04	372	238.35			70.80			
11/29/99	18:04	432	238.80			71.25			
11/30/99	6:52	1200	242.50	6.25	1530	74.95			
11/30/99	9:19	1347	241.70	6.25	1530	74.15			
11/30/99	9:20	1348	241.70				0		74.15
11/30/99	9:21	1349	184.80				1	1349.0	17.25
11/30/99	9:22	1350	183.20				2	675.0	15.65
11/30/99	9:23	1351	181.25				3	450.3	13.70
11/30/99	9:24	1352	180.25				4	338.0	12.70
11/30/99	9:25	1353	179.65				5	270.6	12.10
11/30/99	9:26	1354	179.20				6	225.7	11.65
11/30/99	9:27	1355	178.90				7	193.6	11.35
11/30/99	9:28	1356	178.50				8	169.5	10.95
11/30/99	9:29	1357	178.35				9	150.8	10.80
11/30/99	9:30	1358	178.00				10	135.8	10.45
11/30/99	9:31	1359	177.85				11	123.5	10.30
11/30/99	9:32	1360	177.60				12	113.3	10.05
11/30/99	9:33	1361	177.40				13	104.7	9.85

Table A4. Aquifer Tests for Duke Energy Well 4-2

				Pumping Test			Recovery Test		
Date	Time	Elapsed Time (min)	Depth to Water	Flow Velocity (ft/s)	Discharge (gpm)	Drawdown	Elapsed Time since pump stop	T/T'	Residual Drawdo
11/30/99	9:34	1362	177.25				14	97.3	9.70
11/30/99	9:35	1363	177.10				15	90.9	9.55
11/30/99	9:36	1364	176.90				16	85.3	9.35
11/30/99	9:37	1365	176.80				17	80.3	9.25
11/30/99	9:38	1366	176.65				18	75.9	9.10
11/30/99	9:39	1367	176.50				19	71.9	8.95
11/30/99	9:40	1368	176.35				20	68.4	8.80
11/30/99	9:41	1369	176.25				21	65.2	8.70
11/30/99	9:42	1370	176.15				22	62.3	8.60
11/30/99	9:43	1371	176.00				23	59.6	8.45
11/30/99	9:44	1372	175.90				24	57.2	8.35
11/30/99	9:45	1373	176.75				25	54.9	9.20
11/30/99	9:46	1374	176.60				26	52.8	9.05
11/30/99	9:47	1375	175.15				27	50.9	7.60
11/30/99	9:48	1376	174.80				28	49.1	7.25
11/30/99	9:49	1377	174.65				29	47.5	7.10
11/30/99	9:50	1378	174.50				30	45.9	6.95
11/30/99	9:51	1379	174.40				31	44.5	6.85
11/30/99	9:52	1380	174.30				32	43.1	6.75
11/30/99	9:53	1381	174.20				33	41.8	6.65
11/30/99	9:54	1382	174.15				34	40.6	6.60
11/30/99	9:55	1383	174.10				35	39.5	6.55
11/30/99	10:00	1388	173.80				40	34.7	6.25
11/30/99	10:05	1393	173.55				45	31.0	6.00
11/30/99	10:10	1398	173.33				50	28.0	5.78
11/30/99	10:15	1403	173.15				55	25.5	5.60
11/30/99	10:20	1408	172.95				60	23.5	5.40
11/30/99	10:25	1413	172.78				65	21.7	5.23
11/30/99	10:40	1428	172.35				80	17.9	4.80
11/30/99	10:55	1443	172.02				95	15.2	4.47
11/30/99	11:10	1458	171.75				110	13.3	4.20
11/30/99	11:40	1488	171.25				140	10.6	3.70
11/30/99	12:10	1518	170.80				170	8.9	3.25
11/30/99	12:40	1548	170.55				200	7.7	3.00
11/30/99	13:40	1608	170.03				260	6.2	2.48
11/30/99	14:40	1668	169.67				320	5.2	2.12
11/30/99	15:40	1728	169.35				380	4.5	1.80

Appendix B

Application of a Numerical Groundwater Model (Quickflow) to the Region Surrounding the Proposed Duke Energy Power Plant.

Approach and Methodology

Quickflow™ (Version 1.19) is an analytical two-dimensional groundwater flow modeling software package developed by ARCADIS Geraghty & Miller. The transient modeling analysis used by Quickflow™ solves for the Theis equation. The model assumes a uniform, isotropic, homogeneous aquifer with an infinite lateral extent. No recharge or leakage conditions were applied to the model for this analysis. The groundwater flow model was used to calculate the amount of drawdown over the 30-year expected lifetime of the Plant that can be attributed to withdrawals from the DENA supply wells.

The driving parameters used by Quickflow™ to simulate transient groundwater conditions are hydraulic conductivity, pumping rate, a reference groundwater gradient and elevation point, and an aquifer storage coefficient. Values used for modeling are summarized in Table B1. Hydraulic conductivity was chosen both from the lowest and highest ends of a range of conductivity values determined experimentally by aquifer tests conducted by ARCADIS Geraghty & Miller on November 29th and 30th, 1999 as described in Appendix A. Modeled well locations were chosen to be close to the anticipated DENA plant site. Pumping rates were chosen to meet the maximum anticipated water requirements for the DENA power plant. Local groundwater gradient and elevation information was taken from a 1995 ADWR publication (Hammett and Herther, 1995). An aquifer storage coefficient was chosen based on the ADWR Salt River Valley groundwater model whose western boundary is approximately 10 miles east of the proposed power plant site.

In the case of each of the available parameters listed above, the "worst-case" possibility was selected. ARCADIS Geraghty & Miller anticipates actual impact to the aquifer from pumping to have an affect equal to, or less than the results produced by the resultant modeling effort associated with the low-conductivity scenario.

Quickflow™ does not have the capacity to calculate drawdowns by itself, however these were estimated by subtracting the hydraulic head field produced by a simulation incorporating pumping wells from a simulation conducted without any wells present.

Modeling Results

Aquifer impact in the form of drawdown was estimated at 30 years, the expected lifetime of the power plant. Results for these time periods can be seen in Figure B1. Drawdown using the high-conductivity scenario at 30 years can be seen in Figures B2. Direct Quickflow™ model output can be seen at the end of Appendix B.

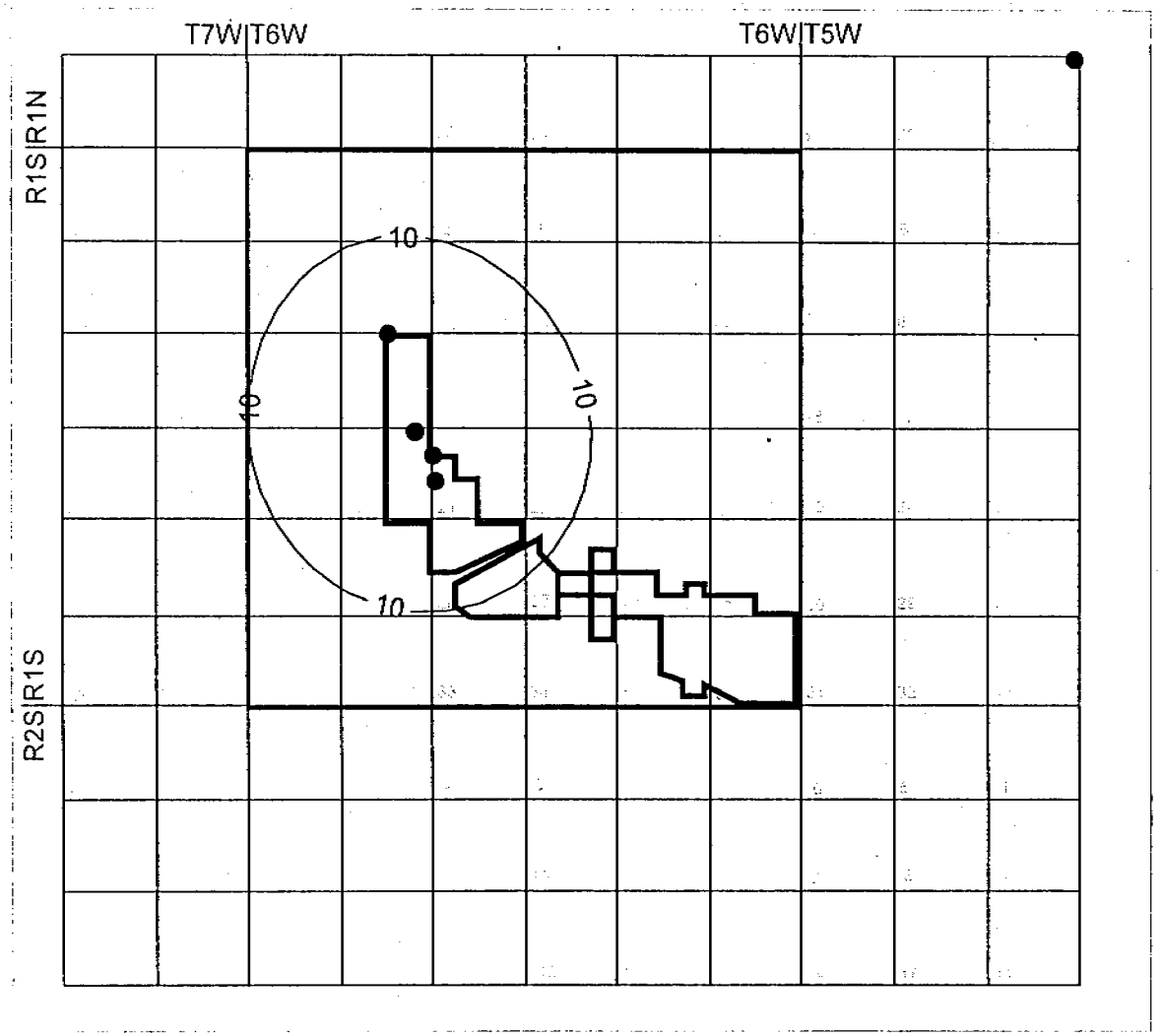
Low Hydraulic Conductivity Modeling Results

After 30 years, the 10 foot drawdown contour extends just under 2 miles radially from the selected well locations. The maximum simulated drawdown for this time interval was 26.24 feet, at the well located in the northern part of section 20. During this simulation, the 25 foot drawdown contour never extended off of DENA property.

High Hydraulic Conductivity Modeling Results

After 30 years, the 10 foot drawdown contour extends approximately 1 mile radially from the selected well locations. The maximum simulated drawdown for this time interval was 18.70 feet, at the well located in the northern part of section 20. At no location was there greater than 25 feet of drawdown during this simulation.

Project No. AZ000771.0008 | File Name: TLKHPD30.SRF | Checked: Garrett | Drafter: Gutmann



Transient State Conditions at 30 years
K= 13.2 feet/day
Storage Coefficient = 0.1
All pumping wells at 1,055 gpm

ARCADIS
GERAGHTY & MILLER

30-Year Transient State Drawdown Based on High Pumping Rate; Low Hydraulic Conductivity

Arlington Valley Energy Project
Arlington, Arizona

FIGURE
B1

Table B1. Summary of Hydrogeologic Parameters used in Quickflow Simulations

		Commonly used units		Model Input Units		Data Source
Hydraulic Conductivity	Low	13.2	ft/day	0.00918	ft/min	Well 4-1 and 4-2 Aquifer Tests
	High	18.7	ft/day	0.0130	ft/min	Well 4-1 and 4-2 Aquifer Tests
Aquifer Bottom		0	ft	0	ft	
Aquifer Top		1300	ft	1300	ft	Well 7-1 Driller's log
Reference Water Level		717.8	ft	717.8	ft	Hammett and Herther, 1995
Groundwater gradient		0.001	ft/ft	0.001	ft/ft	Hammett and Herther, 1995
Recharge		0		0		
Porosity		0.2		0.2		Arbitrary
Storage		0.1		0.1		ADWR SRV Model
Leakage		0		0		
Time Interval 1		5	years	2629744	min	
Time Interval 2		30	years	15778462	min	
Pumping Rate for each individual well		1055	gpm	141	ft3/min	Projected DENA Requirements

QuickFlow
Analytical Model of 2D Ground-Water Flow

Developed by

James O. Rumbaugh, III

(c) 1991 Geraghty & Miller, Inc.

Date: 12/10/1999
Time: 15:52:23.16

Input File: tlkhph30.qfl
Map File : bigbase.map

Model Entities

Number of Linesinks Defined by Infiltration Rate = 0

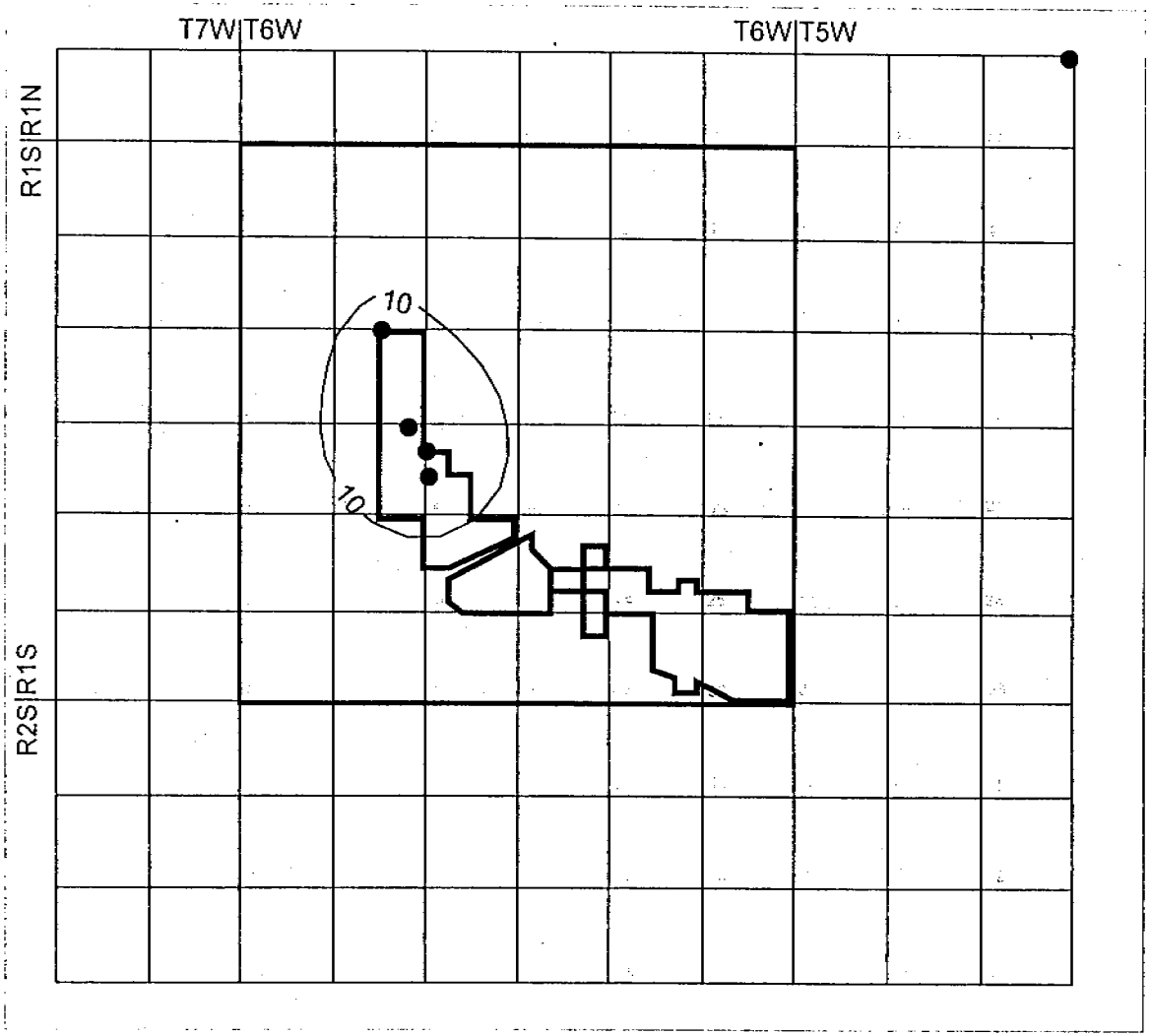
Number of Linesinks Defined by Head = 0

Number of Ponds = 0

Number of Wells = 4

```
Well #1
   Center of Well --  x: 18616.960938   y: 37011.761719
   Radius = 1.000000
   Pumping Rate = 141.000000
   Head at Well Radius           = 656.901391
Well #2
   Center of Well --  x: 20162.429688   y: 31501.830078
   Radius = 1.000000
   Pumping Rate = 141.000000
   Head at Well Radius           = 648.025317
Well #3
   Center of Well --  x: 21197.220703   y: 30153.470703
   Radius = 1.000000
   Pumping Rate = 141.000000
   Head at Well Radius           = 646.399379
Well #4
   Center of Well --  x: 21328.919922   y: 28704.759766
```

Project No. AZ000771.0008 | File Name: THKHPD30.SRF | Checked: Garrett | Drafter: Gutmann



Transient State Conditions at 30 years
K= 18.7 feet/day
Storage Coefficient = 0.1
All pumping wells at 1,055 gpm

ARCADIS
GERAGHTY & MILLER

30-Year Transient State Drawdown Based on High Pumping Rate; High Hydraulic Conductivity

Arlington Valley Energy Project
Arlington, Arizona

FIGURE
B2

Radius = 1.000000
Pumping Rate = 141.000000
Head at Well Radius = 646.592161

Reference Head = 717.799988 Defined at -- x: 57941.710938 y: 52674.289062

Aquifer Properties

.... Transient Flow Model ....

Permeability.....= 0.009180 [L/T]
Porosity.....= 0.200000
Storage.....= 0.100000
Leakage factor.....= 0.000000
Elevation of Aquifer Top....= 1300.000000
Elevation of Aquifer Bottom.= 0.000000
Uniform Regional Gradient...= 0.001000
Angle of Uniform Gradient...= 242.175903

Model Results Computed at Time = 15778460.000000

==========

QuickFlow
Analytical Model of 2D Ground-Water Flow

Developed by

James O. Rumbaugh, III

(c) 1991 Geraghty & Miller, Inc.

==========

Date: 12/10/1999
Time: 15:52: 5.91

Input File: thkhph30.qfl
Map File : bigbase.map

==========

Model Entities

Number of Linesinks Defined by Infiltration Rate = 0

Number of Linesinks Defined by Head = 0

Number of Ponds = 0

Number of Wells = 4

```
Well #1
   Center of Well --  x: 18616.960938   y: 37011.761719
   Radius = 1.000000
   Pumping Rate = 141.000000
   Head at Well Radius           = 665.163184
Well #2
   Center of Well --  x: 20162.429688   y: 31501.830078
   Radius = 1.000000
   Pumping Rate = 141.000000
   Head at Well Radius           = 657.672352
Well #3
   Center of Well --  x: 21197.220703   y: 30153.470703
   Radius = 1.000000
   Pumping Rate = 141.000000
   Head at Well Radius           = 656.316072
Well #4
   Center of Well --  x: 21328.919922   y: 28704.759766
```

Radius = 1.000000
Pumping Rate = 141.000000
Head at Well Radius = 656.094533

Reference Head = 717.799988 Defined at -- x: 57941.710938 y: 52674.289062

Aquifer Properties

.... Transient Flow Model ....

Permeability.....= 0.013000 [L/T]
Porosity.....= 0.200000
Storage.....= 0.100000
Leakage factor.....= 0.000000
Elevation of Aquifer Top....= 1300.000000
Elevation of Aquifer Bottom.= 0.000000
Uniform Regional Gradient...= 0.001000
Angle of Uniform Gradient...= 242.175903

Model Results Computed at Time = 15778460.000000

EXHIBIT B-3

LAND USE STUDY

LAND USE

INTRODUCTION

The land use study identifies potential impacts of the proposed Project on existing and future land uses. Where necessary, mitigation measures were developed to reduce potential impacts. The land use study consists of three subsections -- inventory, impact assessment, and mitigation.

1. Inventory

The purpose of the land use inventory was to compile baseline data in an effort to assess potential land use impacts that may result from the construction, operation, and maintenance of the proposed Project. The inventory included current land jurisdiction, existing and future land uses, and zoning information within a 2-mile radius (study area) of the project site.

A base map was prepared using aerial photography. Subsequently, land use information was inventoried within a 2-mile radius of the project site. Information compiled for the land use study was based on a review of existing maps, aerial photographs, planning agency contacts and publications, and field reconnaissance.

The project site is approximately 1.5 miles southwest of the Palo Verde Nuclear Generating Station ("PVNGS") and is located on the south side of Elliot Road, between the 387th Avenue and 391st Avenue alignments. The Southern Pacific Railroad is approximately 1.5 miles to the south. The project site is located on vacant land, and there is no indication that the property has been farmed or otherwise actively used in the past decade. The proposed transmission line corridor extends across agricultural land and vacant land.

Study Components

The land use analysis was divided into three major components to facilitate the inventory and impact analysis for the proposed project, as described below. Four study maps detailing the land use components have been included as follows:

- General Land Ownership – Figure 1
- Known Residential Structures – Figure 2
- Zoning and Subdivision s- Figure 3
- Existing Land Use – Figure 4

Ownership

The project site is located on privately owned land and the transmission line corridor crosses private land and State Trust Lands within an unincorporated area of Maricopa County. Private land, State Trust Lands administered by the Arizona State Land Department, and Bureau of Land Management land are present within the study area. See Figure 1 for land ownership information within the study area.

Existing Land Use

The study area is rural in nature and consists primarily of agricultural, vacant and scattered residential areas, and the PVNGS (see Figure 4). Descriptions of the specific types of land uses and their respective locations within the study area are provided below.

Residential -- There are approximately nine (9) occupied single-family dwelling units and a few abandoned homes within the study area.

Agriculture--Agricultural use in the study area is predominantly irrigated farmland with alfalfa the primary crop. The majority of active agricultural land within the study area is located southeast of the project site, along Centennial Wash and adjacent to the Southern Pacific Railroad. Several properties in the area that were previously used for agriculture are now out of production and are returning to vacant desert.

Industrial--Industrial uses within the study area include portions of the PVNGS property located in the northern portion of the study area.

Utilities– A network of electrical transmission lines are present in the study area (see Figure 5).

Several agricultural irrigation wells and canals/ditches were identified throughout the study area. Several of these facilities were found at the project site, but none appear to be in operation.

Transportation–The majority of the roads within the study area are unpaved, two-track roads used by local property owners. Major arterial roads within the study area that are paved include Elliot Road and Wintersburg Road (383rd Avenue).

The Southern Pacific Railroad operates one main railroad line that generally parallels the southern boundary of the project site. One spur of this railroad serves the PVNGS site and is located approximately 1.5 miles east of the project site.

Vacant Land–A large portion of the study area is undeveloped or vacant land. These tracts of land currently have no visible structures or buildings.

Future Land Use

The purpose of the future land use inventory was to document all planned or proposed land uses. Sources of future land use information include projected uses embodied in officially adopted general and area-wide plans. Planned land uses within the vicinity of the proposed project are described by Maricopa County's *Tonopah Area Land Use Plan* (1992). This land use plan was adopted by the Maricopa County Board of Supervisors in 1992 and amended the original plan to reflect changing growth patterns, population projections, and annexations within the planning area. The Tonopah Area Plan is currently undergoing another update, which should be completed in early 2000. The Land Use Plans from the existing (1992) and the latest draft of the proposed update of the Tonopah Area Plan dated 11/24/99 follow as Figures 6 and 7.

Changes in existing, developed land uses within the study area are unlikely to occur. However, the development of vacant and agricultural lands is more likely to occur as rural-type development (e.g., residential) continues throughout the study area.

The majority of lands within the study area are currently planned for Rural Residential, High Density use. According to Maricopa County's *Tonopah Area Land Use Plan*, the Rural Residential, High Density category denotes areas where single-family residential development is desirable but urban services (e.g., water, sewer, schools, parks, law enforcement, fire protection) are limited. Uses in this category include agricultural and single-family residential. The County is currently drafting an update to the *Tonopah Area Land Use Plan*.

Several locations within the study area are identified in the County Plan as open space; no such designation occurs at the project site in the proposed 1999 *Tonopah Area Land Use Plan*. The majority of land designated as open space is located west of the project site. According to the *Tonopah Area Land Use Plan*, this designation is prescribed for areas that would be best precluded from development except for recreational purposes.

The County Plan designates the existing PVNGS property as a Heavy Industrial Center. Uses permitted in this category include warehousing, storage, distribution activities, and general manufacturing and assembly of small parts.

The proposed Palo Verde South Switchyard will be located approximately 1.5 miles east of the project site and south of Elliot Road at approximately 375th Avenue (between the existing Kyrene and North Gila 500kV transmission lines). Preliminary plans indicate that the Palo Verde South Switchyard will serve as a satellite facility for new and existing power lines and an alternative to connecting directly into the existing PVNGS switchyard.

Zoning

Zoning is a method of land use control that specifies the types of land uses allowed, the intensity or density of the use, and standards for development. The zoning classification for the project area was obtained from the Maricopa County Planning and Development Department. The zoning classification for the project area is shown in Figure 3.

According to the Maricopa County's *Zoning Ordinance* (11/99), the project area is included in the Rural-190 zoning district. The principal purpose of this zoning district is to conserve and protect farms and other open land uses, foster orderly growth in rural areas, and prevent urban and agricultural land use conflicts. Uses permitted in this zoning district typically include both farm and non-farm residential uses, farms, and recreational and institutional uses. The Rural-190 zoning district requires a minimum lot size of 190,000 square feet per dwelling unit.

According to the County's Zoning Ordinance (Article XXIV, Section 2401) a Special Use (rather than rezoning) will be required to construct and operate the proposed project. The Applicant is in the process of applying for a Special Use, which will be issued by the Maricopa County Board

of Supervisors upon recommendation of the County's Planning and Zoning Commission. The PVNGS is currently operated under a Special Use Permit granted by Maricopa County.

Impact Assessment

The proposed project site is located on land under private ownership; the transmission line corridor crosses private land and State Trust Lands. Lands adjacent to the project are primarily undeveloped. The project will not have any direct adverse impacts to existing residential or other uses.

The project site and surrounding lands are designated for future residential use according to the Maricopa County *Tonopah Area Land Use Plan*. Based on a records search at the County's Planning and Development Department, no residential developments have been proposed or approved for the area immediately surrounding the project site. There are two recorded Records of Survey for Unsubdivided Lands (Horseshoe Trails and Horseshoe Trails Phase II) within the 2-mile study area. Recent proposals (i.e., proposed Palo Verde South Switchyard) indicate that other land use plans within the vicinity of the project will be consistent with the proposed project. Therefore, the project would have no adverse impacts to future land use plans.

Mitigation

No site-specific mitigation measures have been identified at this time because no substantial impacts to existing or future land use are expected as a result of constructing and operating the proposed project.

REFERENCES

Maricopa County. 11/99. *Zoning Ordinance*. Phoenix, Arizona.

Maricopa County. *Tonopah Area Land Use Plan*. Phoenix, Arizona.

U.S. Geological Survey. 1984. 1:24,000 scale map - Arlington, Arizona.

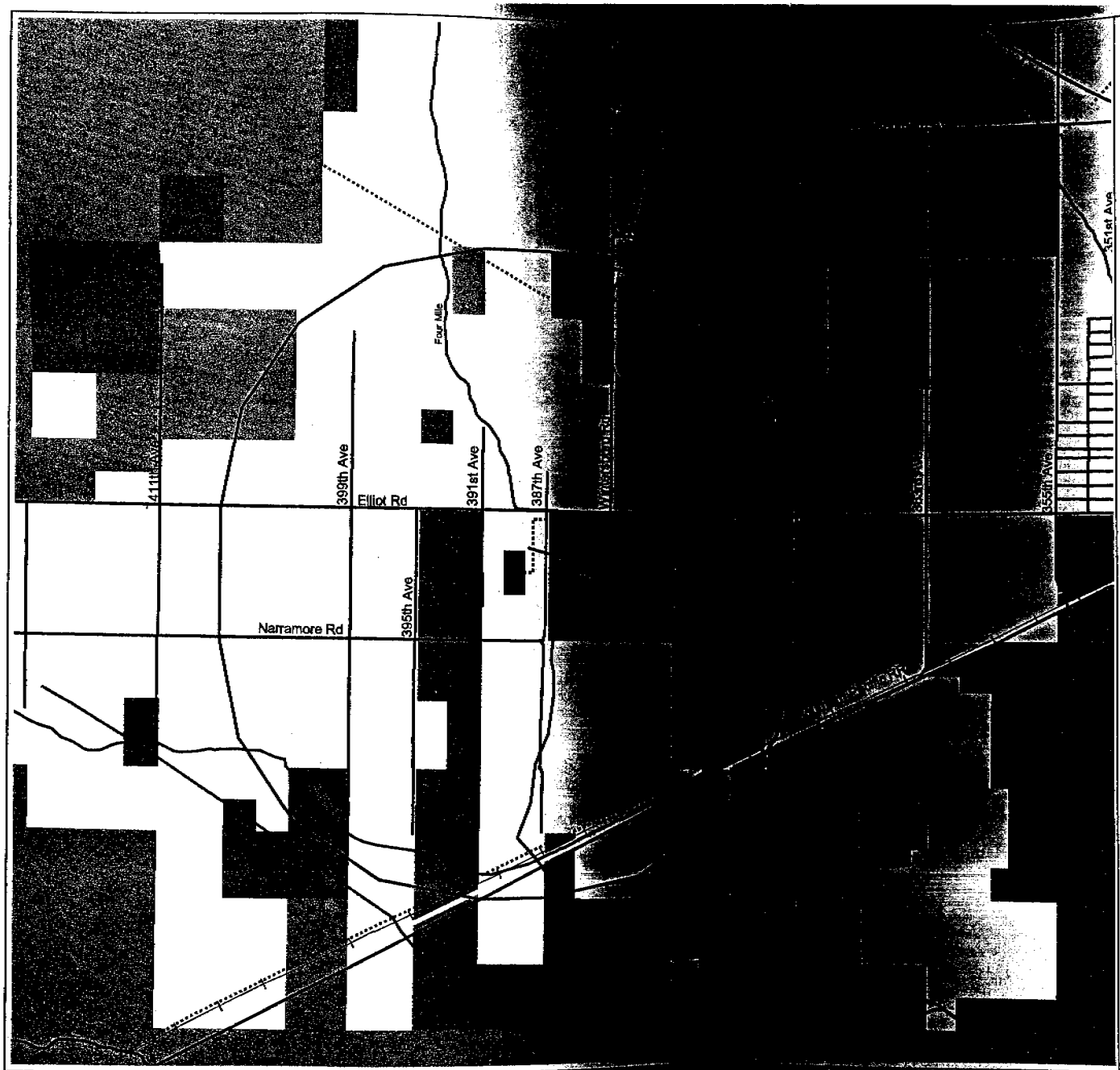


Figure 1:

General Land Ownership

Legend

Ownership

- Private
- State Trust
- BLM

Other Features

- Duke Proposed Project
- Electric Power Transmission Lines
- Natural Gas Line
- Rivers and washes
- Streets
- Railroads
- Area within 2 Miles of Project
- Palo Verde Nuclear Generating Station

0 0.5 1 Miles

Duke Energy

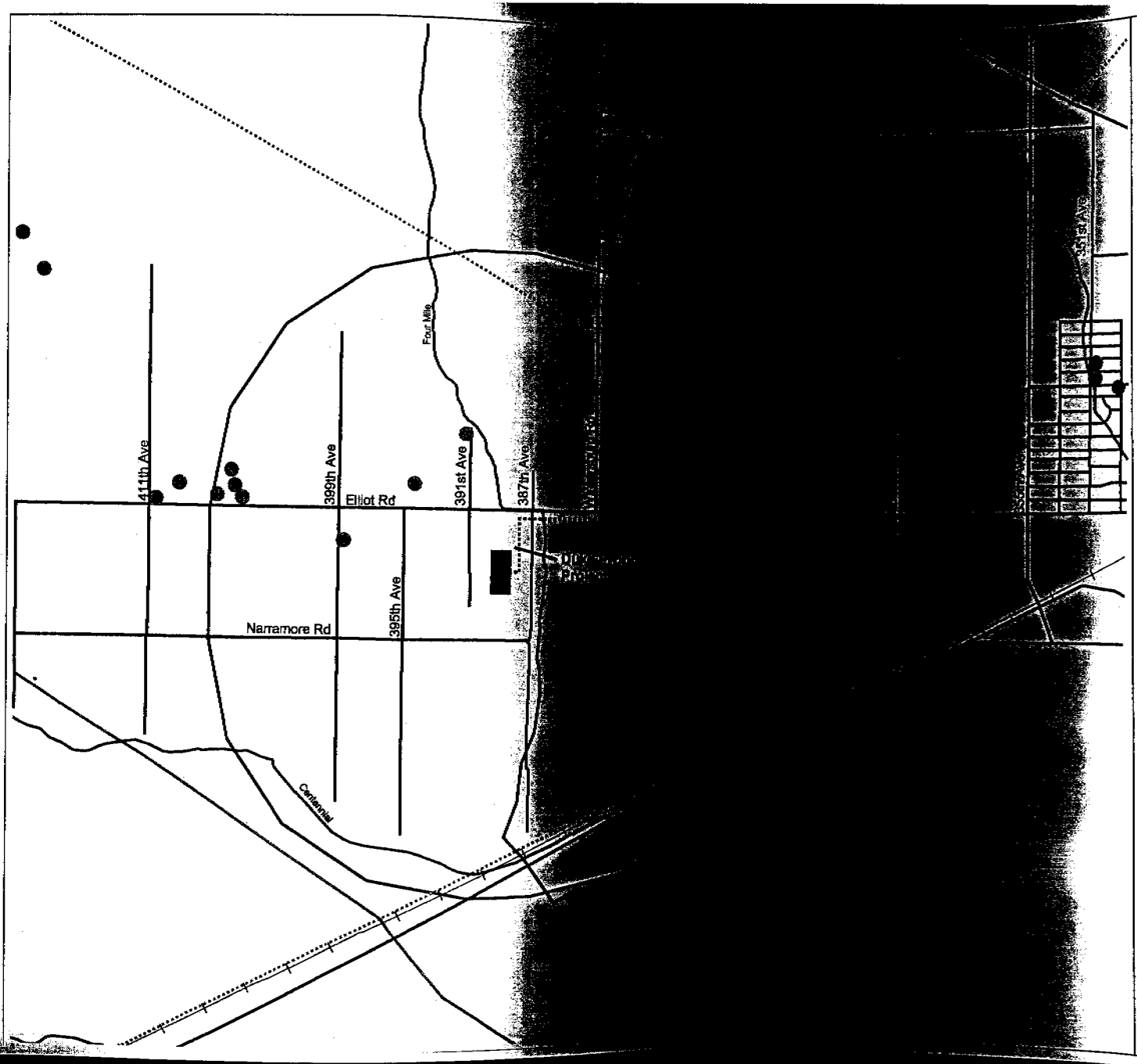


Figure 2

Known Residential Structures

Legend

- Known Residential Structures
- Other Feature
- Legend
- Proposed Electric Power Transmission Line
- Electric Power Transmission Line
- Figure 2 Natural Gas Line
- Known Residential Structures
- Stream
- Railroad
- Other Feature
- Palo Verde Nuclear Generating Station

0 0.5 1 Miles

Duke Energy

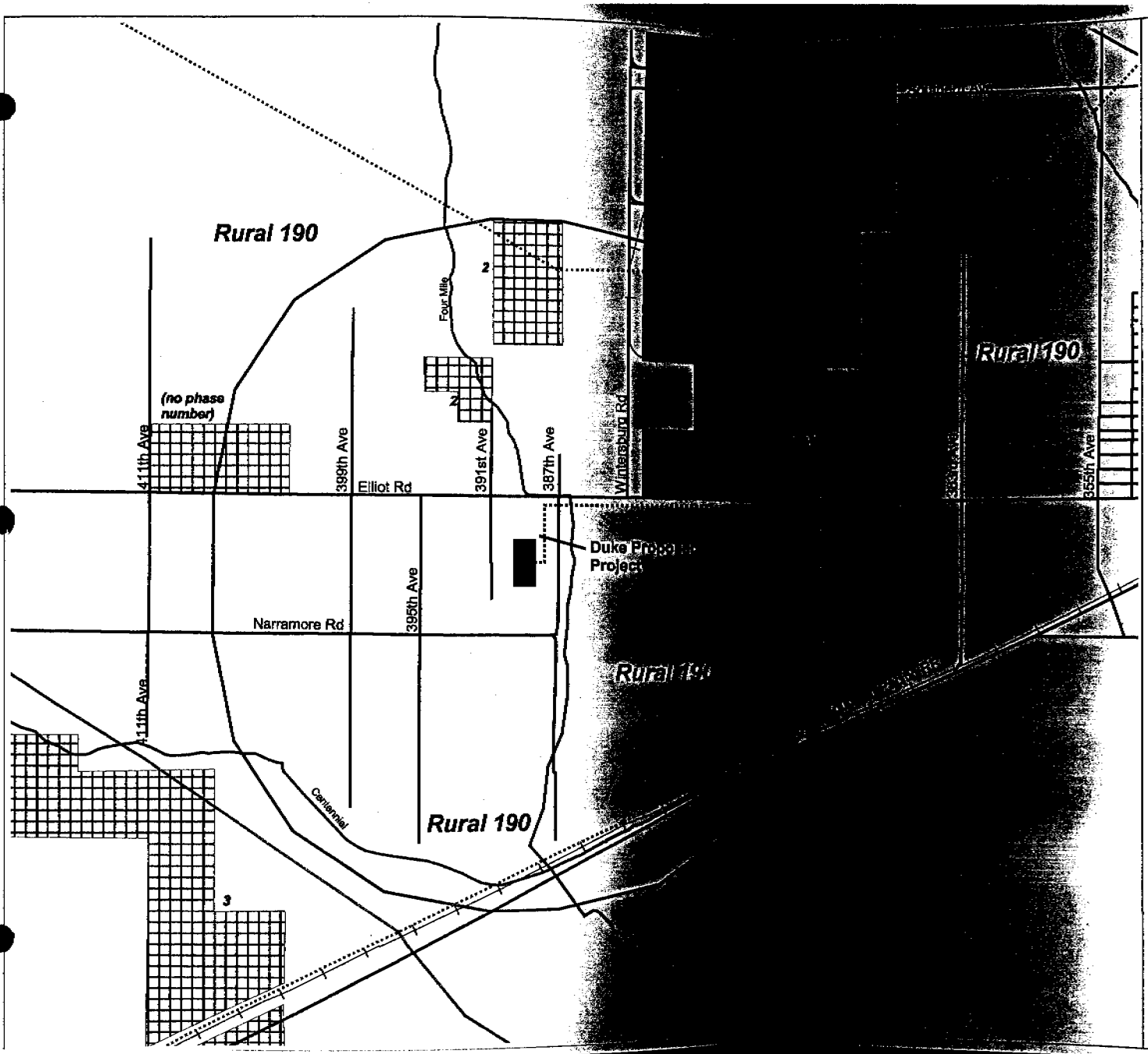


Figure 3:

Zoning and Subdivisions

Legend

Zoning and Subdivisions

Special Use Permit for Nuclear Generating Station

Underlying Zoning for the entire area is Rural 190

Horseshoe Trails subdivision (Phase Designations labeled on Map)

Other Features

Duke Proposed Project

Proposed Electric Power Transmission Line

Electric Power Transmission Line

Natural Gas Line

Rivers and washes

Streets

Railroads

Area within 2 Miles of Facility

Palo Verde Nuclear Generating Station

0 0.5 Miles

Duke Energy

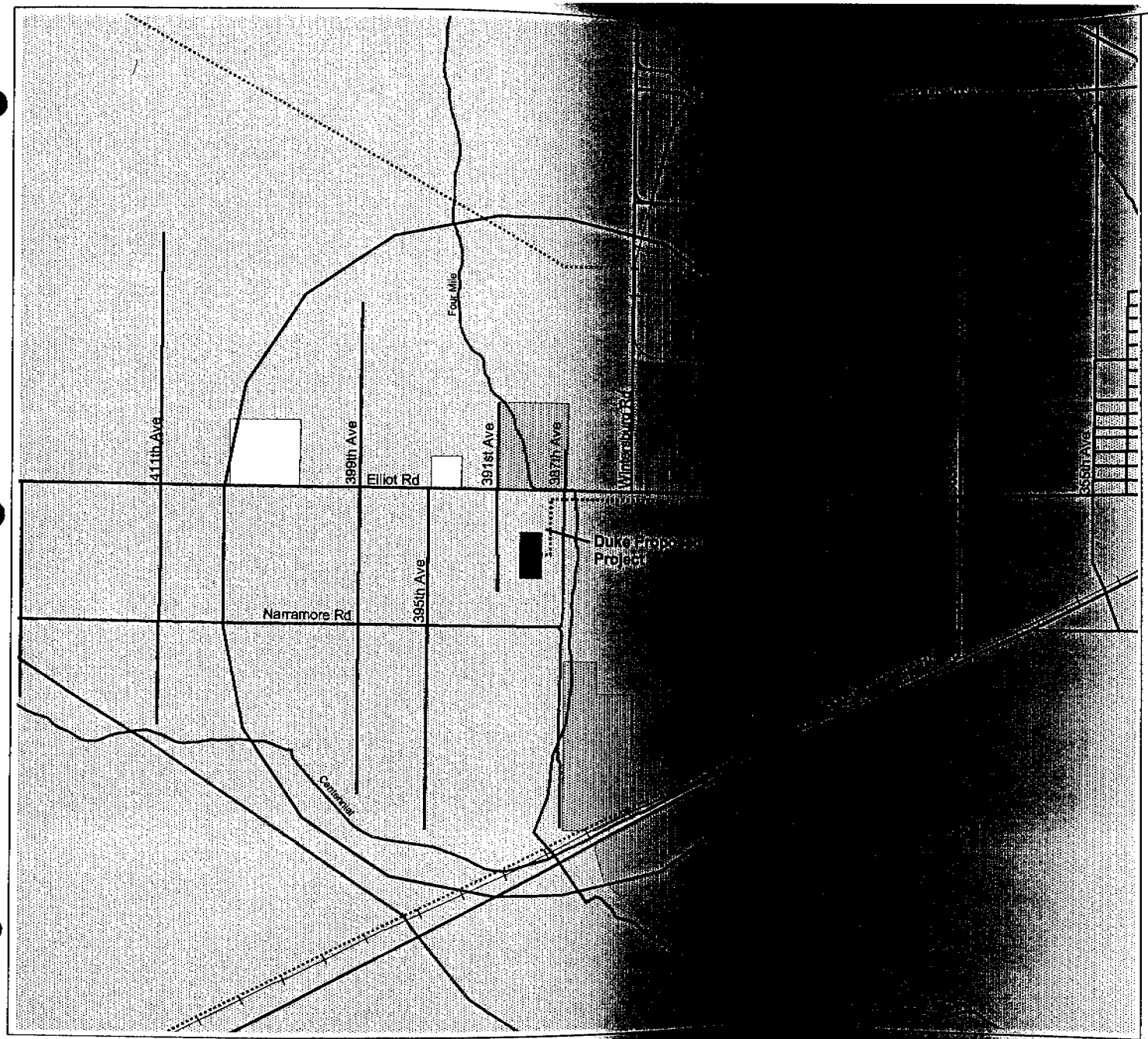


Figure 4:

Existing Land Use (1999)

Legend

Existing Land Use (1999)

- Vacant Land
- Agricultural Land
- Palo Verde Nuclear Generating Station
- Residential Land

Other Features

- Duke Proposed Project
- Proposed Electric Power Transmission Lines
- Electric Power Transmission Lines
- Natural Gas Line
- Rivers and washes
- Streets
- Railroads
- Area within 2 Miles of Project
- Palo Verde Nuclear Generating Station

0 0.5 1
Miles

Duke Energy

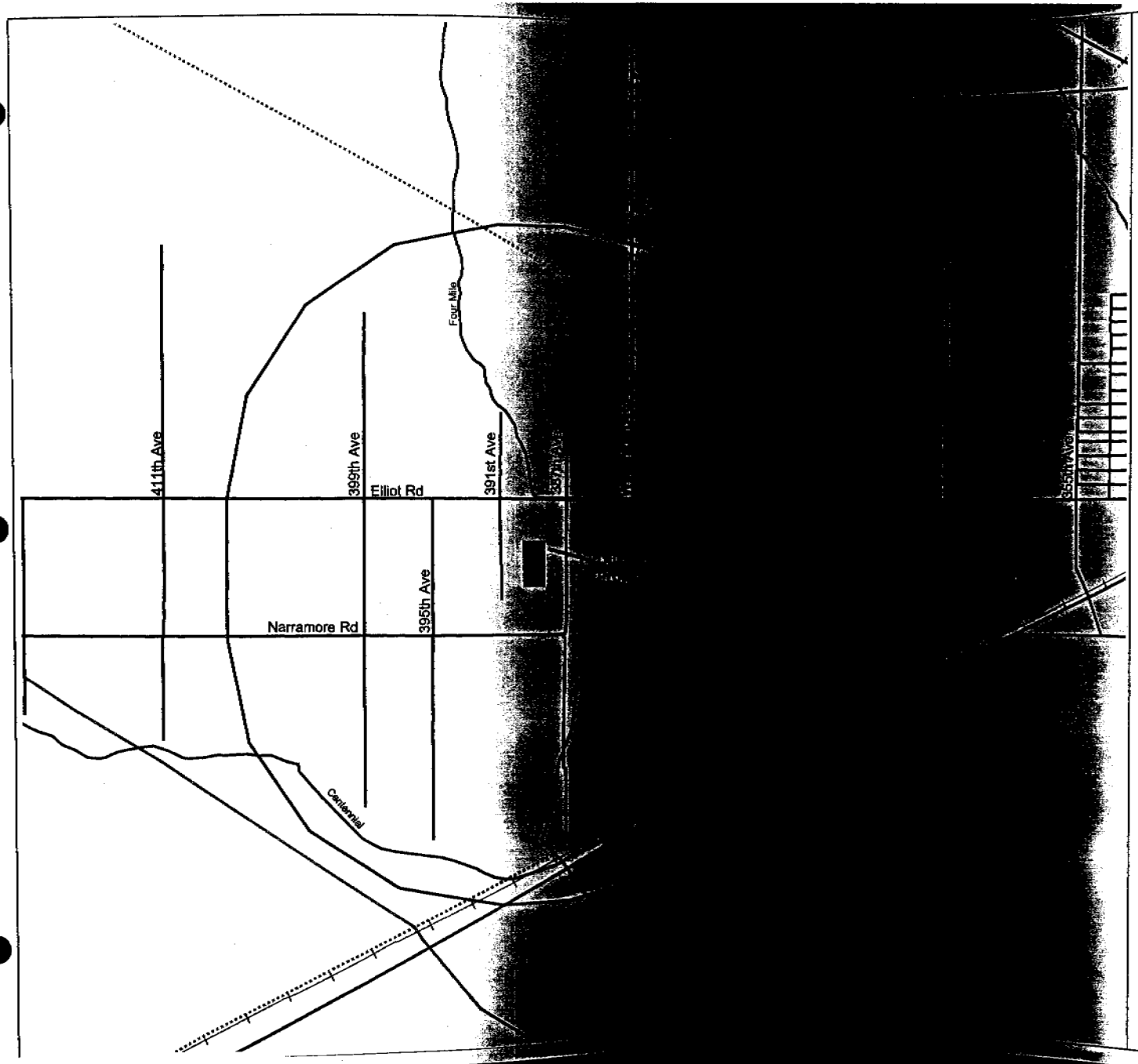


Figure 5:

Existing Utility Lines (1999)

Legend

Existing Utility Lines (1999)

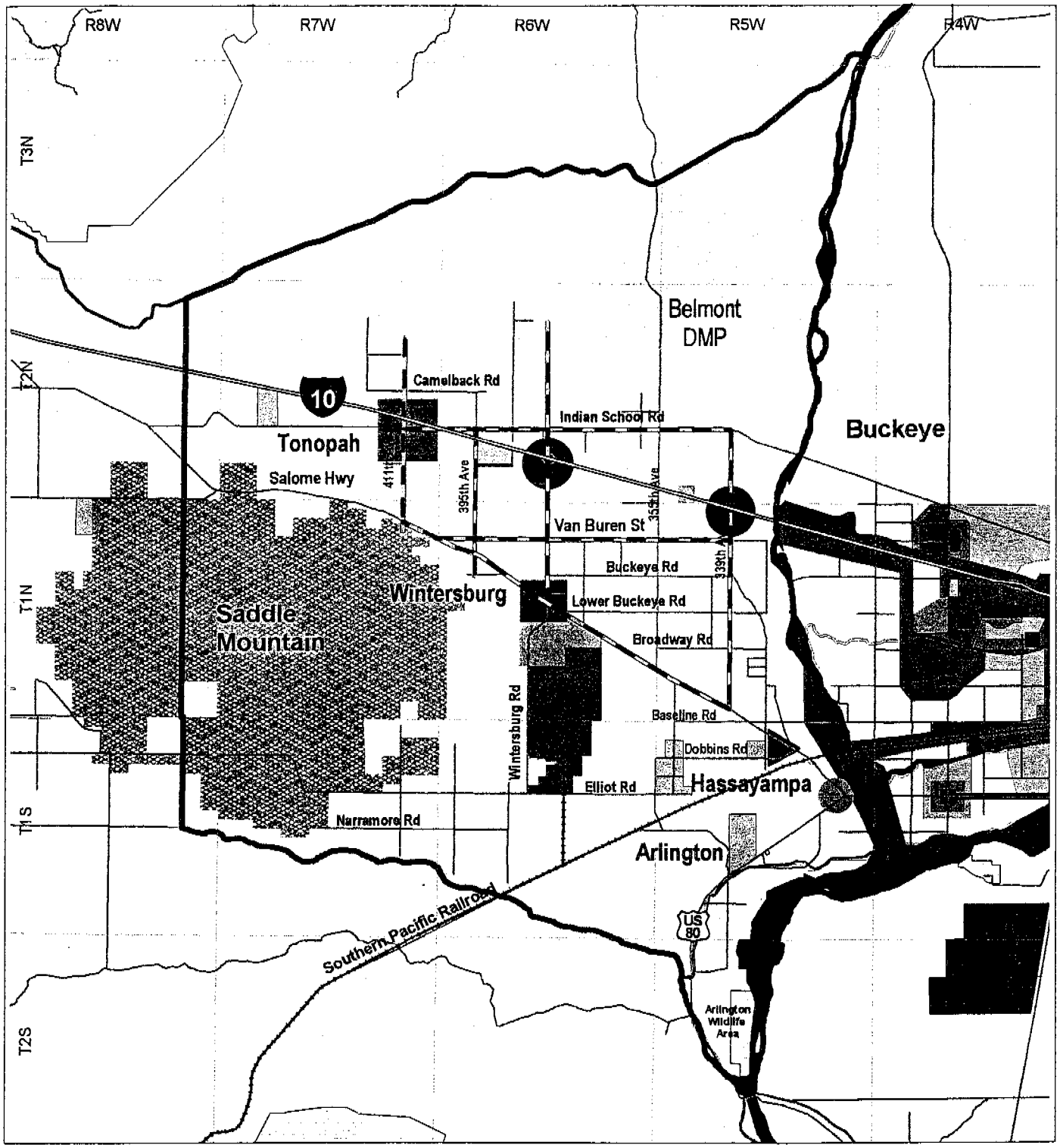
- Electric Power Transmission Lines
- Natural Gas Line

Other Features

- Duke Proposed Project
- Electric Power Transmission Lines
- Natural Gas Line
- Rivers and washes
- Streets
- Railroads
- Area within 2 Miles of Project
- Palo Verde Nuclear Generating Station

0 0.5 1
Miles

Duke Energy



Land Use Categories

- Rural
- Large Lot Residential
- Small Lot Residential
- Neighborhood Retail Center
- Community Retail Center
- Regional Retail Center
- Proposed Open Space
- Recreation
- Open Space
- Educational
- Mixed Use
- Industrial
- Public Facility
- Palo Verde NGS Belmont DMP
- Freeway
- Streets
- Core Arterials
- Railroad
- Area Plan Boundary

Land Use Map

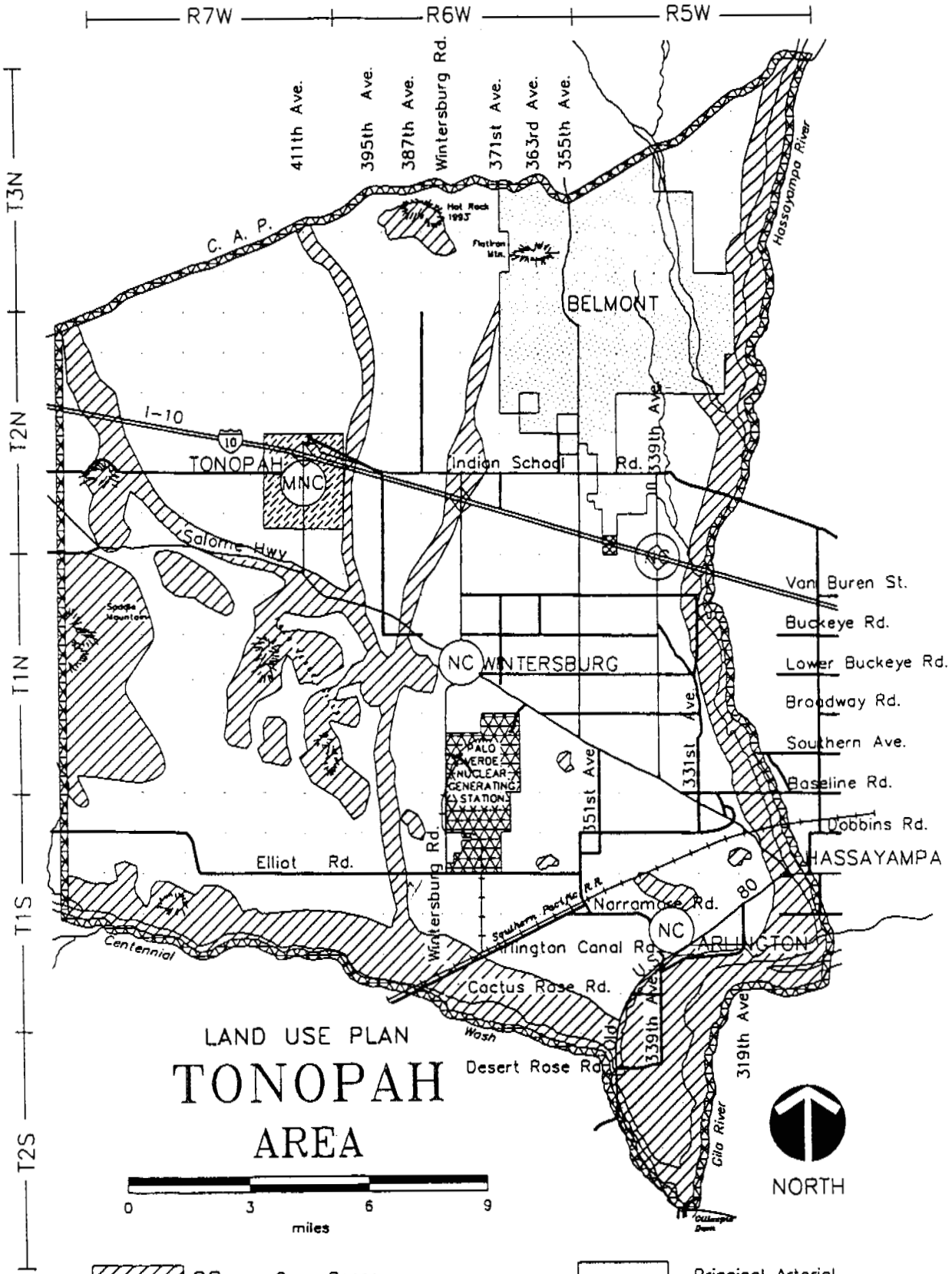
Figure 7

DRAFT

Scale in Miles

0 1 2 3 4 5

Revised 11/24/99



LAND USE PLAN

TONOPAH AREA

OS	Open Space		Principal Arterial
RR/H	Rural Residential/High (0–1 dwelling units per acre)		Freeway
UR/VL	Urban Residential/Very Low (0–4 dwelling units per acre)	NC	Neighborhood Commercial
HIC	Heavy Industrial Center	MNC	Multi–Neighborhood Commercial
DMP	Development Master Plan		Existing Freeway Interchange
	Boundary of Planning Area		Future Freeway Interchange

Figure 6

ADOPTED JANUARY 21, 1992

EXHIBIT C
AREAS OF BIOLOGICAL WEALTH

EXHIBIT C
AREAS OF BIOLOGICAL WEALTH

As stated in Arizona Corporation Commission Rules of Practice and Procedure R14-3-219:

"Describe any areas in the vicinity of the proposed site or route which are unique because of biological wealth or because they are habitats for rare and endangered species. Describe the biological wealth or species involved, and state the effects, if any, the proposed facilities will have thereon."

The proposed power plant site is located on agricultural land that has been out of production for several years. The sparsely vegetated site is dominated by Russian thistle, Bermuda grass, nightshade, and pigweed, with scattered mesquite and tamarisk. The proposed transmission line route crosses agricultural land, creosote bush flats, and a riparian area associated with Winters Wash. Winters Wash and Centennial Wash are located east and south of the plant site, respectively. Dominant plant species in these riparian areas include mesquite, blue palo verde, ironwood, and catclaw acacia. Other species present include fourwing saltbush, panicum, pigweed, and ragweed.

Special status wildlife and plant species documented for Maricopa County are listed in Table C-1. These include species listed as endangered or threatened by the U.S. Fish and Wildlife Service (ISFWS), Wildlife of Special Concern identified by the Arizona Game and Fish Department (AGFD), and Highly Safeguarded Plants protected by the Arizona Native Plant Law per Arizona Department of Agriculture (ADA). Letters from the USFWS and AGFD that provide information on special status species that may occur in the site vicinity are presented in Attachments 1 and 2.

Only a few species (peregrine falcon, ferruginous hawk, southwestern willow flycatcher, California leaf-nosed bat, lesser long-nosed bat, and southern yellow bat) potentially could occur at or near the project site and along the transmission line corridor.

Neither peregrine falcons nor ferruginous hawks are expected to breed in the vicinity of the proposed project; however, they may forage in the area during spring or fall migration. Such occurrences would be very rare, as the project area does not support large numbers of prey species required by either raptor. Impacts to these species from construction and operation of the project are expected to be negligible.

Southwestern willow flycatchers breed in dense riparian areas of cottonwood, willow, and/or salt cedar in the lowlands of southern Arizona and willow thickets in montane areas, and are

Table C-1

Special Status Species of Maricopa County, Arizona

Common Name	Scientific Name	Federal Status[1]	State Status[2]	Habitat Present on Site[3]
MAMMALS				
California leaf-nosed bat	Macrotus californicus		SC	Yes, forage
Lesser long-nosed bat	*Leptonycteris curasoae yerbabuenae*	E	SC	Yes, forage
Western red bat	*Lasiurus blossevillii*		SC	No
Southern yellow bat	*Lasiurus ega*		SC	Yes, forage
Spotted bat	*Euderma maculatum*		SC	No[4]
Jaguar	*Panthera onca*		SC	No
Chihuahuan pronghorn	*Antilocapra americana mexicana*		SC	No
Sonoran pronghorn	*Antilocapra americana sonoriensis*	E	SC	No
BIRDS				
American bittern	*Botaurus lentiginosus*		SC	No
Least bittern	*Ixobrychus exilis*		SC	No
Great egret	*Ardea alba*		SC	No
Snowy egret	*Egretta thula*		SC	No
Black-bellied whistling duck	*Dendrocygna autumnalis*		SC	No
Osprey	*Pandion haliaetus*		SC	No
Mississippi kite	*Ictinia mississippiensis*		SC	No
Bald eagle	*Haliaeetus leucocephalus*	T	SC	No
Northern goshawk	*Accipiter gentilis*		SC	No
Gray hawk	*Asturina nitida*		SC	No
Common black-hawk	*Buteogallus anthracinus*		SC	No
Ferruginous hawk	*Buteo regalis*		SC	Yes, migration
American peregrine falcon	*Falco peregrinus anatum*		SC	Yes, migration
Yuma clapper rail	*Rallus longirostris yuman ensis*	E	SC	No
Snowy plover	*Charadrius alexandrinus*		SC	No
Western yellow-billed cuckoo	*Coccyzus americanus*		SC	No
Cactus ferruginous pygmy-owl	*Glaucidium brasilianum cactorum*	E	SC	No
Mexican spotted owl	*Strix occidentalis lucida*	T	SC	No
Belted kingfisher	*Ceryle alcyon*		SC	No
Southwestern willow flycatcher	*Empidonax trailli extimus*	E	SC	Yes, migration
Tropical kingbird	*Tyrannus melancholicus*		SC	No

Common Name	Scientific Name	Federal Status[1]	State Status[2]	Habitat Present on Site[3]
REPTILES AND AMPHIBIANS				
Chiricahua leopard frog	Rana chiricahuensis		SC	No
Lowland leopard frog	*Rana yavapaiensis*		SC	No
Desert tortoise	*Gopherus agassizii*		SC	No
Arizona skink	*Eumeces gilberti arizonensis*		SC	No
Narrow-headed garter snake	*Thamnophis rufipunctatus*		SC	No
FISHES				
Colorado squawfish	Ptychocheilus lucius		SC	No
Spikedace	*Meda fulgida*		SC	No
Razorback sucker	*Xyrauchen texanus*	E	SC	No
Desert pupfish	*Cyprinodon macularius macularius*	E	SC	No
Gila topminnow	*Poeciliopsis occidentalis occidentalis*	E	SC	No
PLANTS				
Arizona agave	Agave arizonica	E	HS	No
Hohokam agave	Agave murpheyi		HS	No
Arizona cliffrose	Purshia subintegra	E	HS	No
Crested or Fan-top saguaro	Carnegiea gigantea	E	HS	No
Arizona hedgehog cactus	Echinocereus triglochidiatus arizonicus	E	HS	No
Acuna cactus	Echinomastus erectocentrus acunensis		HS	No
Lemmon fleabane	Erigeron lemmoni		HS	No

Key:

Federal Status: E = Endangered T = Threatened
SC = Special Concern HS = Highly Safeguarded

Sources:
[1]USFWS 1999
[2]AGFD 1996 and ADA 1999
[3]Habitat assessments based on discussions with USFWS and AGFD staff specialists, field evaluations in November 1999, and the following sources: Kearney and Peebles 1960, Stebbins 1985, and Hoffmeister 1986.
[4]Habitat requirements for the spotted bat are not well known, but appear to include cliffs and rocks (Hoffmeister 1986).

associated with water or saturated soil conditions (Sogge et al. 1997). These habitats are not present within or adjacent to the proposed site and transmission line corridor. As a result, impacts to southwestern willow flycatchers associated with construction and operation of the project are not expected to occur.

California leaf-nosed bat, lesser long-nosed bat, and southern yellow bat could potentially forage over or near the project (AGFD 1993). No known bat roosts have been documented in or near the project area. As a result, impact to these species are expected to be negligible.

Based on the results of field evaluations, AGFD Heritage Data Management System records (AGFD 1999), a field project review meeting with AGFD staff specialists in November 1999, and the proposed project design (i.e., transmission line would span Winter Wash), construction and operation of the power plant and associated transmission line are not expected to impact threatened, endangered, or otherwise sensitive species of plants and animals identified by USFWS, AGFD, or ADA. Loss of habitat associated with the project is expected to be negligible for any of these species.

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ATTACHMENT 1

USFWS LETTER

United States Department of the Interior
U.S. Fish and Wildlife Service
2321 W. Royal Palm Road, Suite 103
Phoenix, Arizona 85021-4951
(602)640-2720 FAX (602)640-2730

In Reply Refer To:

AESO/SE
2-21-00-I-036

November 17, 1999

Mr. Phil Hackney
Project Manager
ENSR Consulting
1601 Prospect Parkway
Fort Collins, Colorado 80525

RE: Arlington Valley Energy Project located in Maricopa County

Dear Mr. Hackney:

This letter responds to your November 11, 1999, request for an inventory of threatened or endangered species, or those that are proposed to be listed as such under the Endangered Species Act of 1973, as amended (Act), which may potentially occur in your project area (Maricopa County). The enclosed list may include candidate species as well. We hope the enclosed county list of species will be helpful. In future communications regarding this project, please refer to consultation number 2-21-00-I-036.

The enclosed list of the endangered, threatened, proposed, and candidate species includes all those potentially occurring anywhere in the county, or counties, where your project occurs. Please note that your project area may not necessarily include all or any of these species. The information provided includes general descriptions, habitat requirements, and other information for each species on the list. Also on the enclosed list is the Code of Federal Regulations (CFR) citation for each list and is available at most public libraries. This information should assist you in determining which species may or may not occur within your project area. Site-specific surveys could also be helpful and may be needed to verify the presence or absence of a species or its habitat as required for the evaluation of proposed project-related impacts.

Endangered and threatened species are protected by Federal law and must be considered prior to project development. If the action agency determines that listed species or critical habitat may be adversely affected by a federally funded, permitted, or authorized activity, the action agency must request formal consultation with the Service. If the action agency determines that the planned action may jeopardize a proposed species or destroy or adversely modify proposed critical habitat, the action agency must enter into a section 7 conference with the Service. Candidate species are those which are being considered for addition to the list of threatened or endangered species. Candidate species are those for which there is sufficient information to support a

proposal for listing. Although candidate species have no legal protection under the Act, we recommend that they be considered in the planning process in the event that they become listed or proposed for listing prior to project completion.

If any proposed action occurs in or near areas with trees and shrubs growing along watercourses, known as riparian habitat, the Service recommends the protection of these areas. Riparian areas are critical to biological community diversity and provide linear corridors important to migratory species. In addition, if the project will result in the deposition of dredged or fill materials into waterways or excavation in waterways, we recommend you contact the Army Corps of Engineers which regulates these activities under Section 404 of the Clean Water Act.

The State of Arizona protects some plant and animal species not protected by Federal law. We recommend you contact the Arizona Game and Fish Department and the Arizona Department of Agriculture for State-listed or sensitive species in your project area.

The Service appreciates your efforts to identify and avoid impacts to listed and sensitive species in your project area. If we may be of further assistance, please feel free to contact Tom Gatz.

Sincerely,

Jacqueline Hanson

for David L. Harlow
Field Supervisor

Enclosure

cc: John Kennedy, Habitat Branch, Arizona Game and Fish Department, Phoenix, AZ

LISTED, PROPOSED, AND CANDIDATE SPECIES FOR THE FOLLOWING COUNTY: MARICOPA

08/26/1999

1) LISTED

TOTAL= 13

NAME: **ARIZONA AGAVE** *AGAVE ARIZONICA*

STATUS: ENDANGERED CRITICAL HAB No RECOVERY PLAN: No CFR: 49 FR 21055, 05-18-1984

DESCRIPTION: HAS ATTRACTIVE ROSETTES OF BRIGHT GREEN LEAVES WITH DARK MAHOGANY MARGINS. FLOWER: BORNE ON SUB-UMBELLATE INFLORESCENCES.

ELEVATION RANGE: 3000-6000 FT.

COUNTIES: GILA, YAVAPAI, MARICOPA

HABITAT: TRANSITION ZONE BETWEEN OAK-JUNIPER WOODLAND & MOUNTAIN MAHOGANY-OAK SCRUB

SCATTERED CLONES IN NEW RIVER MOUNTAINS AND SIERRA ANCHA. USUALLY FOUND ON STEEP, ROCKY SLOPES. POSSIBLY MAZATAL MOUNTAINS. SHOULD BE LOOKED FOR WHEREVER THE RANGES OF Agave toumeyana var. bella AND Agave chrystantha OVERLAP.

NAME: **ARIZONA CLIFFROSE** *PURSHIA SUBINTEGRA*

STATUS: ENDANGERED CRITICAL HAB No RECOVERY PLAN: Yes CFR: 49 FR 22326 5-29-84

DESCRIPTION: EVERGREEN SHRUB OF THE ROSE FAMILY (ROSEACEAE). BARK PALE SHREDDY. YOUNG TWIGS WITH DENSE HAIRS. LEAVES 1-5 LOBES AND EDGES CURL DOWNWARD (REVOLUTE). FLOWERS: 5 WHITE OR YELLOW PETALS <0.5 INCH LONG.

ELEVATION RANGE: <4000 FT.

COUNTIES: GRAHAM YAVAPAI MARICOPA MOHAVE

HABITAT: CHARACTERISTIC WHITE SOILS OF TERTIARY LIMESTONE LAKEBED DEPOSITS.

WHITE SOILS OF TERITIARY LIMESTONE LAKEBED DEPOSITS CAN BE SEEN FROM A DISTANCE.

NAME: **ARIZONA HEDGEHOG CACTUS** *ECHINOCEREUS TRIGLOCHIDIATUS ARIZONICUS*

STATUS: ENDANGERED CRITICAL HAB No RECOVERY PLAN: No CFR: 44 FR 61556,10-15-1979

DESCRIPTION: DARK GREEN CYLINDROID 2.5-12 INCHES TALL, 2-10 INCHES IN DIAMETER, SINGLE OR IN CLUSTERS. 1-3 GRAY OR PINKISH CENTRAL SPINES LARGEST DEFLEXED AND 5-11 SHORTER RADIAL SPINES. FLOWER: BRILLIANT RED, SIDE OF STEM IN APRIL- MAY

ELEVATION RANGE: 3700-5200 FT.

COUNTIES: MARICOPA, GILA, PINAL

HABITAT: ECOTONE BETWEEN INTERIOR CHAPPARAL AND MADREAN EVERGREEN WOODLAND

OPEN SLOPES, IN NARROW CRACKS BETWEEN BOULDERS, AND IN UNDERSTORY OF SHRUBS. THIS VARIETY IS BELIEVED TO INTERGRADE AT THE EDGES OF ITS DISTRIBUTION WITH VARIETIES MELANCANTHUS AND NEOMEXICANUS CAUSING SOME CONFUSION IN IDENTIFICATION.

NAME: **LESSER LONG-NOSED BAT** *LEPTONYCTERIS CURASOAE YERBABUENAE*

STATUS: ENDANGERED CRITICAL HAB No RECOVERY PLAN: Yes CFR: 53 FR 38456, 09-30-88

DESCRIPTION: ELONGATED MUZZLE, SMALL LEAF NOSE, AND LONG TONGUE. YELLOWISH BROWN OR GRAY ABOVE AND CINNAMON BROWN BELOW. TAIL MINUTE AND APPEARS TO BE LACKING. EASILY DISTURBED.

ELEVATION RANGE: <6000 FT.

COUNTIES: COCHISE, PIMA, SANTA CRUZ, GRAHAM, PINAL, MARICOPA

HABITAT: DESERT SCRUB HABITAT WITH AGAVE AND COLUNMNAR CACTI PRESENT AS FOOD PLANTS

DAY ROOSTS IN CAVES AND ABANDONED TUNNELS. FORAGES AT NIGHT ON NECTAR, POLLEN, AND FRUIT OF PANICULATE AGAVES AND COLUMNAR CACTI. THIS SPECIES IS MIGRATORY AND IS PRESENT IN ARIZONA , USUALLY FROM APRIL TO SEPTMBER AND SOUTH OF THE BORDER THE REMAINDER OF THE YEAR.

NAME: **SONORAN PRONGHORN** *ANTILOCAPRA AMERICANA SONORIENSIS*

STATUS: ENDANGERED CRITICAL HAB No RECOVERY PLAN: Yes CFR: 32 FR 4001, 03-11-67

DESCRIPTION: BUFF ON BACK AND WHITE BELOW, HOOFED WITH SLIGHTLY CURVED BLACK HORNS HAVING A SINGLE PRONG. SMALLEST AND PALEST OF THE PRONGHORN SUBSPECIES.

ELEVATION RANGE: 2000-4000 FT.

COUNTIES: PIMA, YUMA, MARICOPA

HABITAT: BROAD, INTERMOUNTAIN ALLUVIAL VALLEYS WITH CREOSOTE-BURSAGE & PALO VERDE-MIXED CACTI ASSOCIATIONS

TYPICALLY, BAJADAS ARE USED AS FAWNING AREAS AND SANDY DUNE AREAS PROVIDE FOOD SEASONALLY. HISTORIC RANGE WAS PROBABLY LARGER THAN EXISTS TODAY. THIS SUBSPECIES ALSO OCCURS IN MEXICO.

NAME: **DESERT PUPFISH** *CYPRINODON MACULARIUS*

STATUS: ENDANGERED CRITICAL HAB Yes RECOVERY PLAN: Yes CFR: 51 FR 10842, 03-31-1986

DESCRIPTION: SMALL (2 INCHES) SMOOTHLY ROUNDED BODY SHAPE WITH NARROW VERTICAL BARS ON THE SIDES. BREEDING MALES BLUE ON HEAD AND SIDES WITH YELLOW ON TAIL. FEMALES & JUVENILES TAN TO OLIVE COLORED BACK AND SILVERY SIDES.

ELEVATION RANGE: <5000 FT.

COUNTIES: LA PAZ, PIMA, GRAHAM, MARICOPA, PINAL, YAVAPAI, SANTA CRUZ

HABITAT: SHALLOW SPRINGS, SMALL STREAMS, AND MARSHES. TOLERATES SALINE & WARM WATER

CRITICAL HABITAT INCLUDES QUITOBAQUITO SPRING, PIMA COUNTY, PORTIONS OF SAN FELIPE CREEK, CARRIZO WASH, AND FISH CREEK WASH, IMPERIAL COUNTY, CALIFORNIA. TWO SUBSPECIES ARE RECOGNIZED: DESERT PUPFISH (C. m. macularis) AND QUITOBAQUITO PUPFISH (C. m. eremus).

LISTED, PROPOSED, AND CANDIDATE SPECIES FOR THE FOLLOWING COUNTY: **MARICOPA**

08/26/1999

NAME: **GILA TOPMINNOW** *POECILIOPSIS OCCIDENTALIS OCCIDENTALIS*

STATUS: ENDANGERED CRITICAL HAB No RECOVERY PLAN: Yes CFR: 32 FR 4001, 03-11-1967

DESCRIPTION: SMALL (2 INCHES), GUPPY-LIKE, LIVE BEARING, LACKS DARK SPOTS ON ITS FINS. BREEDING MALES ARE JET BLACK WITH YELLOW FINS.

ELEVATION RANGE: <4500 FT.

COUNTIES: GILA, PINAL, GRAHAM, YAVAPAI, SANTA CRUZ, PIMA, MARICOPA, LA PAZ

HABITAT: SMALL STREAMS, SPRINGS, AND CIENEGAS VEGETATED SHALLOWS

SPECIES HISTORICALLY OCCURRED IN BACKWATERS OF LARGE RIVERS BUT IS CURRENTLY ISOLATED TO SMALL STREAMS AND SPRINGS

NAME: **RAZORBACK SUCKER** *XYRAUCHEN TEXANUS*

STATUS: ENDANGERED CRITICAL HAB Yes RECOVERY PLAN: Yes CFR: 55 FR 21154, 05-22-1990; 59 FR 13374, 03-21-1994

DESCRIPTION: LARGE (UP TO 3 FEET AND UP TO 16 POUNDS) LONG, HIGH SHARP-EDGED KEEL-LIKE HUMP BEHIND THE HEAD. HEAD FLATTENED ON TOP. OLIVE-BROWN ABOVE TO YELLOWISH BELOW.

ELEVATION RANGE: <6000 FT.

COUNTIES: GREENLEE, MOHAVE, PINAL, YAVAPAI, YUMA, LA PAZ, MARICOPA (REFUGIA), GILA, COCONINO, GRAHAM

HABITAT: RIVERINE & LACUSTRINE AREAS, GENERALLY NOT IN FAST MOVING WATER AND MAY USE BACKWATERS

SPECIES IS ALSO FOUND IN HORSESHOE RESERVOIR (MARICOPA COUNTY).CRITICAL HABITAT INCLUDES THE 100-YEAR FLOODPLAIN OF THE RIVER THROUGH GRAND CANYON FROM CONFLUENCE WITH PARIA RIVER TO HOOVER DAM; HOOVER DAM TO DAVIS DAM; PARKER DAM TO IMPERIAL DAM. ALSO GILA RIVER FROM AZ/NM BORDER TO COOLIDGE DAM; AND SALT RIVER FROM HWY 60/SR 77 BRIDGE TO ROOSEVELT DAM; VERDE RIVER FROM FS BOUNDARY TO HORSESHOE LAKE.

NAME: **BALD EAGLE** *HALIAEETUS LEUCOCEPHALUS*

STATUS: THREATENED CRITICAL HAB No RECOVERY PLAN: Yes CFR: 60 FR 35999, 07-12-95

DESCRIPTION: LARGE, ADULTS HAVE WHITE HEAD AND TAIL. HEIGHT 28 - 38"; WINGSPAN 66 - 96". 1-4 YRS DARK WITH VARYING DEGREES OF MOTTLED BROWN PLUMAGE. FEET BARE OF FEATHERS.

ELEVATION RANGE: VARIES FT.

COUNTIES: YUMA, LA PAZ, MOHAVE, YAVAPAI, MARICOPA, PINAL, COCONINO, NAVAJO, APACHE, SANTA CRUZ, PIMA, GILA, GRAHAM, COCHISE

HABITAT: LARGE TREES OR CLIFFS NEAR WATER (RESERVOIRS, RIVERS AND STREAMS) WITH ABUNDANT PREY

SOME BIRDS ARE NESTING RESIDENTS WHILE A LARGER NUMBER WINTERS ALONG RIVERS AND RESERVOIRS. AN ESTIMATED 200 TO 300 BIRDS WINTER IN ARIZONA. ONCE ENDANGERED (32 FR 4001, 03-11-1967; 43 FR 6233, 02-14-78) BECAUSE OF REPRODUCTIVE FAILURES FROM PESTICIDE POISONING AND LOSS OF HABITAT, THIS SPECIES WAS DOWN LISTED TO THREATENED ON AUGUST 11, 1995. ILLEGAL SHOOTING, DISTURBANCE, LOSS OF HABITAT CONTINUES TO BE A PROBLEM. SPECIES HAS BEEN PROPOSED FOR DELISTING (64 FR 36454) BUT STILL RECEIVES FULL PROTECTION UNDER ESA.

LISTED, PROPOSED, AND CANDIDATE SPECIES FOR THE FOLLOWING COUNTY: **MARICOPA**

08/26/1999

NAME: **CACTUS FERRUGINOUS PYGMY-OWL** *GLAUCIDIUM BRASILIANUM CACTORUM*

STATUS: ENDANGERED CRITICAL HAB Yes RECOVERY PLAN: No CFR: 62 FR 10730, 3-10-97

DESCRIPTION: SMALL (APPROX. 7"), DIURNAL OWL REDDISH BROWN OVERALL WITH CREAM-COLORED BELLY STREAKED WITH REDDISH BROWN. SOME INDIVIDUALS ARE GRAYISH BROWN

ELEVATION RANGE: <4000 FT.

COUNTIES: MARICOPA, YUMA, SANTA CRUZ, GRAHAM, GREENLEE, PIMA, PINAL, GILA, COCHISE

HABITAT: MATURE COTTONWOOD/WILLOW, MESQUITE BOSQUES, AND SONORAN DESERTSCRUB

RANGE LIMIT IN ARIZONA IS FROM NEW RIVER (NORTH) TO GILA BOX (EAST) TO CABEZA PRIETA MOUNTAINS (WEST). ONLY A FEW DOCUMENTED SITES WHERE THIS SPECIES PERSISTS ARE KNOWN, ADDITIONAL SURVEYS ARE NEEDED. CRITICAL HABITAT IN PIMA, COCHISE, PINAL, AND MARICOPA COUNTIES (64 FR 37419).

NAME: **MEXICAN SPOTTED OWL** *STRIX OCCIDENTALIS LUCIDA*

STATUS: THREATENED CRITICAL HAB No RECOVERY PLAN: Yes CFR: 56 FR 14678, 04-11-91

DESCRIPTION: MEDIUM SIZED WITH DARK EYES AND NO EAR TUFTS. BROWNISH AND HEAVILY SPOTTED WITH WHITE OR BEIGE.

ELEVATION RANGE: 4100-9000 FT.

COUNTIES: MOHAVE, COCONINO, NAVAJO, APACHE, YAVAPAI, GRAHAM, GREENLEE, COCHISE, SANTA CRUZ, PIMA, PINAL, GILA, MARICOPA

HABITAT: NESTS IN CANYONS AND DENSE FORESTS WITH MULTI-LAYERED FOLIAGE STRUCTURE

GENERALLY NESTS IN OLDER FORESTS OF MIXED CONIFER OR PONDERSA PINE/GAMBEL OAK TYPE, IN CANYONS, AND USE VARIETY OF HABITATS FOR FORAGING. SITES WITH COOL MICROCLIMATES APPEAR TO BE OF IMPORTANCE OR ARE PREFERED.

NAME: **SOUTHWESTERN WILLOW FLYCATCHER** *EMPIDONAX TRAILLII EXTIMUS*

STATUS: ENDANGERED CRITICAL HAB Yes RECOVERY PLAN: No CFR: 60 FR 10694, 02-27-95

DESCRIPTION: SMALL PASSERINE (ABOUT 6") GRAYISH-GREEN BACK AND WINGS, WHITISH THROAT, LIGHT OLIVE-GRAY BREAST AND PALE YELLOWISH BELLY. TWO WINGBARS VISIBLE. EYE-RING FAINT OR ABSENT.

ELEVATION RANGE: <8500 FT.

COUNTIES: YAVAPAI, GILA, MARICOPA, MOHAVE, COCONINO, NAVAJO, APACHE, PINAL, LA PAZ, GREENLEE, GRAHAM, YUMA, PIMA, COCHISE, SANTA CRUZ

HABITAT: COTTONWOOD/WILLOW & TAMARISK VEGETATION COMMUNITIES ALONG RIVERS & STREAMS

MIGRATORY RIPARIAN OBLIGATE SPECIES THAT OCCUPIES BREEDING HABITAT FROM LATE APRIL TO SEPTEMBER. DISTRIBUTION WITHIN ITS RANGE IS RESTRICTED TO RIPARIAN CORRIDORS. DIFFICULT TO DISTINGUISH FROM OTHER MEMBERS OF THE EMPIDONAX COMPLEX BY SIGHT ALONE. TRAINING SEMINAR REQUIRED FOR THOSE CONDUCTING FLYCATCHER SURVEYS. CRITICAL HABITAT ON PORTIONS OF THE 100-YEAR FLOODPLAIN ON SAN PEDRO AND VERDE RIVERS; WET BEAVER AND WEST CLEAR CREEKS, INCLUDING TAVASCI MARSH AND ISTER FLAT; THE COLORADO RIVER, THE LITTLE COLORADO RIVER, AND THE WEST, EAST, AND SOUTH FORKS OF THE LITTLE COLORADO RIVER, REFERENCE 60 CFR:62 FR 39129, 7/22/97.

LISTED, PROPOSED, AND CANDIDATE SPECIES FOR THE FOLLOWING COUNTY: **MARICOPA**

08/26/1999

NAME: **YUMA CLAPPER RAIL** *RALLUS LONGIROSTRIS YUMANENSIS*

STATUS: ENDANGERED CRITICAL HAB No RECOVERY PLAN: Yes CFR: 32 FR 4001, 03-11-67; 48 FR 34182, 07-27-83

DESCRIPTION: WATER BIRD WITH LONG LEGS AND SHORT TAIL. LONG SLENDER DECURVED BILL. MOTTLED BROWN ON GRAY ON ITS RUMP. FLANKS AND UNDERSIDES ARE DARK GRAY WITH NARROW VERTICAL STRIPES PRODUCING A BARRING EFFECT.

ELEVATION RANGE: <4500 FT.

COUNTIES: YUMA, LA PAZ, MARICOPA, PINAL, MOHAVE

HABITAT: FRESH WATER AND BRACKISH MARSHES

SPECIES IS ASSOCIATED WITH DENSE EMERGENT RIPARIAN VEGETATION. REQUIRES WET SUBSTRATE (MUDFLAT, SANDBAR) WITH DENSE HERBACEOUS OR WOODY VEGETATION FOR NESTING AND FORAGING. CHANNELIZATION AND MARSH DEVELOPMENT ARE PRIMARY SOURCES OF HABITAT LOSS.

ATTACHMENT 2

AGFD LETTER

THE STATE OF ARIZONA

GAME & FISH DEPARTMENT

2221 West Greenway Road, Phoenix, Arizona 85023-4399 (602) 942-3000
www.gf.state.az.us

Governor
Jane Dee Hull

Commissioners:
Chairman, William Berlat, Tucson
W. Hays Gilstrap, Phoenix
Dennis D. Manning, Alpine
Michael M. Golightly, Flagstaff
Joe Carter, Safford

Director
Duane L. Shroufe

Deputy Director
Steve K. Ferrell

November 15, 1999

Mr. Phil Hackney
ENSR
1601 Prospect Parkway
Fort Collins, Colorado 80525

Re: Special Status Species Request for Arlington Valley Energy Project
Township 1 South, Range 6 West, Sections 8,9,10,15,16,17,20,21,22,28

Dear Mr. Hackney:

The Arizona Game and Fish Department (Department) has received your letter, dated November 11, 1999, regarding special status species for the above-referenced project and the following information is provided.

The Department's Heritage Data Management System has been accessed and current records do not indicate the presence of any Endangered, Threatened or other special status species in the project vicinity.

At this time, the Department's comments are limited to the special status species information provided above. This correspondence does not represent the Department's evaluation of impacts to wildlife or wildlife habitat associated with activities occurring in the subject area. If the Department has specific comments or concerns regarding this project, they will be provided to you by December 10, 1999. Please contact me at (602) 789-3593 if you require additional information concerning this special status species list.

Sincerely,

Aimee MacIlroy
Project Evaluation Specialist
Habitat Branch

cc: Russ Engel, Habitat Program Manager, Region IV, Yuma

AGFD# 11-5-99(01)

EXHIBIT D
BIOLOGICAL RESOURCES

EXHIBIT D

As stated in Arizona Corporation Commission Rules of Practice and Procedure R14-3-219:

"List the fish, wildlife, plant life, and associated forms of life in the vicinity of the proposed site or route and describe the effects, if any, other proposed facilities will have thereon."

BIOLOGICAL RESOURCES

Tables D-1, D-2, D-3, and D-4 list the mammal, bird, reptiles and amphibians, and plant species, potentially occurring within the vicinity of the project. Because no flowing streams are present within the project area, fish species have not been listed.

Construction of the project is expected to have negligible impacts to native vegetation since the plant site is characterized by sparse, primarily non-native plant species, and the transmission line towers will be located on agricultural land and creosote bush flats. Agricultural lands and creosote bush flats are common in the region, and removal of the relatively small amount of vegetation at the project site and along the transmission line corridor will not impact the vegetation communities as a whole.

Impacts to wildlife populations in the vicinity of the project are expected to be minimal due to the low quality habitat of the agricultural lands affected as well as the abundance of the creosote bush flats within the vicinity of the project area. Additionally, construction will not impact unique vegetation or wildlife species, habitat, or movement corridors for wildlife.

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Table D-1

Mammals Potentially Present in the Project Area

Common Name	Scientific Name[1]	Habitat Type[1]
Desert shrew	*Notiosorex crawfordi*	Desert with adequate hiding/nest cover
Western pipistrelle	*Pipistrellus hesperus*	Desert with nearby cliffs or rock outcrops; summer only
Big brown bat	*Eptesicus fuscus*	Pine forests to desert with caves, mine shafts, or saguaro cavities for roosting; summer only
Pallid bat	*Antrozous pallidus*	Desert with buildings, bridges, mine shafts, or cliffs for roosting
Brazilian free-tailed bat	*Tadarida brasiliensis*	Desert with caves or mine shafts
Desert cottontail	*Sylvilagus audubonii*	Desert to juniper woodlands in areas with dense shrub cover
Black-tailed jackrabbit	*Lepus californicus*	Desert to juniper woodlands
Harris' antelope squirrel	*Ammospermophilus harrisii*	Saltbush-creosote bush-bursage desert
Round-tailed ground squirrel	*Spermophilus tereticaudus*	Creosote-bush-saltbush desert
Botta's pocket gopher	*Thomomys bottae*	All environments with adequate plant cover
Arizona pocket mouse	*Perognathus amplus*	Sonoran, and Mojave deserts
Little pocket mouse	*Perognathus longimembris*	Sandy creosote bush desert
Desert pocket mouse	*Perognathus penicillatus*	Sonoran desert
Rock pocket mouse	*Chaetodipus intermedius*	Rocky areas of Sonoran desert
Desert kangaroo rat	*Dipodomys deserti*	Sandy areas of Sonoran desert
Merriam's kangaroo rat	*Dipodomys merriami*	Creosote bush-mesquite desert
Western harvest mouse	*Reithrodontomys megalotis*	Wide variety of environments with grassy or weedy areas
Cactus mouse	*Peromyscus eremicus*	Variety of desert environments
Southern grasshopper mouse	*Onychomys torridus*	Desert with mesquite and cacti
Arizona cotton rat	*Sigmodon arizonae*	Desert with mesquite
White-throated wood rat	*Neotoma albigula*	Wide variety of desert environments
Desert wood rat	*Neotoma lepida*	Variety of environments from creosote bush to pine
Coyote	*Canis latrans*	All environments
Kit fox	*Vulpes macrotis*	Desert with sandy or diggable clay soils
Gray fox	*Urocyon cinereoargenteus*	Wide variety of environments including open desert
Collared peccary	*Tayassu tajacu*	Sonoran desert with shrub and tree thickets and cactus patches
Mule deer	*Odocoileus hemionus*	Variety of environments from desert to pine forests

Source:
[1]Hoffmeister 1986

Table D-2

Common Bird Species Potentially Present in the Project Area[1]

Common Name	Scientific Name[2]	Habitat Type[3]
Red-tailed hawk	*Buteo jamaicensis*	Habitat variable
American kestrel	*Falco sparverius*	Open country
Gambel's quail	*Callipepla gambelii*	Desert scrublands and thickets
White-winged dove	*Zenaida asiatica*	Dense mesquite, mature citrus groves, riparian woodlands, saguaro-paloverde desert
Mourning dove	*Zenaida macroura*	Wide variety of habitats; often near drainages
Greater roadrunner	*Geococcyx californianus*	Scrub desert, mesquite groves
Great horned owl	*Bubo virginianus*	Habitat variable
Burrowing owl	*Athene cunicularia*	Open country
Lesser nighthawk	*Chordeiles acutipennis*	Dry open country, scrubland, desert
Common poorwill	*Phalaenoptilus nuttali*	Sagebrush and chaparral slopes
Costa's hummingbird	*Calypte costae*	Desert washes, dry chaparral
Gila woodpecker	*Melanerpes uropygialis*	Scrub desert, cactus country, streamside woods
Gilded flicker	*Colaptes chrysoides*	Low desert woodlands, saguaros
Ash-throated flycatcher	*Mylarchus cinerascens*	Wide variety of habitats
Western kingbird	*Tyrannus verticalis*	Dry open country
Loggerhead shrike	*Lanius ludovicianus*	Open or brushy areas
Common raven	*Corvus corax*	Variety of habitats
Verdin	*Aurilparus flaviceps*	Mesquite and other dense thorny shrubs or southwestern desert
Cactus wren	*Campylorhynchus brunneicapillus*	Cactus country and arid hillsides and valleys
Black-tailed gnatcatcher	*Polioptila melanura*	Desert resident, partial to washes
Northern mockingbird	*Mimus polyglottos*	Variety of habitats
European starling	*Sturnis vulgaris*	Wide variety of habitats
Curve-billed thrasher	*Toxostoma curvirostre*	Canyons, semiarid brushland
Phainopepla	*Phainopepla nitens*	Mesquite brushland
Lucy's warbler	*Vermivora luciae*	Mesquite and cottonwoods along watercourses
Black-throated sparrow	*Amphispiza bilineata*	Desert, especially rock slopes
Northern cardinal	*Cardinalis cardinalis*	Taller and denser Lower Sonoran brush[4]
Brown-headed cowbird	*Molothrus ater*	Woodlands, farmlands, suburbs
House finch	*Carpodacus mexicanus*	Habitat variable
Turkey vulture	*Cathartes aura*	Habitat variable
Northern harrier	*Circus cyaneus*	Habitat variable

Sources:
[1]Potential for occurrence based on Monson and Phillips 1981 and Witzeman et al. 1997
[2]American Ornithological Union 1998
[3]National Geographic Society 1999
[4]Monson and Phillips 1981

Table D-3

Reptile and Amphibian Species Potentially Present in the Project Area[1]

Common Name	Scientific Name	Habitat Type[2]
TOADS		
Couch spadefoot	*Scaphiopus couchi*	Shortgrass plains, mesquite savannah, creosote bush desert, and other areas of low rainfall
Western spadefoot	*Scaphiopus hammondii*	Washes, floodplains, alluvial fans, playas, alkali flats
Red-spotted toad	*Bufo punctatus*	Desert streams, open grassland and scrubland, oak woodland, rocky canyons
LIZARDS		
Western banded gecko	*Coleonyx variegatus*	Variety of habitats, from creosote bush flats to pinon-juniper belt
Desert iguana	*Dipsosaurus dorsalis*	Creosote bush desert
Zebratail lizard	*Callisaurus draconoides*	Washes, desert pavement, hardpan
Desert spiny lizard	*Sceloporus magister*	Arid/semiarid plains and lower mountain slopes
Side-blotched lizard	*Uta stansburiana*	Sand, rock, hardpan or loam with grass, shrubs, and scattered trees
Desert horned lizard	*Phrynosoma platyrhinos*	Sandy flats, alluvial fans, washes, dune edges
Western whiptail	*Cnemidophorus tigris*	Desert and semiarid areas with sparse vegetation
SNAKES		
Spotted leaf-nosed snake	*Phyllorhynchus decurtatus*	Open desert plains
Coachwhip	*Masticophis flagellum*	Variety of habitats
Western patch-nosed snake	*Salvadora hexalepis*	Grasslands, chaparral, sagebrush plains, pinon-juniper woodland, desert scrub
Glossy snake	*Arizona elegans*	Variety of open desert and grassland areas
Gopher snake	*Pituophis melanoleucus*	Variety of habitats
Common kingsnake	*Lampropeltis getulus*	Variety of habitats
Long-nosed snake	*Rhinocheilus lecontei*	Desert, prairies, shrubland
Ground snake	*Sonora semiannulata*	Arid and semiarid regions; river bottoms, desert flats, sand hummocks, rocky hillsides
Western shovel-nosed snake	*Chionactus occipitalis*	Washes, dunes, sandy flats, loose soils, rocky hillsides
Night snake	*Hypsiglena torquata*	Variety of habitats
Arizona coral snake	*Micruroides euryxanthus*	Arid and semiarid thornscrub, brushland, woodland, grassland, farmland
Western diamondback rattlesnake	*Crotalus atrox*	Variety of habitats in arid and semiarid regions
Sidewinder	*Crotalus cerastes*	Sand hummocks topped with creosote bushes, mesquite, or other desert plants; also windswept flats, barren dunes, hardpan, rocky hillsides

Sources:
[1]Potential for occurrence based on Stebbins 1985
[2]Stebbins 1985

Table D-4

Plant Species Potentially Present in the Project Area

Common Name	Scientific Name[1]	Habitat Type[2]
Red brome	*Bromus rubens*	Roadside and waste places
Arabian grass	*Schismus arabicus*	Sandy soil
Mediterranean grass	*Schismus barbatus*	Open desert
Wingscale	*Atriplex canescens*	Sandy, sometimes saline soil
Quail brush	*Atriplex lentiformes*	Moist or dry saline soil
All scale	*Atriplex polycarpa*	Moderately saline to nonsaline soil
Russian thistle[3]	*Salsola iberica*	Roadsides, overgrazed ranges
Yellow tansy mustard	*Descurainia pinnata*	Open ground
London rocket	*Sisymbrium irio*	Abundant in irrigated areas
Catclaw acacia[3]	*Acacia greggi*	Along streams and washes
Velvet mesquite[3]	*Prosopis velutina*	Along watercourses, on grasslands and lower mountain slopes
Blue paloverde[3]	*Cercidium floridum*	Along washes, on floodplains
Filaree	*Erodium cicutarium*	Common on plains and mesas
Creosote bush[3]	*Larrea tridentata*	Dry plains and mesas
Corona de Cristo	*Castela emoryi*	Desert plains
Graythorn	*Ziziphus obtusifolia*	Dry mesa, plains, slopes
Alkali pink, globe mallow	*Sphaeralcea spp.*	Roadsides, fields, edges of sandy washes, well-drained slopes
Tamarisk, salt cedar[3]	*Tamarix pentandra*	Along streams
Wolfberry	*Lycium spp.*	Washes and dry slopes in desert or semidesert areas
Desert willow	*Chilopsis linearis*	Along washes in deserts and foothills
Triangle-leaf bursage	*Ambrosia deltoidea*	Plains and mesas
White bursage[3]	*Ambrosia dumosa*	Dry plains and mesas
Desert broom[3]	*Baccharis sarothroides*	Hillsides and bottomlands, sometimes in saline soil
Alkali goldenbush	*Isocoma acradenius*	Various habitats, often in saline soils
Jimmy weed	*Isocoma heterophyllus*	Mesas and plains, often in saline soil and on overgrazed rangeland
Prickly lettuce	*Lactuca serriola*	Waste land and roadsides
Bermuda grass[3]	*Cynodon dactylon*	Fields, washes, disturbed sites
Pigweed[3]	*Amaranthus sp.*	Disturbed sites
Cholla cactus[3]	*Opvutia sp.*	Creosote bush flats, washes
Brittle bush	*Encelia farinosa*	Creosote bush flats, washes
Nightshade[3]	*Solanum sp.*	Disturbed sites, fields
Purslane[3]	*Portulaca sp.*	Disturbed sites, fields
Ragweed[3]	*Ambrosia sp.*	Disturbed sites, fields, washes

Sources:
[1]Lehr 1978
[2]Kearney and Peebles 1960
[3]Observed during November 1999 site visit

EXHIBIT E
SCENIC AREAS, HISTORIC SITES AND STRUCTURES, AND ARCHAEOLOGICAL SITES

EXHIBIT E
SCENIC AREAS, HISTORIC SITES AND STRUCTURES, ARCHAEOLOGICAL SITES

As stated in Arizona Corporation Commission Rules of Practice and Procedure R14-3-219:

"Describe any existing scenic areas, historic sites and structures or archaeological sites in the vicinity of the proposed facilities and state the effects, if any, the proposed facilities will have thereon."

SCENIC AREAS AND VISUAL RESOURCES

The visual resource study addressed the inherent aesthetics of the landscape, public value of viewing the landscape, and sensitivity to visual effects from the proposed project. The visual analysis was conducted by Duke Energy-Flour Daniel in late 1999 and included an evaluation of the existing visual conditions, scenic quality, and visual sensitivity.

The project area is located within the Basin and Range physiographic province in southwest Arizona (USDA 1989). More specifically it is within the Sonoran Desertscrub – Lower Colorado Subdivision (Lowe 1964). The topographic features within and surrounding the project area can be characterized as flat, with isolated hills occurring within 1 to 2 miles of the proposed project. The Palo Verde Hills and Yellow Medicine Hills are located 5 to 7 miles northwest and southwest of the project, respectively. The White Tank Mountains and Gila Bend Mountains occur 12 to 15 miles northeast and south of the project, respectively. The average elevation above mean sea level is approximately 875 feet in the project area.

The vegetation in the project vicinity is dominated by agricultural land and creosote bush flats. Along Winters Wash and Centennial Wash, located east and south of the plant site, respectively, mesquite, salt cedar, ironwood, and acacia dominate the landscape. The proposed project site is located on vacant agricultural land and the transmission line corridor crosses agricultural land, creosote bush flats, and a riparian area associated with Winters Wash.

At present, the most dominant man-made features within the project area include the PVNGS, high-voltage transmission line corridors, numerous above-ground electrical subtransmission and distribution lines, a distribution substation, the Union Pacific Railroad, a few occupied residences and unoccupied structures, concrete irrigation canals, abandoned structures, paved and unpaved road surfaces, range gates, signs, as well as other man-made elements (e.g., abandoned water tanks) that have significantly altered the natural setting.

Visual Quality

The scenic value or visual quality of the landscape is a function of the attributes or amenities that naturally occur within that setting (land forms, rock formations, topography, presence of water, vegetation patterns) which add to or diminish its value. Within the project area, the landscape is lacking in natural amenities and could be described as common or non-distinctive. Exhibit E-1 provides a photograph of the proposed project site looking southwest from the northeast corner of the plant site property, near Elliott Road.

Sensitive Viewpoints

The sensitivity of a viewpoint reflects the degree of public concern for change in the scenic quality of the landscape visible from that location. Sensitivity is measured by evaluating the type of viewpoint and viewer concern for change in the landscape, volume of use, viewing duration, public concerns, and influence of adjacent land use. Sensitive viewpoints that were identified within the project area include residences and the old U.S. 80. Exhibit E-2 presents a photosimulation of the proposed power plant facility looking southwest from the northeast corner of the plant site property, near Elliott Road.

Residences - Residences are considered high sensitivity viewpoints since their occupants have a high concern for change in the landscape and have long-term viewing conditions. There are two ranch residents located approximately 0.7 to 0.8 mile northwest of the proposed project site. It is anticipated that residential views of the proposed project would be unobstructed due to insufficient topographic variances to effectively screen the site. However, the presence of existing high-voltage transmission lines between these viewers and the proposed project site has already altered the landscape setting.

Another 2 ranch residences are located approximately 1.0 to 1.5 miles west and northwest of the proposed project site. A residential area is located approximately 1.8 miles west-northwest of the project site. Variation in topography between the proposed project and these residences will partially screen the majority of the power plant. It is anticipated that portions of the stacks will be visible from these residences.

Large-scale residential and supporting infrastructure (schools, regional parks, churches, retail services) developments are not expected to occur in the reasonable foreseeable future within the project area. The majority of lands within the immediate vicinity of the proposed project are currently planned for Rural Residential High-Density use. According to Maricopa County's *Tonopah Area Land Use Plan*, this residential category denotes areas where single-family residential development is desirable but urban services (e.g., water, sewer, schools, parks, law

EXHIBIT E-1, PHOTOGRAPH OF THE PROPOSED PROJECT SITE

EXHIBIT E-2. PHOTOSIMULATION OF THE PROPOSED POWER PLANT FACILITY

enforcement, fire protection) are limited. The County is currently drafting an update to the County Plan (see Exhibit B-3, Land Use Study).

Travel Routes – The old U.S. 80 alignment has not been designated by the State Historic Preservation Office as being eligible as a listed historic property. Further, the distance from this road to the proposed project site is in excess of 2 miles. It is not anticipated that the proposed project will significantly affect this road.

Mitigation

In an effort to blend with the background landscape setting, dark hues of browns, greens, and grays will be utilized to the extent feasible in the painting of the proposed project facility.

REFERENCES

Lowe, Charles H. 1964. *Arizona's Natural Environment.* The University of Arizona Press: Tucson, Arizona.

U.S. Department of Agriculture. 1989. Landscape Character Types of the National Forests in Arizona and New Mexico.

U.S. Geological Survey. 1981. 1:100,000 Scale Metric Topographic Map of Phoenix South, Arizona.

HISTORIC SITES AND STRUCTURES AND ARCHAEOLOGICAL SITES

Methods

In November 1999, a comprehensive literature search and records review were conducted by the Arizona State Museum and through the Arizona State Historic Preservation Office. The file search identified previously completed cultural resources surveys, all previously recorded archaeological sites and historic properties listed on the National Register of Historic Places (NRHP), and previously recorded standing structures situated within a 2-mile radius of the proposed project site, which encompasses the proposed transmission line corridor. The goal of the review was to determine whether the construction and operation of the proposed project might affect archaeological or historic cultural resources.

Findings

The review of agency and museum files documented 8 cultural resource surveys previously conducted within a 2-mile radius of the project site (Table E-1). The earliest of these surveys was conducted in 1972 and 1973 at geotechnical boring locations associated with the PVNGS. The plant site and buffer zone were intensively surveyed and the results were summarized in a report (Trott 1974). This report does not document the full extent and methods of this survey work, but a large block encompassing approximately 8,360 acres apparently was surveyed intensively (Stein 1981). At least 31 archaeological and historical sites were identified and recorded within this block, and 22 additional sites were recorded in adjacent areas. These sites include aboriginal archaeological sites containing approximately 20 lithic scatters, 10 trails, 2 petroglyphs, 5 rock enclosures, and 16 historic sites consisting primarily of 1920's-1930's homestead remnants. Five of these sites, designated AZ T:9:25, 27, 29, 37, and 49 (MNA), are located within a 2-mile radius of the proposed project site, but not within the project site.

In 1975, studies were conducted at 13 sites to mitigate the impacts of construction of the PVNGS (Stein 1981). Two of these sites, AZ T:9:25 (MNA) and AZ T:9:29 (MNA), are aboriginal archaeological sites recorded by Trott (1974) and are located within a 2-mile radius of the proposed project site, but not within the project site. Site AZ T:9:25 (MNA) consists of seven rock enclosures ranging from circular to rectangular in form; no artifacts or other cultural remains were found in association with these rock enclosures. Site AZ T:9:29 (MNA) consists of a trail leading up the southwestern side of a basalt hill; one plainware sherd was located at the base of the trail. The function of the trail is interpreted as an intaglio art-form rather than a transportation route.

In 1976, the Museum of Northern Arizona surveyed two alternate transmission line corridors that extend from the PVNGS to the Colorado River (Berry 1978). Of the 73 recorded sites, only two (AZ T:9:21 and 22[ASM]) are located within a 2-mile radius of the proposed project site; neither of these lie within the project site. Both sites are identified as temporary camps of Patayan cultural affiliation. The sites contain numerous basalt lithics, millingstone fragments, flakes, and ceramics. Neither of the sites is recommended as eligible to the NRHP due to off-road vehicle disturbance and cattle grazing trails.

Several studies were conducted for the transmission lines that were constructed to connect the PVNGS to the regional power grid. Surveys for the Palo Verde-Kyrene line (Powers et al. 1978) covered a 200-foot-wide corridor that falls within a 2-mile radius of the proposed project site, but not within the project site. The survey documented a single site, AZ T:9:5 (ASM), located on the south side of Centennial Wash. The site is a scatter of fewer than 50 artifacts including a few pieces of flaked stone and six types of ceramic sherds, including both Hohokam and Patayan varieties.

Table E-1 Previous Cultural Resource Surveys			
Project Name and Number	**Scope**	**Sites**	**Reference**
All American pipeline survey	145 miles x 200 feet (3,515 acres)	none within 2-mile radius of project site	Batcho 1985
Palo Verde-Devers transmission line survey	190 miles x 400 feet (9,212 acres)	AZ T:9:21 and 22 (ASM) within 2-mile radius; not within project site	Berry 1978
Yuma 500kV transmission line	119.8 miles x 200 feet (2,904 acres)	AZ T:9:1, 2, and 3 (ASM) within 2-mile radius; not within project site	Effland and Green 1982
All American pipeline survey	95 miles x 200 feet (2,303 acres)	None in 2-mile radius	Higgins and Brunson 1985
Palo Verde to Kyrene transmission line	73.3 miles x 100-330 feet (~1,777 acres)	AZ T:9:5 (ASM) not within 2-mile radius of project site	Powers et al 1978
PacifiCorp turbine pipeline survey	6.8 miles x 200 feet (165 acres)	none within 2-mile radius	Rogge and Darrington 1994
Devers-Palo Verde transmission line No. 2 survey	385 acres	AZ R:8:61 (ASM), AZ S:6:20 and 21 (ASM); none within 2-mile radius	Swartz and Dongoske 1987
Palo Verde plant survey	9,300 acres	AZ T:9:25, 27, 29, 37, and 49 (MNA) within 2-mile radius; not within project site	Trott 1974

In 1981, twenty-three cultural resources were inventoried during the intensive 100 percent survey of the Yuma 500 kV transmission line (Effland and Green 1982). Three sites (AZ T:9:1, 2, and 3) are located within a 2-mile radius of the proposed project site; none of these sites lie within the project site. Site AZ T:9:1 (ACS) is an historic homestead circa 1920's - 1930's and includes structures in various stages of disrepair, irrigation canals, and domestic debris. AZ T:9:2 (ACS) is the site of the Crag railroad station building complex (dismantled) and associated debris. The remaining site, AZ T:9:3 (ACS) is an aboriginal lithic scatter consisting of cores, flakes, and angular waste occurring in low densities. None of the sites is recommended as eligible to the NRHP.

Two pedestrian surveys were conducted by New Mexico State University for the All American Pipeline right-of-way. The first survey was conducted in the spring of 1985 between Oracle, Arizona and a point 145 miles to the west (Batcho 1985). The survey resulted in the documentation of 13 sites, 9 low-density artifact scatters, and 49 isolated occurrences. None of the recorded sites is located within a 2-mile radius of the proposed project site. Between March and August 1985, the second cultural resources survey was conducted between Ward Road and a point 95 miles to the west (Higgins and Brunson 1985). The inventory identified 20 sites and 25 isolated occurrences. Aboriginal lithic debris, rock rings, and trails without artifacts characterize nineteen of the 20 sites. The remaining site is the La Paz Pumping Station in which 3 small modern rock cairns were discovered. None of the sites is situated within a 2-mile radius of the project site.

The Institute for American Research conducted a non-collection survey for the Devers-Palo Verde No. 2 Transmission Line in May to June of 1987 (Swartz and Dongoske 1987). Thirty-four previously recorded sites were located and three additional sites were recorded. The 3 newly recorded sites (AZ R:8:61, AZ S:6:20 and 21[ASM]) are characterized by prehistoric lithic scatter of unknown cultural affiliation and a single trail segment with no artifacts or additional features. None of the 37 sites lies within a 2-mile radius of the project site.

In 1994, a Class III cultural resource survey was conducted for the Pacificorp Turbine Pipeline Project Wintersburg Alternatives (Rogge and Darrington 1994). No archaeological sites, isolated finds, or other types of cultural resources were encountered during the survey.

Conclusion

A total of 11 archaeological and historic sties have been discovered within a 2-mile radius of the proposed project site, but not within the project site and transmission line corridor. Nine of these are aboriginal sites, consisting of lithic scatters, or features such as trails, intaglios, rock enclosures, and hearths. One site appears to be the remnants of a homestead dating to the first half of the twentieth century, and the remaining site is the historic Crag railroad station. No traditional cultural properties were identified.

Today, the significance of archaeological, historical, and traditional cultural properties commonly is evaluated by using the criteria (36 CFR 60.4 [a-d]) for inclusion on the National Register of Historic Places and the counterpart Arizona Register of Historic Places. Criteria for both of these registers are essentially the same. When the PVNGS studies were conducted in the late 70s, the use of register criteria to evaluate significance was not standard procedure. However, field

recommendations for further study in order to mitigate project impacts or protect resources in situ are a good indication of resource significance.

Of the 11 sites located within a 2-mile radius of the project, mitigation studies were conducted on 5 sites, 5 sites were recommended as not eligible for inclusion to the NRHP, and the remaining site was not recommended for further study.

Many of the aboriginal archaeological sites were found along major washes or clustered around the volcanic hills scattered throughout the area. The proposed project site and the disturbance areas associated with the transmission line lack both of these topographic features. In addition, no aboriginal sites were found within those portions of the proposed project area that had been farmed.

In summary, little potential exists for the proposed project to affect significant archaeological or historical sites. A cultural resources pedestrian survey at the proposed plant site and within the transmission line corridor will be conducted in early 2000 in order to ensure that impacts to cultural resources will be avoided or mitigated.

REFERENCES:

Batcho, D. G. 1985. A Preliminary Report of Archaeological Sites found along the All American Pipeline Right-of-Way between Oracle, Arizona and a Point 145 Miles to the west. Cultural Resources Management Division, Sociology and Anthropology Department, New Mexico State University, Las Cruces, New Mexico.

Berry, C. 1978. Archaeological Investigations Southern California Edison Palo Verde-Devers 500 kV Transmission Line, Palo Verde Nuclear Generating Station to the Colorado River. Museum Of Northern Arizona, Department of Anthropology.

Effland, R. W. and M. Green. 1982. Cultural Resource Investigations for the Yuma 500kV Transmission Line, Arizona Public Service Company. Cultural Resources Report 14.

Higgins, H. C. and J. Brunson. 1985. A Preliminary Report of Archaeological Sites found along the All American Pipeline Right-of-Way between Ward Road in Maricopa County, Arizona and a Point 95 Miles to the West. New Mexico State University, Las Cruces.

Powers, M. A., M. J. Keane and D. E. Weaver, Jr. 1978. An Archaeological Survey of the Palo Verde to Kyrene 500kV Transmission Line, Maricopa County, Arizona. Museum of Northern Arizona, Flagstaff, Arizona.

Rogge, A. E. and G. P. Darrington. 1994. PacifiCorp Turbine Pipeline Project Wintersburg Alternatives: A Class III Cultural Resource Survey. Dames & Moore, Phoenix, Arizona.

Stein, P. H. 1981. The Palo Verde Archaeological Investigations: Part 1, Aboriginal Resources at the Palo Verde Plant Site: Part 2, Wintersburg: An Archaeological, Archival and Folk Account of Homesteading in Arizona. Research Paper 21. Museum of Northern Arizona, Flagstaff.

Swartz, D. and K. Dongoske. 1987. Cultural Resource Assessment of Construction Locations and Towers along the Devers-Palo Verde No. 2 Transmission Line, Western Arizona. Technical Report No. 87-7. Institute for American Research, Tucson, Arizona.

Trott, J. J. 1974. Final Report for Phase II Investigations at the Palo Verde Hills Plant Site Location (A-75-141). Museum of Northern Arizona, Flagstaff.

EXHIBIT F
RECREATIONAL PURPOSES AND ASPECTS

EXHIBIT F
RECREATIONAL PURPOSES AND ASPECTS

As stipulated in Arizona Corporation Commission Rules of Practice and Procedure R14-3-219:

"State the extent, if any, the proposed site or route will be available to the public for recreational purposes, consistent with safety considerations and regulations and attach any plans the applicant may have concerning the development of the recreational aspects of the proposed site or route."

RECREATIONAL PURPOSES AND ASPECTS

Duke is unaware of any official approved plans for the development of additional recreational facilities within the vicinity of the proposed project. The construction, operation, and maintenance of proposed project facilities will be consistent with safety considerations, and will not be open to public access.

EXHIBIT G
CONCEPT OF PROJECT FACILITIES

EXHIBIT G
CONCEPT OF PROJECT FACILITIES

As stated in Arizona Corporation Commission Rules of Practice and Procedure R14-3-219:

"Attach any artist's or architect's conception of the proposed plant or transmission line structures and switchyards which applicant believes may be informative to the committee."

Exhibit G-1: Conceptual drawing of power plant similar to Duke's proposed plant facility

Exhibit G-2: Drawing of typical transmission line tower

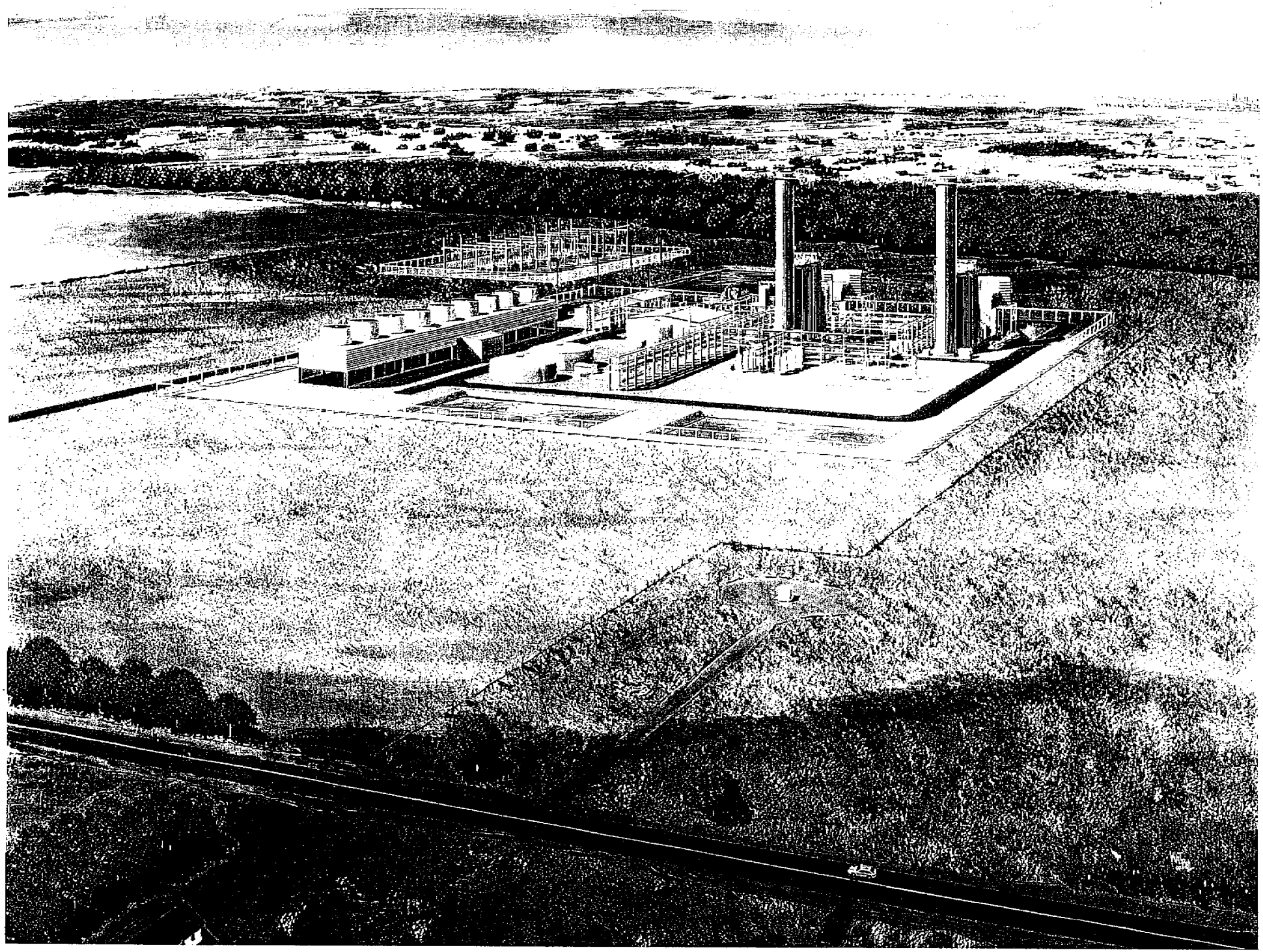

EXHIBIT G-1. CONCEPTUAL DRAWING OF POWER PLANT FACILITY

STANDARD 525 KV SINGLE CIRCUIT STEEL TOWER

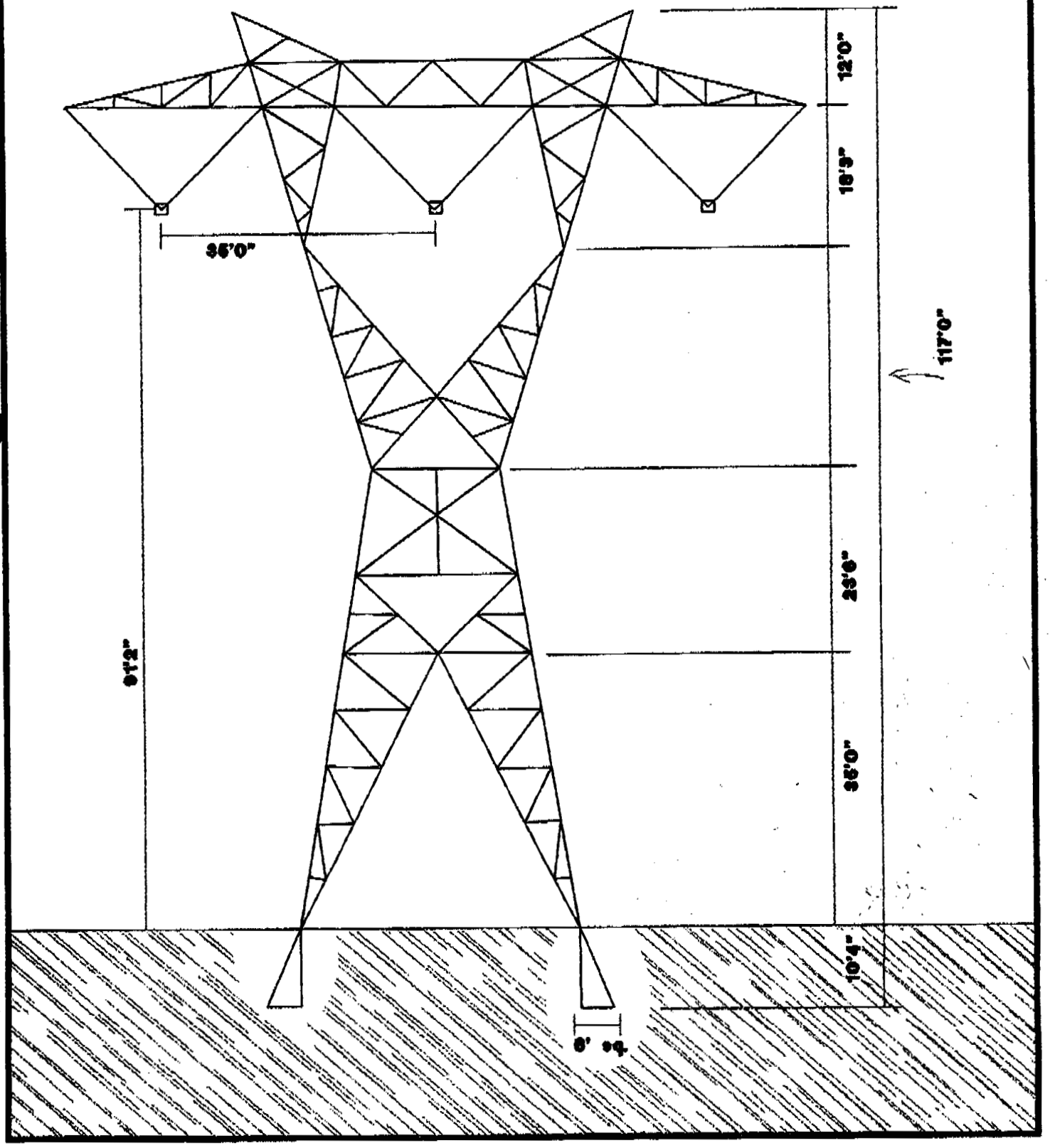

EXHIBIT G-2. DRAWING OF TYPICAL TRANSMISSION LINE TOWER

EXHIBIT H
EXISTING PLANS

EXHIBIT H
EXISTING PLANS

As stated in Arizona Corporation Commission Rules of Practice R-14-3-219:

"To the extent applicant is able to determine, state the existing plans of the state, local government and private entities for other developments at or in the vicinity of the proposed site or route."

Existing and future land uses are described in Exhibits A and B-3. A records search conducted at Maricopa County's Planning and Development Department revealed that no residential subdivisions or other developments have been approved for the area immediately surrounding the proposed project. Only two residential subdivisions (Horseshoe Trails and Horseshoe Trails Phase II) have been approved within a two-mile radius of the project site.

A proposed satellite switchyard (Palo Verde South) will be located approximately 1.5 miles east of the proposed power plant, immediately south of Elliot Road (near the intersection of Elliot Road and 375th Avenue). This switchyard will be flanked by the existing Kyrene and North Gila 500kV transmission lines). Preliminary plans indicate that the Palo Verde South switchyard will provide interconnections for new and existing transmission lines as an alternative to direct connections with the existing PVNGS switchyard.

Based on information received to date, Duke is unaware of any other planned developments within the vicinity of the proposed project other than merchant power plants proposed by other companies.

EXHIBIT I

ANTICIPATED NOISE/INTERFERENCE WITH COMMUNICATION FACILITIES

EXHIBIT I
ANTICIPATED NOISE/INTERFERENCE WITH COMMUNICATION FACILITIES

As stated in Arizona Corporation Commission Rules of Practice and Procedures R14-3-219:

"Describe the anticipated noise emission levels and any interference with communication signals which will emanate from the proposed facilities."

ANTICIPATED NOISE

The expected noise levels generated during full load operation of the proposed project at the nearest residences have been evaluated by means of a detailed analytical noise model. The model results indicate that plant noise will be insignificant at all of the residential locations within 2 miles of the project site.

There are 4 private residences and 1 residential area located outside the project site and within a 2-mile radius of the site. Plant noise emissions were modeled for each of these locations. The locations of the nearest occupied residences and the expected noise levels from the facility operating at base load are provided below.

Table I-1
Anticipated Facility Noise Emissions
At the Nearest Residences

	Potential Sensitive Noise Receptor Location	Expected Plant Noise Level During Full Load Operation in Decibels (dBA)
1	Single residence approximately 3,450 feet (0.7 mile) northwest from center of the facility	43
2	Single residence approximately 4,200 feet (0.8 mile) north-northwest from center of the facility	42
3	Single residence approximately 4,900 feet (0.9 mile) west from center of the facility	36
4	Single residence approximately 7,380 feet (1.4 miles) north-northwest from center of the facility	32
5	A Residential Area with it's center approximately 9,500 feet (1.8 miles) west-northwest from center of the facility	27

The low noise levels are basically attributable to the large distances between the project facilities and the receptor points. Despite the remote location of the site and the strong likelihood that current background sound levels are quite low, the probability of disturbance from such sound levels is negligible. On an absolute scale sound levels in the vicinity of 25 dBA are virtually inaudible and are beyond the detection capabilities of the human ear as well as many sound level meters. Under normal circumstances plant noise should be negligible regardless of the existing ambient sound level and no adverse impact is expected at any of the residences evaluated.

The noise modeling was conducted by Vibranalysis, Inc. in November 1999. The methodology used to model plant emissions was to break the project facilities down into an extensive list of individual noise sources and calculate the relative contribution of each component, as well as the total noise level from the project, at the receptor locations. The model calculates the propagation losses that occur with respect to each source over the line of sight between it and the receptor in accordance with ISO 9613 *Attenuation of Sound During Propagation Outdoors* and other studies in the professional literature on acoustics.

In general, the validity of this modeling has been verified on a number of other projects by comparing the actual emissions of similar power plants at a particular far field location to the predicted levels at the same position. The results yielded by the model are considered realistic and practices used to produce the model have been approved by the industry.

INTERFERENCE WITH COMMUNICATION SIGNALS

No interference with communication signals will be caused by the project.

EXHIBIT J
SPECIAL FACTORS

EXHIBIT J
SPECIAL FACTORS
PUBLIC INVOLVEMENT PROGRAM

The public involvement program for the proposed project was initiated once Duke formally announced its intention to construct a gas-fired electric power plant and associated transmission line near Arlington in Maricopa County, Arizona (Exhibit J-1). This public involvement was initiated by Duke and consisted of contact with local regulators and community leaders. These efforts were undertaken in an attempt to provide information to the public and seek preliminary feedback regarding any potential issues or areas of concern. Exhibit J-2 includes the Questions and Answers information package distributed during public meetings held at Arlington Valley Elementary School on October 7 and December 9, 1999. Public feedback forms are included in Exhibit J-3. An economic and fiscal impact study also has been conducted and is attached as Exhibit J-4.

Potential issues or questions raised during the public involvement program (based on public feedback forms) include:

- Plant visibility
- Open space
- Reclamation
- Water requirements and use
- Light pollution
- Transmission line towers
- Safety and emergency planning
- Pollution
- Community interest
- Job opportunities
- Project location rationale
- Cultural resources
- Benefits to schools and community
- Utility costs

EXHIBIT J-1

PUBLIC INFORMATION - PROJECT ANNOUNCEMENT LETTER

Duke Energy North America
A Duke Energy Company
Arlington Valley Energy
P. O. Box 26
Arlington, AZ 85322
(623) 386-7243

November 11, 1999

Dear Resident of Arlington Valley:

Duke Energy North America is in the process of planning the construction and operation of a clean, gas-fired electric power plant in Arlington Valley. On October 7th, we held a community meeting at the Arlington Valley Elementary School. We were pleased with the turnout and the questions we received regarding our project.

This was just the first of a series of meetings we intend to host relating to our project. Our next meeting is scheduled for December 9, 1999 from 5:00 - 8:00 PM in the cafeteria of the Arlington Valley Elementary School. This meeting will feature a series of stations staffed by our DENA team, detailing various aspects of the project:

- Duke Energy North America and our reputation in the energy industry
- Renderings of the Arlington Valley Energy, state-of-the-art combined-cycle power plant
- Information on the environmental aspects of the plant relating to water use and air emissions
- Economic benefits of the project to the County
- A map specifying where the plant will be located.

I hope you can attend the meeting on December 9th. Food and childcare will be provided.

If you have any questions about our event, please call Kevin Richardson in Arlington Valley at (623) 386-7243. Or, write to us at:

Arlington Valley Energy
PO Box 26
Arlington, AZ 85322

I look forward to visiting with you in December.

Sincerely,

Max Shilstone
Project Manager
Arlington Valley Energy
(602) 258-0822

EXHIBIT J-2

PUBLIC INFORMATION - QUESTIONS AND ANSWERS

Duke Energy North America
A Duke Energy Company

Duke Energy North America
A Duke Energy Company

Arlington Valley Energy
P. O. Box 26
Arlington, AZ 85322
(623) 386-7243

Answers To Your Questions About Arlington Valley Energy

Who is Duke Energy North America?

Duke Energy North America (DENA) is the North American unregulated power plant development arm of Duke Energy Corporation, a worldwide energy company with more than $29 billion in assets. Duke Energy reaches into more than 50 countries, producing energy, transporting energy, marketing energy and providing energy services.

In the United States, Duke Energy companies:

- provide electric service to approximately two million customers in North Carolina and South Carolina
- operate interstate pipelines that deliver natural gas to various regions of the country
- are leading marketers of electricity, natural gas and natural gas liquids.

Further information about Duke Energy North America can be found on the Internet at www.duke-energy.com.

Why does DENA want to build a power plant in the Arlington Valley?

DENA has had a team working to develop a power plant in the Arlington Valley area for more than one year. The Arlington Valley has numerous advantages to unregulated wholesale power plant developers. It has available land, a large natural gas pipeline running through the valley to provide fuel for the plant, a large transmission system nearby to tie into so the plant can provide low-cost and environmentally-friendly electricity to Arizona and the southwest.

What happened to regulated utilities in Arizona and how can DENA sell wholesale electricity in Arizona?

In 1992, the United States Congress passed legislation to deregulate the wholesale electricity market. Like the legislation that deregulated the telephone and trucking industries, electricity deregulation was by driven high prices – and the thought that competition would bring prices down for electricity consumers.

Since Arlington Valley Energy will be able to produce power 40% more efficiently than existing power plants, it will be able to sell into the market more cheaply. This is exactly what Congress had in mind in 1992. And, since the power plant is being built at no risk to customers,

Duke Energy North America
A Duke Energy Company

they have nothing to loose and everything to gain.

Regulated utilities will still own the electric transmission and distribution lines and provide customer service. They will benefit from Arlington Valley Energy's low-cost electricity because it will lower their operating expenses. Ultimately these savings should be passed on to customers in the form of cheaper retail electricity.

Continued from Page 1

Arlington Valley cotton farm.

To gain access to more than enough groundwater to operate the power plant, DENA has purchased, or has acquired options to purchase, approximately 2,800 acres of Arlington Valley land. The majority of this land is not currently being farmed and has been out of production for many years. DENA had done extensive research using qualified hydrologists to ensure that our operations will not harm Arlington Valley area water supplies in any way.

What are the air emissions of the power plant?

Since Arlington Valley Energy will use clean-burning natural gas as a fuel and state-of-the-art combined-cycle technology, its emissions will be a fraction of what people have come to expect from power plants. Nitrogen oxide emissions, the primary cause of smog and the most closely watched emissions by regulators, will be only 3 parts per million. This is almost too low to measure and compares very favorably to many existing power plants using older technology and emitting nitrogen oxide at 100 parts per million or more.

How much water does Arlington Valley Energy need and where is it coming from?

The maximum amount of water that Arlington Valley Energy will need (calculated at the maximum possible operating level of 24 hours per day, 365 days a year) is 6,700 acre feet annually. This is approximately the same amount needed to irrigate a 1400 to 1600 acre

What type of power plant is DENA planning to build?

Arlington Valley Energy is a 550 megawatt combined-cycle natural gas fueled power plant that will use the latest technology to generate electricity 40% more efficiently than traditional power plants in use today. The plant is very compact and much smaller than traditional power plants. It consists of the following primary structures:

- Two industrial-size 170 megawatt natural gas turbines, approximately 30 feet tall.

Duke Energy North America
A Duke Energy Company

- Two heat recovery steam generators (modern version of a power plant boiler) that will be approximately 85 feet tall.
- Two stacks that are 18 feet in diameter and approximately 160 feet tall.
- A 210 megawatt steam turbine that will use the 1,200° waste heat from the natural gas turbines. This heat is "recycled" by blowing it into the boiler to drive the steam turbine. The left-over heat is discharged from the stacks at only 225°. This turbine is also about 30 feet tall.

DENA will do extensive landscaping around the plant's 40 acre site, which is located within a 320 acre tract of land off of Elliot Road, about two miles west of the Palo Verde Nuclear Station. We will also be consulting with local residents about management practices for the company's approximate remaining 2,500 acres in the Arlington Valley.

Has DENA built many other combined-cycle merchant power plants?

DENA is one of a handful of energy companies building merchant wholesale power plants in areas of the United States that have high-priced electricity, and we believe that we are the best at what we do. We currently have combined-cycle power plants that are virtually identical to the Arlington Valley Energy project under construction in Veazie, Maine and Edinburg, Texas. We have also recently completed construction of a plant in Bridgeport, Connecticut.

In each of these communities we have an excellent working relationship with local governments and our operations have been enthusiastically received. In addition, we have about a dozen other power plant projects currently under development throughout the United States.

Continued from Page 2

What company will build Arlington Valley Energy?

Duke Energy North America
A Duke Energy Company

Arlington Valley Energy will be built by Duke Fluor Daniel, an affiliate of DENA that has built more combined-cycle power plants than any other company in the world.

Our relationship with Duke Fluor Daniel is indicative of the edge DENA has over its competitors – we bring the full strength of our company's business units to every project we undertake:

- Duke Energy North America will develop and own the plant
- Duke Fluor Daniel will build and operate the plant
- Duke Engineering & Services will handle much of the engineering
- Duke Trading & Marketing will purchase the natural gas for the plant and sell the electricity on the wholesale market.

Each of these DENA business units is among the very best in the industry. No other energy company can bring this much expertise to it's own power plant projects in a single package.

Does DENA plan to help local schools and other worthy groups?

DENA recognizes the value and importance of being a good corporate citizen. Our Arlington Valley team has already begun a partnership with Arlington Valley Elementary by donating 10 high quality computers and printers to the school. In addition, our DENA team will personally provide computer training for the teachers and administrators. We view this as the beginning of a long-term partnership with the school.

DENA has a long tradition of developing very successful relationships in the communities in which we operate - not just because we believe

Duke Energy North America
A Duke Energy Company

it's the right thing to do but because it's in our best interest to be involved members of the community where our employees live and work.

DENA is looking forward to a long and strong relationship with the Arlington Valley community.

EXHIBIT J-3

PUBLIC FEEDBACK FORMS

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting.

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy	5
Leaning about Arlington Valley Energy	5
Having your interests and concerns addressed	9
Hearing the interests and concerns of others	

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes X No_____ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments:
SEE ATTACHMENT

3. What is your opinion of the Arlington Valley Energy Project?

very desirable X desirable_____ ok_____ undesirable_____

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations	3
Letters to community	2
Internet	1
Newspaper	4

5. What groups or organizations do you think we should keep informed about Arlington Energy?

Would you like to be on our mailing list? If so, please fill in the information below

Name: NEIL A.M. PETERS

Address PO BOX 57 ARLINGTON AZ 85322

Email Address PETERSN@USWEST.NET

Telephone (602) 242-2631

PLANT VISIBILITY

1. PREFERED - TAKE ADVANTAGE of SHAPES etc AND COLOR ACCORDINGLY -
2. IF YOU MUST MAKE THE PLANT INVISIBLE THEN FIVE SHADES of GRAY WILL DO THE TRICK

OPEN SPACE

THIS IS THE BIG PLUS FACTOR. RETURN THE LAND BACK TO DESSERT, USE WATER HARVESTING METHODS, WORK WITH LOCAL (MARICOPA) DESSERT MUSEUMS & GARDENS, DIVERT SMALL % OF WATER INTO WINTERS WASH.

LANDSCAPE

AVOID TRYING TO HIDE THE PLANT. USE INDUSTRIAL LAWN ART AT YOUR ENTRANCE. I WOULD LIKE TO WORK WITH YOU ON THIS. THIS COULD BE A JOINT ADVENTURE.

NEIL A.M. PETERS

¡ NECESITAMOS SUS COMENTARIOS !

Gracias por visitarnos esta tarde. Sus comentarios tienen mucho valor para nosotros. Por favor tome unos minutos para proveernos sus comentarios sobre la información presentada en ésta junta comunitaria.

1. ¿De cuanto uso fue la información compatida acerca de la compañía Duke Energy y nuestro proyecto de Arlington Valley Energy? En terminos de (0-de ningun uso, 5-algo de uso, 10 de mucho uso)

Aprender sobre Duke Energy 10
Aprender sobre Arlington Valley Energy 10
Que sus intereses o preocupaciones fueron atendidos ____
Escuchar los intereses de otros ____

2. ¿Sus intereses o preocupaciones de Arlington Valley Energy fueron atendidos a su satisfación?

Sí ✓ No____ (Si su respuesta fue no, por favor indique en el espacio abajo lo que Duke Energy podria hacer para atenderlos)
Comentarios:

3. ¿Que es su opinion del Proyecto de Arlington Valley Energy?

Muy deseable___ deseable ✓ mas o menos___ no deseable____

4. ¿Como le gustaria recibir información tocante el proyecto de modernización en el futuro?
(Por favor apunte en orden de preferencia del 1 a 4)

Presentaciones de grupo____
Cartas a la comunidad ✓
Internet ____
Periodico ____

5. ¿Cuales grupos o organizaciones piensa Usted que deberiamos mantener informados sobre Arlington Energy?

¿Le gustaria estar en la lista de correspondencia? Si gusta estar en la lista, por favor llene la información abajo.

Nombre: María R Martínez
Domicilio Po Box 554.
Domicilio de Email Tonapah AZ. 85354.
Numero de Telefono 372-2270

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting.

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy	10
Leaning about Arlington Valley Energy	10
Having your interests and concerns addressed	10
Hearing the interests and concerns of others	10

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes ✓ No_____ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments: Jobs in the community - Partnerships with schools

3. What is your opinion of the Arlington Valley Energy Project?

very desirable_____ desirable ✓ ok_____ undesirable_____

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations	1
Letters to community	2
Internet	4
Newspaper	3

5. What groups or organizations do you think we should keep informed about Arlington Energy?

Would you like to be on our mailing list? If so, please fill in the information below

Name: Jim McLaughlin

Address P.O. Box 123, Arlington Ariz

Email Address

Telephone (623) 386-2999

Arlington Valley Energy

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting.

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy	5
Leaning about Arlington Valley Energy	5
Having your interests and concerns addressed	9
Hearing the interests and concerns of others	

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Yes X No_____ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments:
SEE ATTACHMENT

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very desirable X desirable_____ ok_____ undesirable_____

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Letters to community	2
Internet	1
Newspaper	4

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Name: NEIL A.M. PETERS

Address PO BOX 57 ARLINGTON AZ 85322

Email Address PETERSN@USWEST.NET

Telephone (602) 242-2631

Arlington Valley Energy

PLANT VISIBILITY

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Learning about Duke Energy	10
Leaning about Arlington Valley Energy	10
Having your interests and concerns addressed	10
Hearing the interests and concerns of others	10

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes ✓ No_____ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments: Jobs in the community - Partnerships with schools

3. What is your opinion of the Arlington Valley Energy Project?

very desirable_____ desirable ✓ ok_____ undesirable_____

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations	1
Letters to community	2
Internet	4
Newspaper	3

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Name: Jim McLaughlin

Address P.O. Box 123, Arlington Ariz

Email Address

Telephone (623) 386-2999

Arlington Valley Energy

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Aprender sobre Duke Energy 10
Aprender sobre Arlington Valley Energy 10
Que sus intereses o preocupaciones fueron atendidos ____
Escuchar los intereses de otros ____

2. ¿Sus intereses o preocupaciones de Arlington Valley Energy fueron atendidos a su satisfación?

Sí ✓ No____ (Si su respuesta fue no, por favor indique en el espacio abajo lo que Duke Energy podria hacer para atenderlos)
Comentarios:

3. ¿Que es su opinion del Proyecto de Arlington Valley Energy?

Muy deseable___ deseable ✓ mas o menos___ no deseable____

4. ¿Como le gustaria recibir información tocante el proyecto de modernización en el futuro?
(Por favor apunte en orden de preferencia del 1 a 4)

Presentaciones de grupo____
Cartas a la comunidad ✓
Internet ____
Periodico ____

5. ¿Cuales grupos o organizaciones piensa Usted que deberiamos mantener informados sobre Arlington Energy?

¿Le gustaria estar en la lista de correspondencia? Si gusta estar en la lista, por favor llene la información abajo.

Nombre: María R. Martínez
Domicilio Po Box 554.
Domicilio de Email Tonopah AZ. 85354.
Numero de Telefono 372-2370

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting.

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy	5
Leaning about Arlington Valley Energy	9
Having your interests and concerns addressed	10
Hearing the interests and concerns of others	5

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes ✓ No_____ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments:

3. What is your opinion of the Arlington Valley Energy Project?

very desirable ✓ desirable_____ ok_____ undesirable_____

PLANT VISIBILITY. TAKE ADVANTAGE OF SHAPES & COLOR. OPEN SPACE: RETURN THE LAND BACK TO THE NATURE DESERT. LANDSCAPE DON'T HIDE THE PLANT. INDUST. LAWN A

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations	3
Letters to community	2
Internet	1
Newspaper	4

5. What groups or organizations do you think we should keep informed about Arlington Energy?

Would you like to be on our mailing list? If so, please fill in the information below

Name: DONNA L. STAGGS

Address: PO BOX 57 ARLINGTON, AZ 85322

Email Address_____

Telephone 602-242-2631

Arlington Valley Energy

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting.

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy	10
Leaning about Arlington Valley Energy	10
Having your interests and concerns addressed	10
Hearing the interests and concerns of others	10

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes ✓ No_____ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments: Water Requirements Towers
Site
Light Pollution

3. What is your opinion of the Arlington Valley Energy Project?

very desirable ✓ desirable_____ ok_____ undesirable_____

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations	1.
Letters to community	2
Internet	3
Newspaper	4

5. What groups or organizations do you think we should keep informed about Arlington Energy? Arlington Area School, Neighbors

Would you like to be on our mailing list? If so, please fill in the information below

Name: George Doughty

Address P.O. Box 7

Email Address Clowns7297@AOL.Com

Telephone (623) 386-6688

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting.

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy	8
Leaning about Arlington Valley Energy	8
Having your interests and concerns addressed	8
Hearing the interests and concerns of others	8

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes ✓ No_____ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments:

3. What is your opinion of the Arlington Valley Energy Project?

very desirable 10 desirable_____ ok_____ undesirable_____

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations	1
Letters to community	2
Internet	4
Newspaper	3

5. What groups or organizations do you think we should keep informed about Arlington Energy? Community

Would you like to be on our mailing list? If so, please fill in the information below

Name:_____

Address_____

Email Address_____

Telephone_____

Arlington Valley Energy

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting.

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy	10
Leaning about Arlington Valley Energy	10
Having your interests and concerns addressed	10
Hearing the interests and concerns of others	10

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes ✓ No_____ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments:

3. What is your opinion of the Arlington Valley Energy Project?

very desirable_____ desirable_____ ok ✓ undesirable_____

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations	1
Letters to community	2
Internet	4
Newspaper	3

5. What groups or organizations do you think we should keep informed about Arlington Energy? farmers & general citizen

Would you like to be on our mailing list? If so, please fill in the information below

Name:_____

Address_____

Email Address_____

Telephone_____

Arlington Valley Energy

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting.

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy	10
Leaning about Arlington Valley Energy	10
Having your interests and concerns addressed	8
Hearing the interests and concerns of others	10

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes ___ No X (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments: Safety Records, Emergency Planning (has any formed), Constructions, Revolutions of Water (7-15 times) How Many

3. What is your opinion of the Arlington Valley Energy Project?

very desirable ___ desirable ___ ok X undesirable ___

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations	X
Letters to community	X
Internet	
Newspaper	

5. What groups or organizations do you think we should keep informed about Arlington Energy? community, schools, SITE COMMITEE

Would you like to be on our mailing list? If so, please fill in the information below

Name: Martina Chaffin

Address P.O. Box 23 Arlington, Az 85322

Email Address

Telephone 602 761-4302

Arlington Valley Energy

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting.

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy _____
Leaning about Arlington Valley Energy _____
Having your interests and concerns addressed _____
Hearing the interests and concerns of others _____

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes X No_____ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments: Would like to see desert trees planted & WATER used for this project. Would like to see landscape depicting what project is about IE: TURBINE engines etc.

3. What is your opinion of the Arlington Valley Energy Project?

very desirable X desirable_____ ok_____ undesirable_____

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations X
Letters to community X
Internet X
Newspaper X

5. What groups or organizations do you think we should keep informed about Arlington Energy?

Would you like to be on our mailing list? If so, please fill in the information below

Name: Patti Kuhn

Address PO Box 245 Arlington, AZ 85322

Email Address PattiK1298@cs.com

Telephone 623-386-4067

Arlington Valley Energy

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting.

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy	7
Leaning about Arlington Valley Energy	7
Having your interests and concerns addressed	10
Hearing the interests and concerns of others	10

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes ✓ No_____ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments:

3. What is your opinion of the Arlington Valley Energy Project?

very desirable X desirable_____ ok_____ undesirable_____

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations	1
Letters to community	2
Internet	3
Newspaper	4

5. What groups or organizations do you think we should keep informed about Arlington Energy? I think you should form a community panel.

Would you like to be on our mailing list? If so, please fill in the information below

Name: Virginia (Ginger) Hammock

Address HCR 3, Box 113, Arlington, AZ 85322

Email Address gingerhehuitt-zollars.com

Telephone 602-920-7331 cell-602-952-9128

Arlington Valley Energy

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting.

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy Mail
Leaning about Arlington Valley Energy Mail
Having your interests and concerns addressed Yes
Hearing the interests and concerns of others ✓

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes ✓ No_____ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments: Would like mail to keep up on project.

3. What is your opinion of the Arlington Valley Energy Project?

very desirable ✓ desirable_____ ok_____ undesirable_____

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations ✓
Letters to community ✓
Internet _____
Newspaper _____

5. What groups or organizations do you think we should keep informed about Arlington Energy?

Would you like to be on our mailing list? If so, please fill in the information below

Name: Chuck & Kathleen Schlessman

Address HC3 Box 112, Arlington, Az, 85322

Email Address off Grid

Telephone 602 881-9466

Arlington Valley Energy

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting.

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy	5
Leaning about Arlington Valley Energy	5
Having your interests and concerns addressed	5
Hearing the interests and concerns of others	10

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes ✓ No_____ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments:

3. What is your opinion of the Arlington Valley Energy Project?

very desirable_____ desirable_____ ok ✓ undesirable_____

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations	1 ✓
Letters to community	2 ✓
Internet	3
Newspaper	4

5. What groups or organizations do you think we should keep informed about Arlington Energy?

Would you like to be on our mailing list? If so, please fill in the information below

Name: KEN Finchum

Address 15905 S. OLD U.S Hwy 80 ARLington

Email Address_____

Telephone 386-2696

Arlington Valley Energy

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting.

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy _____
Leaning about Arlington Valley Energy _____
Having your interests and concerns addressed _____
Hearing the interests and concerns of others _____

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes X No_____ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments:

3. What is your opinion of the Arlington Valley Energy Project?

very desirable X desirable____ ok____ undesirable____

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations 4
Letters to community ____
Internet 4
Newspaper 4

5. What groups or organizations do you think we should keep informed about Arlington Energy?

Would you like to be on our mailing list? If so, please fill in the information below

Name: Judy Richardson

Address 34401 W. Desert Rose RD Arlington

Email Address Jrich1967@yahoo.com

Telephone 623-386-7243

Arlington Valley Energy

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting.

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy	10
Leaning about Arlington Valley Energy	10
Having your interests and concerns addressed	10
Hearing the interests and concerns of others	10

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes ✓ No_____ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments:

3. What is your opinion of the Arlington Valley Energy Project?

very desirable ✓ desirable_____ ok_____ undesirable_____

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations	1
Letters to community	2
Internet	4
Newspaper	3

5. What groups or organizations do you think we should keep informed about Arlington Energy? COMMUNITY AS A WHOLE

Would you like to be on our mailing list? If so, please fill in the information below

Name: BILL LANFORD

Address P.O. Box 75 BUCKEYE, AZ 85326 HOME 30051 W. OLD U.S. 80 PALO VERDE 85343

Email Address FARMANFIRE@AOL.COM

Telephone 623-386-5906

Arlington Valley Energy

¡ NECESITAMOS SUS COMENTARIOS !

Gracias por visitarnos esta tarde. Sus comentarios tienen mucho valor para nosotros. Por favor tome unos minutos para proveernos sus comentarios sobre la información presentada en ésta junta comunitaria.

1. ¿De cuanto uso fue la información compatida acerca de la compañía Duke Energy y nuestro proyecto de Arlington Valley Energy? En terminos de (0-de ningun uso, 5-algo de uso, 10 de mucho uso)

Aprender sobre Duke Energy	10
Aprender sobre Arlington Valley Energy	10
Que sus intereses o preocupaciones fueron atendidos	10
Escuchar los intereses de otros	10

2. ¿Sus intereses o preocupaciones de Arlington Valley Energy fueron atendidos a su satisfación?

Sí ✓ No____ (Si su respuesta fue no, por favor indique en el espacio abajo lo que Duke Energy podria hacer para atenderlos)
Comentarios:

3. ¿Que es su opinion del Proyecto de Arlington Valley Energy?

Muy deseable ✓ deseable___ mas o menos___ no deseable____

4. ¿Como le gustaria recibir información tocante el proyecto de modernización en el futuro?
(Por favor apunte en orden de preferencia del 1 a 4)

Presentaciones de grupo	1
Cartas a la comunidad	2
Internet	4
Periodico	3

5. ¿Cuales grupos o organizaciones piensa Usted que deberiamos mantener informados sobre Arlington Energy? TODO HOMBRES!

¿Le gustaria estar en la lista de correspondencia? Si gusta estar en la lista, por favor llene la información abajo.

Nombre: GUILLERMO LANFORD
Domicilio P.O. Box 75 BUCKEYE, AZ 85326
Domicilio de Email
Numero de Telefono 623-386-5900

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting.

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy 8
Leaning about Arlington Valley Energy 8
Having your interests and concerns addressed 9
Hearing the interests and concerns of others 0 didn't really hear others concerns

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes X No_____ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments:

3. What is your opinion of the Arlington Valley Energy Project?

very desirable_____ desirable_____ ok X undesirable_____

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations 1
Letters to community 2
Internet 4
Newspaper 3

5. What groups or organizations do you think we should keep informed about Arlington Energy? Arlington CATS, Lions, School & community

Would you like to be on our mailing list? If so, please fill in the information below

Name: Chris Larson

Address P.O. Box 194 Arlington, AZ 85322

Email Address

Telephone 623-386-6253

Arlington Valley Energy

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting.

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy	10
Leaning about Arlington Valley Energy	8
Having your interests and concerns addressed	10
Hearing the interests and concerns of others	10

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes X No_____ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments:

3. What is your opinion of the Arlington Valley Energy Project?

very desirable_____ desirable X ok_____ undesirable_____

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations	2
Letters to community	4
Internet	4
Newspaper	1

5. What groups or organizations do you think we should keep informed about Arlington Energy?

Would you like to be on our mailing list? If so, please fill in the information below

Name: Carrie Mayhew

Address 35939 W. Buckeye Rd. TONOPAH 85354

Email Address SEEBEAR@JUNO.COM

Telephone (623) 386-5467

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting.

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy	5
Leaning about Arlington Valley Energy	5
Having your interests and concerns addressed	10
Hearing the interests and concerns of others	5

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes_____ No ✓ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments: Water usage, OSHA Fines, pollution + Community interest.

3. What is your opinion of the Arlington Valley Energy Project?

very desirable_____ desirable_____ ok_____ undesirable ✓

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations	1
Letters to community	2
Internet	4
Newspaper	3

5. What groups or organizations do you think we should keep informed about Arlington Energy? County, Schools, + newspaper (local) + Post Office

Would you like to be on our mailing list? If so, please fill in the information below

Name: Sally Bigg

Address P.O. Box 1696 Tonopah, Az. 85354

Email Address_____

Telephone_____

Arlington Valley Energy

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting.

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy 10
Leaning about Arlington Valley Energy 10
Having your interests and concerns addressed
Hearing the interests and concerns of others

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes ✓ No ____ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments:

3. What is your opinion of the Arlington Valley Energy Project?

very desirable ✓ desirable ____ ok ____ undesirable ____

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations ____
Letters to community 4
Internet ____
Newspaper ____

5. What groups or organizations do you think we should keep informed about Arlington Energy?

Would you like to be on our mailing list? If so, please fill in the information below

Name: Donec/Elisa Bigbay

Address 9640 S. Sun-up Blvd
Tonopah. AZ 85354

~~Email Address~~

Telephone

Arlington Valley Energy

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting.

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy	10
Leaning about Arlington Valley Energy	10
Having your interests and concerns addressed	10
Hearing the interests and concerns of others	10

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes ✓ No_____ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments:

Partnerships with schools - Jobs in the community

3. What is your opinion of the Arlington Valley Energy Project?

very desirable_____ desirable ✓ ok_____ undesirable_____

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations	2
Letters to community	1
Internet	4
Newspaper	3

5. What groups or organizations do you think we should keep informed about Arlington Energy?

Would you like to be on our mailing list? If so, please fill in the information below

Name: Mandi J Martin

Address PO Box 123 Arlington, AZ 85322

Email Address

Telephone 623-386-2999

Arlington Valley Energy

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting.

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy	10
Leaning about Arlington Valley Energy	10
Having your interests and concerns addressed	10
Hearing the interests and concerns of others	10

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes X No_____ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments:
THANKS FOR THE NICE DINNER!
NEED MORE INFO ON WHAT YOU ARE BUILDING HERE?
(UNINCORPORATED?) (GROUND WATER, CHEAP LAND?)

3. What is your opinion of the Arlington Valley Energy Project?

very desirable_____ desirable_____ ok X undesirable_____

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations	2
Letters to community	1
Internet	4
Newspaper	3

5. What groups or organizations do you think we should keep informed about Arlington Energy?

Would you like to be on our mailing list? If so, please fill in the information below

Name: PATRICK DOMZALSKI

Address P. O. BOX 269 ARLINGTON, AZ 85322

Email Address_____

Telephone_____

Arlington Valley Energy

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting.

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy	5
Leaning about Arlington Valley Energy	0
Having your interests and concerns addressed	10
Hearing the interests and concerns of others	10

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes_____ No_X_____ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments:

3. What is your opinion of the Arlington Valley Energy Project?

very desirable_____ desirable_____ ok_____ undesirable_____

ASK ME A YEAR FROM NOW

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations	2
Letters to community	1
Internet	4
Newspaper	3

5. What groups or organizations do you think we should keep informed about Arlington Energy?

Would you like to be on our mailing list? If so, please fill in the information below

Name: FRANK MARTINEZ

Address P. O. BOX 12

Email Address ARLington AZ 85322

Telephone_____

Arlington Valley Energy

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting.

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy	5
Leaning about Arlington Valley Energy	5
Having your interests and concerns addressed	5
Hearing the interests and concerns of others	5

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes X No_____ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments:
- LANDSCAPING → LAWN ART → ARTIFACTS

3. What is your opinion of the Arlington Valley Energy Project?

very desirable X desirable_____ ok_____ undesirable_____

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations	3
Letters to community	1
Internet	2
Newspaper	4

5. What groups or organizations do you think we should keep informed about Arlington Energy?

Would you like to be on our mailing list? If so, please fill in the information below

Name: NEIL PETERS

Address PO BOX 57 ARLINGTON AZ 85322

Email Address PETERSN@USWEST.NET

Telephone 602-242-2631 VOICE & FAX

Arlington Valley Energy

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting.

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy	5
Leaning about Arlington Valley Energy	5
Having your interests and concerns addressed	5
Hearing the interests and concerns of others	10

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes ✓ No_____ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments:

3. What is your opinion of the Arlington Valley Energy Project?

very desirable ✓ desirable_____ ok_____ undesirable_____

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations	1
Letters to community	3
Internet	4
Newspaper	2

5. What groups or organizations do you think we should keep informed about Arlington Energy?

Would you like to be on our mailing list? If so, please fill in the information below

Name: DONNA STAGGS

Address PO BOX 57 ARLINGTON ARIZ 85322

Email Address

Telephone 602-242-2631

Arlington Valley Energy

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting.

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy	8
Leaning about Arlington Valley Energy	10
Having your interests and concerns addressed	10
Hearing the interests and concerns of others	10

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes X No_____ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments: Put box letter

3. What is your opinion of the Arlington Valley Energy Project?

very desirable X desirable____ ok____ undesirable____

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations	3
Letters to community	1
Internet	N/A
Newspaper	N/A

Box holder

5. What groups or organizations do you think we should keep informed about Arlington Energy?

Would you like to be on our mailing list? If so, please fill in the information below

Name: Patti Kuhn

Address PO Box 245 / 13816 S 337th Ave

Email Address Arlington, Az. 85322

Telephone (623) 386 4067

Arlington Valley Energy

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting. .

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy	5
Leaning about Arlington Valley Energy	10
Having your interests and concerns addressed	5
Hearing the interests and concerns of others	10

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes_____ No X (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments: Have you looked into Water Treatment Facilities to recycle wastewater for plant use? Protect our valley. School needs computers, improvements, books for library.

3. What is your opinion of the Arlington Valley Energy Project?

very desirable X desirable____ ok____ undesirable____

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations	1
Letters to community	2
Internet	3
Newspaper	4

5. What groups or organizations do you think we should keep informed about Arlington Energy?

Would you like to be on our mailing list? If so, please fill in the information below

Name: Maria M. Chaffin

Address P.O. Box 23, Arlington, Az 85322

Email Address —

Telephone (xxx) xxx - xxxx

Arlington Valley Energy

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting.

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy	5
Leaning about Arlington Valley Energy	5
Having your interests and concerns addressed	5
Hearing the interests and concerns of others	5

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes_____ No_____ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments: Need time to take it in.

Please go to the Community (CATS Club) (School Board, Lions Club) to decide how to help the School

3. What is your opinion of the Arlington Valley Energy Project?

very desirable_____ desirable_____ ok ✓ undesirable_____

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations	X	1
Letters to community	X	2
Internet		4
Newspaper	X	3

5. What groups or organizations do you think we should keep informed about Arlington Energy? Arlington School Community Lions Club CATS Club

Would you like to be on our mailing list? If so, please fill in the information below

Name: Buck Larson

Address P.O. Box 194 Arlington, AZ 85322

Email Address

Telephone 623-386-6253

Arlington Valley Energy

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting.

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy	5
Leaning about Arlington Valley Energy	5
Having your interests and concerns addressed	5
Hearing the interests and concerns of others	10

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes X No_____ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments:

— Please Contact School Board —

3. What is your opinion of the Arlington Valley Energy Project?

very desirable_____ desirable_____ ok_____ undesirable X

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations	✓
Letters to community	✓
Internet	✓
Newspaper	✓

5. What groups or organizations do you think we should keep informed about Arlington Energy? School board Lion club Cats club

Would you like to be on our mailing list? If so, please fill in the information below

Name: Travis Guble

Address PO Box 226 Arlington Az 85322

Email Address_____

Telephone_____

Arlington Valley Energy

¡ NECESITAMOS SUS COMENTARIOS !

Gracias por visitarnos esta tarde. Sus comentarios tienen mucho valor para nosotros. Por favor tome unos minutos para proveernos sus comentarios sobre la información presentada en ésta junta comunitaria.

1. ¿De cuanto uso fue la información compatida acerca de la compañía Duke Energy y nuestro proyecto de Arlington Valley Energy? En terminos de (0-de ningun uso, 5-algo de uso, 10 de mucho uso)

Aprender sobre Duke Energy _____
Aprender sobre Arlington Valley Energy _____
Que sus intereses o preocupaciones fueron atendidos _____
Escuchar los intereses de otros _____

2. ¿Sus intereses o preocupaciones de Arlington Valley Energy fueron atendidos a su satisfación?

Sí ✓ No____ (Si su respuesta fue no, por favor indique en el espacio abajo lo que Duke Energy podria hacer para atenderlos)
Comentarios:

3. ¿Que es su opinion del Proyecto de Arlington Valley Energy?

Muy deseable___ deseable ✓ mas o menos ✗ no deseable____

4. ¿Como le gustaria recibir información tocante el proyecto de modernización en el futuro?
(Por favor apunte en orden de preferencia del 1 a 4)

Presentaciones de grupo____
Cartas a la comunidad ✓
Internet ✓
Periodico ✓

5. ¿Cuales grupos o organizaciones piensa Usted que deberiamos mantener informados sobre Arlington Energy?

¿Le gustaria estar en la lista de correspondencia? Si gusta estar en la lista, por favor llene la información abajo.

Nombre: HOMERO BOKE
Domicilio_____
Domicilio de Email_____
Numero de Telefono_____

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting.

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy	10
Leaning about Arlington Valley Energy	5
Having your interests and concerns addressed	5
Hearing the interests and concerns of others	10

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes ✓ No_____ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments:

3. What is your opinion of the Arlington Valley Energy Project?

very desirable ✓ desirable_____ ok_____ undesirable_____

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations	✓	1
Letters to community	✓	2
Internet	✓	4
Newspaper	✓	3

5. What groups or organizations do you think we should keep informed about Arlington Energy? Ranchers

Would you like to be on our mailing list? If so, please fill in the information below

Name: Ernesto Nevarez

Address P.O. box 163 Arlington AZ 85322

Email Address_____

Telephone 393-0282

Arlington Valley Energy

¡ NECESITAMOS SUS COMENTARIOS !

Gracias por visitarnos esta tarde. Sus comentarios tienen mucho valor para nosotros. Por favor tome unos minutos para proveernos sus comentarios sobre la información presentada en ésta junta comunitaria.

1. ¿De cuanto uso fue la información compatida acerca de la compañia Duke Energy y nuestro proyecto de Arlington Valley Energy? En terminos de (0-de ningun uso, 5-algo de uso, 10 de mucho uso)

Aprender sobre Duke Energy 5
Aprender sobre Arlington Valley Energy 5
Que sus intereses o preocupaciones fueron atendidos 10
Escuchar los intereses de otros 10

2. ¿Sus intereses o preocupaciones de Arlington Valley Energy fueron atendidos a su satisfación?

Sí ✓ No____ (Si su respuesta fue no, por favor indique en el espacio abajo lo que Duke Energy podria hacer para atenderlos)
Comentarios:

3. ¿Que es su opinion del Proyecto de Arlington Valley Energy?

Muy deseable___ deseable___ mas o menos ✓ no deseable____

4. ¿Como le gustaria recibir información tocante el proyecto de modernización en el futuro?
(Por favor apunte en orden de preferencia del 1 a 4)

Presentaciones de grupo 4
Cartas a la comunidad 4
Internet 2
Periodico 4

5. ¿Cuales grupos o organizaciones piensa Usted que deberiamos mantener informados sobre Arlington Energy? GILA BEND, BUCKEYE, PALO VERDE. AZ.

¿Le gustaria estar en la lista de correspondencia? Si gusta estar en la lista, por favor llene la información abajo.

Nombre: OSCAR A. PEREZ
Domicilio OLD US 80 ≈ (33602) #7 HOUSE
Domicilio de Email P.O. BOX 162, ARLINGTON AZ 85322.
Numero de Telefono (623)-386-93-32

¡ NECESITAMOS SUS COMENTARIOS !

Gracias por visitarnos esta tarde. Sus comentarios tienen mucho valor para nosotros. Por favor tome unos minutos para proveernos sus comentarios sobre la información presentada en ésta junta comunitaria.

1. ¿De cuanto uso fue la información compatida acerca de la compañia Duke Energy y nuestro proyecto de Arlington Valley Energy? En terminos de (0-de ningun uso, 5-algo de uso, 10 de mucho uso)

Aprender sobre Duke Energy _____
Aprender sobre Arlington Valley Energy _____
Que sus intereses o preocupaciones fueron atendidos _____
Escuchar los intereses de otros _____

2. ¿Sus intereses o preocupaciones de Arlington Valley Energy fueron atendidos a su satisfación?

Sí_____ No_____ (Si su respuesta fue no, por favor indique en el espacio abajo lo que Duke Energy podria hacer para atenderlos)
Comentarios:

3. ¿Que es su opinion del Proyecto de Arlington Valley Energy?

Muy deseable___ deseable___ mas o menos___ no deseable_____

4. ¿Como le gustaria recibir información tocante el proyecto de modernización en el futuro?
(Por favor apunte en orden de preferencia del 1 a 4)

Presentaciones de grupo_____
Cartas a la comunidad _____
Internet _____
Periodico _____

5. ¿Cuales grupos o organizaciones piensa Usted que deberiamos mantener informados sobre Arlington Energy?

¿Le gustaria estar en la lista de correspondencia? Si gusta estar en la lista, por favor llene la información abajo.

Nombre: Anacelia Soto
Domicilio P.O. BOX 54, ARLINGTON AZ 85322
Domicilio de Email_____
Numero de Telefono 623-386-1229

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting.

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy	10
Leaning about Arlington Valley Energy	10
Having your interests and concerns addressed	10
Hearing the interests and concerns of others	10

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes X No____ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments:
N/A

3. What is your opinion of the Arlington Valley Energy Project?

very desirable____ desirable X ok____ undesirable____

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations	2
Letters to community	1
Internet	4
Newspaper	3

5. What groups or organizations do you think we should keep informed about Arlington Energy?

Would you like to be on our mailing list? If so, please fill in the information below

Name: Anacelia Soto

Address P.O. Box 54, Arlington AZ 85322

Email Address

Telephone 623-386-1229

Arlington Valley Energy

¡ NECESITAMOS SUS COMENTARIOS !

Gracias por visitarnos esta tarde. Sus comentarios tienen mucho valor para nosotros. Por favor tome unos minutos para proveernos sus comentarios sobre la información presentada en ésta junta comunitaria.

1. ¿De cuanto uso fue la información compatida acerca de la compañía Duke Energy y nuestro proyecto de Arlington Valley Energy? En terminos de (0-de ningun uso, 5-algo de uso, 10 de mucho uso)

Aprender sobre Duke Energy ___YES___
Aprender sobre Arlington Valley Energy ___YES___
Que sus intereses o preocupaciones fueron atendidos ___YES___
Escuchar los intereses de otros ___—___

2. ¿Sus intereses o preocupaciones de Arlington Valley Energy fueron atendidos a su satisfación?

Sí __X__ No____ (Si su respuesta fue no, por favor indique en el espacio abajo lo que Duke Energy podria hacer para atenderlos)
Comentarios: ___—___

3. ¿Que es su opinion del Proyecto de Arlington Valley Energy?

Muy deseable __X__ deseable___ mas o menos___ no deseable____

4. ¿Como le gustaria recibir información tocante el proyecto de modernización en el futuro?
(Por favor apunte en orden de preferencia del 1 a 4)

Presentaciones de grupo __X__
Cartas a la comunidad ____
Internet ____
Periodico __X__

5. ¿Cuales grupos o organizaciones piensa Usted que deberiamos mantener informados sobre Arlington Energy?

¿Le gustaria estar en la lista de correspondencia? Si gusta estar en la lista, por favor llene la información abajo.

Nombre: Jose Hernandez C.
Domicilio PO BOX 336027 #7 House
Domicilio de Email PO BOX 162 Hollstow
Numero de Telefono 623 386 93-52

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting.

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy	5
Leaning about Arlington Valley Energy	6
Having your interests and concerns addressed	10
Hearing the interests and concerns of others	10

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes ✓ No_____ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments:

3. What is your opinion of the Arlington Valley Energy Project?

very desirable_____ desirable_____ ok ✓ undesirable_____

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations	1
Letters to community	
Internet	
Newspaper	

5. What groups or organizations do you think we should keep informed about Arlington Energy?

Would ~~you like to be~~ on our mailing ~~list?~~ If so, please fill in the information below

Name: Regina Ida Gordon

Address P. O. Box 136 Gila Bend Az 85337

Email Address

Telephone 623-386-7985

Arlington Valley Energy

Likert Scale

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting.

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy	10
Leaning about Arlington Valley Energy	5
Having your interests and concerns addressed	5
Hearing the interests and concerns of others	10

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes_____ No ✓ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments: I would like a greater overview of benefits, Arlington's wider benefits! Cheaper power?, More income for schools?, More community services!

3. What is your opinion of the Arlington Valley Energy Project?

very desirable_____ desirable ✓ ok_____ undesirable_____

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations	✓
Letters to community	
Internet	
Newspaper	

Arlington Farms desperately needs Street maintenance!

5. What groups or organizations do you think we should keep informed about Arlington Energy? Arlington Elem. School., All Residents,

Would you like to be on our mailing list? If so, please fill in the information below

Name:_____

Address P.O. Box 94, Arlington, Ariz. 85322

Email Address_____

Telephone 623-386-3641

Arlington Valley Energy

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting.

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy	5
Leaning about Arlington Valley Energy	5
Having your interests and concerns addressed	10
Hearing the interests and concerns of others	10

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes X No _____ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments:

3. What is your opinion of the Arlington Valley Energy Project?

very desirable_____ desirable X ok_____ undesirable_____

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations	1
Letters to community	2
Internet	0
Newspaper	2

5. What groups or organizations do you think we should keep informed about Arlington Energy?

Would you like to be on our mailing list? If so, please fill in the information below

Name: JIMMIE GARNER

Address P. O. Box 87 ARLINGTON, AZ 85322

Email Address

Telephone 386-2059

Arlington Valley Energy

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting.

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy 8
Leaning about Arlington Valley Energy 7
Having your interests and concerns addressed 7
Hearing the interests and concerns of others 6

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes ✓ No ✓ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments: Explain Total Water usage and Long Term Drawdown. The farms you are buying have always had water problems

3. What is your opinion of the Arlington Valley Energy Project?

very desirable____ desirable____ ok ✓ undesirable____

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations 3
Letters to community 3
Internet 2
Newspaper 2

5. What groups or organizations do you think we should keep informed about Arlington Energy?

Would you like to be on our mailing list? If so, please fill in the information below

Name: P.O. Lyle King

Address P.O. Box 713 Buckeye, AZ 85326

Home Location
~~Email~~ Address 28028 S 319 ave Arlington AZ

Telephone 602-393-0081

Arlington Valley Energy

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting.

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy 5
Leaning about Arlington Valley Energy 10
Having your interests and concerns addressed 10
Hearing the interests and concerns of others 10

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes ✓ No _____ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments:

3. What is your opinion of the Arlington Valley Energy Project?

very desirable_____ desirable_____ ok_____ undesirable_____

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations ✓
Letters to community _____
Internet _____
Newspaper _____

5. What groups or organizations do you think we should keep informed about Arlington Energy? Lions Club & PTA

Would you like to be on our mailing list? If so, please fill in the information below

Name: Les Meredith

Address Box 69 Arling AZ 85322

Email Address _____

Telephone _____

Arlington Valley Energy

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting.

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy 5
Leaning about Arlington Valley Energy 5
Having your interests and concerns addressed 10
Hearing the interests and concerns of others 5

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes ✓ No_____ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments:

3. What is your opinion of the Arlington Valley Energy Project?

very desirable_____ desirable_____ ok ✓ undesirable_____

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations ✓
Letters to community ✓
Internet
Newspaper ✓

5. What groups or organizations do you think we should keep informed about Arlington Energy? The Arlington Community.

Would you like to be on our mailing list? If so, please fill in the information below

Name: Grace Molino

Address P.O. Box 131 Arlington AZ 85322

Email Address

Telephone 623 393 0827

Arlington Valley Energy

We Want Your Feedback!

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1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy 10
Leaning about Arlington Valley Energy 10
Having your interests and concerns addressed 10
Hearing the interests and concerns of others 5

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes X No_____ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments:

3. What is your opinion of the Arlington Valley Energy Project?

very desirable_____ desirable_____ ok X undesirable_____

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations 1
Letters to community 2
Internet 4
Newspaper 3

5. What groups or organizations do you think we should keep informed about Arlington Energy? THE RANCHERS

Would you like to be on our mailing list? If so, please fill in the information below

Name: ROSA VALDEZ

Address P.O. BOX 113 ARLINGTON AZ. 85322

Email Address

Telephone (623) 393-0282

Arlington Valley Energy

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting.

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy	7
Leaning about Arlington Valley Energy	3
Having your interests and concerns addressed	10
Hearing the interests and concerns of others	10

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes ✓ No_____ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments:

you did a good job while under attack
Don't forget their are 2 Schools in the area

3. What is your opinion of the Arlington Valley Energy Project? Arlington Ruth Fisher

very desirable____ desirable ✓ ok____ undesirable____

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations ✓
Letters to community ✓ but not delivered by school Children to their homes
Internet ____
Newspaper ____

5. What groups or organizations do you think we should keep informed about Arlington Energy? build some nature areas or parks etc. to use your reclaimed water

Would you like to be on our mailing list? If so, please fill in the information below

Name:_____

Address_____

Email Address_____

Telephone_____

Arlington Valley Energy

We Want Your Feedback!

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1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy ___5___
Leaning about Arlington Valley Energy ___5___
Having your interests and concerns addressed ___5___
Hearing the interests and concerns of others ___5___

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes_____ No_____ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments:

3. What is your opinion of the Arlington Valley Energy Project?

very desirable ✓ desirable_____ ok_____ undesirable_____

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations ✓
Letters to community _____
Internet _____
Newspaper _____

5. What groups or organizations do you think we should keep informed about Arlington Energy?

Would you like to be on our mailing list? If so, please fill in the information below

Name: Richard L Roglin

Address Box 43 ARLINGTON, AZ

Email Address_____

Telephone 386-2704

Arlington Valley Energy

We Want Your Feedback!

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Learning about Duke Energy	7
Leaning about Arlington Valley Energy	5
Having your interests and concerns addressed	10
Hearing the interests and concerns of others	10

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Yes ✓ No_____ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments:

3. What is your opinion of the Arlington Valley Energy Project?

very desirable_____ desirable_____ ok ✓ undesirable_____

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations	
Letters to community	✓
Internet	
Newspaper	✓

5. What groups or organizations do you think we should keep informed about Arlington Energy?

Would you like to be on our mailing list? If so, please fill in the information below

Name: Jim + Susan Thorson

Address P.O. Box 324 Buckeye Az. 85326

Email Address

Telephone 602-399-0526

Arlington Valley Energy

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting.

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy	10
Leaning about Arlington Valley Energy	10
Having your interests and concerns addressed	10
Hearing the interests and concerns of others	10

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes Yes No_____ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments:

A Site Map would have been great! It really hurt not to have one.

3. What is your opinion of the Arlington Valley Energy Project?

very desirable X desirable_____ ok_____ undesirable_____

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations	3
Letters to community	2
Internet	X 1
Newspaper	4

5. What groups or organizations do you think we should keep informed about Arlington Energy?

Would you like to be on our mailing list? If so, please fill in the information below

Name: George Doughty

Address 13300 S 337th Ave, P.O. Box 1, Arlington, AZ 85322-0007

Email Address GDOU105608 Cs.Com / Clowns7297@AOL.Com

Telephone 623-386-6688

Arlington Valley Energy

PS: You Guys did good work in my opinion.

We Want Your Feedback!

Thank you for visiting with us this evening. We value your input. Please take a few minutes to provide us with your comments on the information provided at the community meeting.

1. How useful was the information shared with you about Duke Energy and our project Arlington Valley Energy? In terms of: (0-not useful, 5-somewaht useful, 10 very useful)

Learning about Duke Energy	10
Leaning about Arlington Valley Energy	10
Having your interests and concerns addressed	10
Hearing the interests and concerns of others	10

2. Were your interests and questions concerning Arlington Valley Energy addressed to your satisfaction?

Yes ✓ No_____ (If no, please indicate in the space provided below what Duke Energy could do to address them.)

Comments: HAVING THIS MEETING IS JUST THE START IN THE EDUCATION PROCESS FOR THIS COMMUNITY. I HAVE BEEN DRIVEN TO WATER ISSUES, HAVING SERVED ON THE BUCKEYE IRRIGATION BOARD. CONTINUE TO SHARE BENEFITS TO ARLINGTON.

3. What is your opinion of the Arlington Valley Energy Project?

very desirable_____ desirable ✓ ok_____ undesirable_____

4. How would you like to receive information regarding the modernization project in the future? (Please rank in order of your preference 1-4)

Group Presentations	✓
Letters to community	✓
Internet	✓
Newspaper	✓

5. What groups or organizations do you think we should keep informed about Arlington Energy? ALL LOCAL ORGANIZATIONS

Would you like to be on our mailing list? If so, please fill in the information below

Name: BILL LANFORD

Address P.O. BOX 75 BUCKEYE, AZ 85326

Email Address FARMANFIRE@ADL.COM

Telephone 623-386-5906

Arlington Valley Energy

EXHIBIT J-4

ECONOMIC AND FISCAL IMPACT STUDY

ECONOMIC AND FISCAL IMPACT OF DUKE ENERGY'S ELECTRIC GENERATING STATION ARLINGTON, ARIZONA

Prepared for:

Duke Energy

Prepared by:

Elliott D. Pollack and Company
7505 East Sixth Avenue, Suite 100
Scottsdale, AZ 85251

December 15, 1999

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Economic and Fiscal Impact
of
Duke Energy's Electric Generating Station
Arlington, Arizona

1.0 Executive Summary

Elliott D. Pollack and Company has been retained by Duke Energy to analyze the economic and fiscal impact of a proposed $250 million electric generating station to be located in a rural area southwest of the Town of Buckeye known as Arlington Valley. The plant will use natural gas as its primary fuel and will require a substantial quantity of water to generate steam. Approximately 2,800 acres of land will be purchased to provide a site for the plant and the water rights necessary to operate the facility. Construction is expected to start in February 2001, with completion slated for July 2002. The operation of the plant will generate 25 jobs.

While the investment by Duke Energy is estimated at $250 million, the local construction cost is estimated at about $67 million. Most of the cost of the generating station is associated with the purchase of gas and steam turbines that will be manufactured out of state.

The proposed Duke Energy electric generating station will be located in the Arlington Elementary and Buckeye Union High School Districts. Arlington Elementary (kindergarten through eighth grade) is a small district of approximately 155 students who are fed to the Buckeye Union District for secondary education. Buckeye Union has slightly over 1,000 students and serves a wide rural area of southwest Maricopa County.

This report will evaluate both the economic and fiscal effects of the proposed generating station. Economic impact analysis examines the regional implications of an activity in terms of three basic measures: sales or output, earnings and job creation. Fiscal impact analysis, on the other hand, evaluates the public revenues and costs created by a particular activity. In fiscal impact analysis, the primary revenue sources of a city, county or state are analyzed to determine how the activity may financially affect them. In addition, this report will evaluate the impact of the generating station on the Arlington Elementary and Buckeye Union High School Districts.

1.1 Economic Impact Summary

The economic impact of the Duke Energy generating station is substantial, resulting in the creation of nearly 643 total direct and indirect jobs annually during the two year construction period and 67 total direct and indirect jobs yearly during its operation. Local economic output during construction is $61.7 million annually and about $5

million per year thereafter. The project supports 577 households during construction and 60 households while in operation.

Table 1
Average Annual Economic Impact
Duke Energy Electric Generating Station
(in Inflated Dollars)

	Construction[1]	Operations[2]
Local Economic Output		
Direct output	$33,500,000	$3,877,000
Indirect output	$28,225,000	$1,496,000
Total output	$61,725,000	$5,373,000
Employment		
Direct jobs	298	25
Indirect jobs	345	42
Total jobs	643	67
Wages	$22,718,000	$1,849,500
Population		
Population supported by project	1,512	158
Households supported by project	577	60

[1]Annual total for each year of two year construction period.
[2]Average annual impact from 2003 - 2010.

Sources: IMPLAN; Duke Energy; Elliott D. Pollack & Co.

1.2 Fiscal Impact Summary

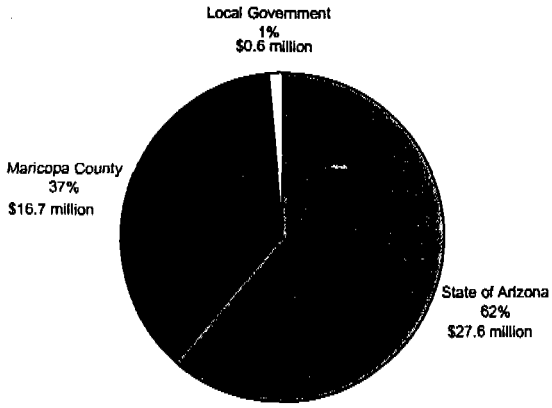
One of the major benefits of the generating station is the increase in the assessed value of the County and other taxing districts within which the plant is located. The projected assessed value of the generating station and land, when first placed in operation and before deducting depreciation, is $62 million. This represents approximately 0.3% of the total $18 billion 1999 assessed value of the County, a fairly significant figure given the size of the metro area. A project of this magnitude is equivalent to a new regional shopping mall or large manufacturing plant from the standpoint of property tax revenue, even though the plant's value will slowly decline over the years as it is depreciated.

The electric generating station produces significant positive effects for the State of Arizona and Maricopa County totaling nearly $45 million dollars between 2001 and 2010. The majority of the revenue, 62%, accrues to the State, but Maricopa County and its taxing districts also receive $16.7 million. The taxation of real property, construction contracts and natural gas consumption accounts for about 90% of the revenue. Impacts resulting from the spending of workers supported by the plant contribute another $4.5 million over the 10 years. During construction of the plant, approximately $5.8 million accrues to governmental entities. After completion of the generating station, total revenues reach $5 million annually.

Chart 1

Distribution of Revenues
From Duke Energy Electric Generating Station
2001 - 2010

Sources: Duke Energy, IMPLAN, AZ Dept. of Revenue, Maricopa County Assessor, Elliott D. Pollack & Co.



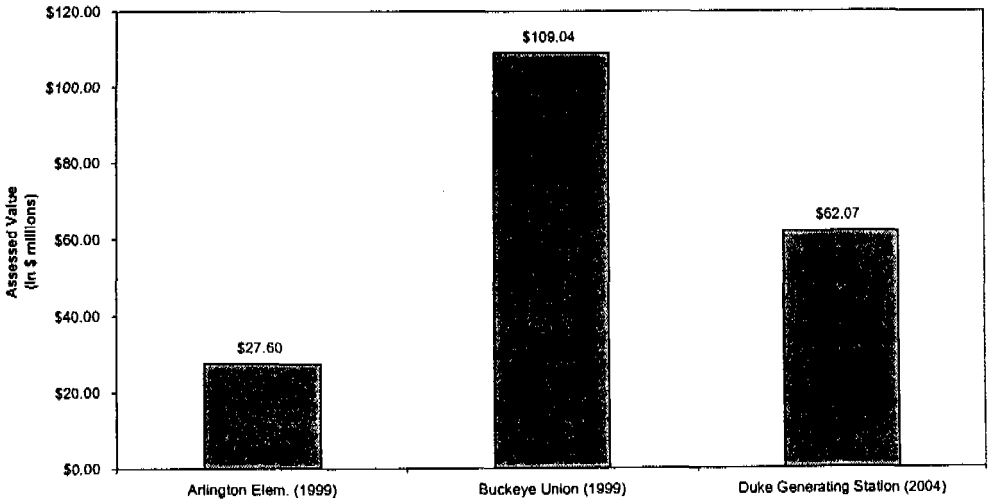
1.3 Impact on School Districts

A large capital investment such as that proposed by Duke Energy will have a significant impact on the assessed value and tax rates of a school district. With the high assessment ratio of 25% for utility companies, the financing of schools is transferred in many respects from local residents to private business. When the plant is completed and added to the tax rolls in 2004, its estimated assessed value will be $62 million. Comparatively, this represents 125% of Arlington Elementary's 1999 primary assessed value and 57% of Buckeye Union's 1999 value.

Chart 2

Comparison of Primary Assessed Values
Arlington Elementary District, Buckeye Union H. S. District, Duke Generating Station

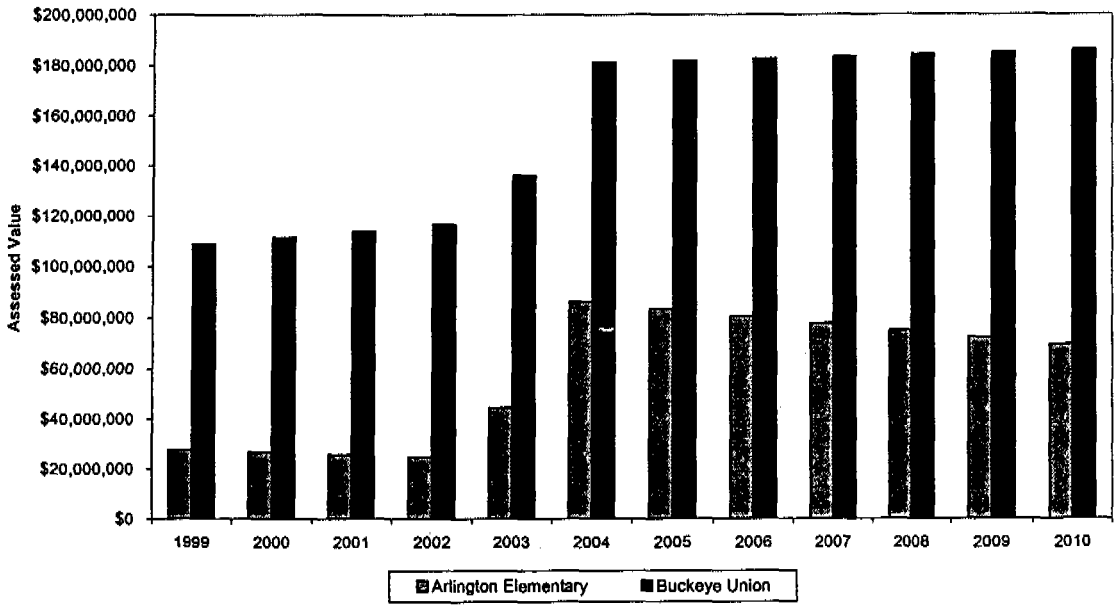
Sources: AZ Dept. of Revenue, Maricopa County Assessor, Elliott D. Pollack & Co.



Duke Energy's investment in the generating station produces a large boost in the assessed valuation of both the Arlington Elementary and Buckeye Union Districts. The projected primary assessed value begins to climb in 2003 with the construction of the plant (there's a two year time lag between construction and the recording of the generating station on the tax rolls). By 2004, the full effect of the plant on assessed values is realized.

Chart 3

Projected Primary Assessed Values
Arlington Elementary and Buckeye Union School Districts
Sources: AZ Dept. of Revenue, Maricopa County Assessor, Elliott D. Pollack & Co.



As a result, the primary and secondary tax rate for both Arlington Elementary and Buckeye Union should experience significant decreases. For instance, Arlington Elementary's primary rate should drop by about 63% between 1999 and 2004 when the plant is completed. The rate is projected to decline from the current $2.2040 to $0.8187, assuming that the school district's revenues needs increase at 3% per year from their current level.

Likewise, Buckeye Union's primary rate is projected to decline by 30% between 1999 and 2004 if revenue needs grow by 3% per year. The primary tax rate falls from $2.1337 in 1999 to a projected $1.4880 in 2004. Similar decreases in the secondary tax rate will also occur.

Individual property owners should see a 46% decline in school district property taxes between 1999 and 2004 as a result of the construction of the electric generating station. The typical annual savings range from $95 for a 40 acre vacant parcel to $421 for a 160 acre agricultural parcel. While these savings seem small for each property owner, the effect across both the Arlington Elementary and Buckeye Union Districts is substantial. Based on the projected future assessed values for the plant and expected property tax

rates, Duke Energy will be absorbing over $1.8 million in school district property taxes each year, once the plant is in service. These are expenses that previously accrued to all other property owners located within the school districts.

Table 2

Estimated Annual School District Property Tax Savings Resulting From Duke Energy Electric Generating Station

Property type	Residence on 1 acre lot	40 acre vacant parcel	160 acre parcel in agriculture
Market value	$70,000	$23,280	$103,200
Assessed value	$7,000	$3,725	$16,512
1999 combined school property tax[1]	$282	$206	$914
Projected 2004 combined school property tax[2]	$153	$111	$493
Tax savings	**$129**	**$95**	**$421**
Percentage tax decrease	**45.7%**	**46.0%**	**46.0%**

[1]Combined Arlington Elementary and Buckeye Union tax rate of $5.5364; reduced homeowner rate of $4.0341.

[2]Projected combined rate of $2.9887; reduced homeowner rate of $2.1899.

Note: Tax calculations do not include County or special district property taxes.

Sources: AZ Dept. of Revenue; Maricopa County Assessor; Elliott D. Pollack & Co.

2.0 Methodology and Sources

This report will describe the projected economic and fiscal impact of the construction and operation of a privately-owned electric generating station on metro Phoenix. Economic impact analysis examines the regional implications of an activity in terms of three basic measures: sales or output, earnings and job creation. Fiscal impact analysis, on the other hand, evaluates the public revenues and costs created by a particular activity. In fiscal impact analysis, the primary revenue sources of a city, county or state are analyzed to determine how the activity may financially affect them.

This study will focus on the benefits that would accrue to the State of Arizona, Maricopa County, and the Arlington Elementary and Buckeye Union High School Districts from the construction of the Duke Energy electrical generating station. The site of the plant is not located within an incorporated area, so the effect on local municipalities will be negligible. The analysis assumes that the current tax structure of the State and County would continue at current rates into the future. The impact on the school districts will be evaluated from the standpoint of increased assessed valuation and potential effect on property tax rates.

The fiscal impact figures cited in this report have been generated from information provided by a variety of sources including:

- Arizona Department of Education;
- Arizona Department of Economic Security;
- Arizona Department of Revenue;
- Duke Energy;
- Maricopa County Assessor's office;
- U.S. Consumer Expenditure Survey.

On of the most important effects of the power plant is the impact on assessed values and property taxes. The Arizona Department of Revenue controls the valuation of electric utility company property for property tax purposes. Utility companies, mines, and railroads are known as "centrally assessed" property and are subject to different standards than other types of real property. The plant is placed on the tax rolls at the book cost of investment and then depreciated over the life of the investment. In this case, depreciation is calculated based on a 30 year straight-line plant life. Pollution control equipment receives a 50% market value exemption under state law. Electric utility company property is assessed at 25% of its full cash value.

During construction of the plant, property taxes are calculated based on 50% of the actual cost expended for the year ending December 31st. A two-year time lag occurs between actual construction of the plant and placing it on the tax rolls. For instance, if the plant were started in 2001 as anticipated, the value of the first year's construction activity would not reach the tax rolls until the 2003 tax year. The full value of the

plant will not be recorded for tax purposes until 2004, based on the projected completion in 2002.

Elliott D. Pollack and Company has relied upon Duke Energy for construction cost estimates, employment projections and operating expenditures. This firm has not provided any estimate of the projected governmental costs to provide services to the generating station. Such analysis is beyond the scope of this study. Unless otherwise stated, all dollar values are expressed in current, inflated dollars using a 3% annual inflation rate.

This report is organized to provide an overview of economic and fiscal impact analysis and the results attributed to this particular project. The following section describes the proposed generating station and the primary assumptions that will drive the impact analysis. Section 4.0 summarizes the economic impact of the generating station on the metro Phoenix area. The fiscal impact of the plant is outlined in Section 5.0. Lastly, the impact of the generating station on the local school districts is described in the final part of the study.

3.0 Description of Project

Duke Energy is proposing to construct a $250 million electric generating plant in a rural area southwest of the Town of Buckeye known as Arlington Valley. Approximately 2,800 acres valued at $5 million will be purchased to provide a site for the plant and the water rights necessary to operate the facility. The plant will use natural gas as its primary fuel, but will also require a substantial quantity of water to generate steam. Duke Energy expects to purchase approximately $50 million of natural gas per year to operate the plant. Construction is expected to start in February 2001, with completion slated for July 2002.

For property tax analysis, it is necessary to differentiate between various parts of the plant and the company's investment. Of the $250 million cost, approximately $10 million will be spent on pollution control equipment, which is the subject of a 50% property tax exemption.

The land parcels that are subject to purchase are all contiguous and located within the Arlington Elementary and Buckeye Union High School Districts. The property is located within Township Six West, Range 1 South, which will provide rail access to the site.

While the investment by Duke Energy is estimated at $250 million, the local construction cost is estimated at about $67 million. Most of the cost of the generating station is associated with the purchase of gas and steam turbines that will be manufactured out of state. The operation of the plant will generate 25 jobs.

4.0 Economic Impact of Generating Station

This portion of the report will outline the economic impacts of both the construction of the generating station as well as its operations. Analysis of the fiscal impacts of the project is provided in the Section 5.0. All dollar figures, unless otherwise stated, are expressed in current, inflated dollars.

An extensive spreadsheet model was developed to evaluate and calculate the fiscal and economic impacts of the Duke Energy generating station from 2001 to 2010. The first subsection describes the economic impact methodology while subsection 4.2 summarizes the total benefits.

4.1 Economic Impact Analysis Methodology

Economic impact analysis examines the economic implications of an activity in terms of sales or output, earnings, and employment. For this study, the following two economic activities associated with the generating station were evaluated:

- the construction of the plant and
- the operations of the plant once completed.

Construction phase economic impacts are generally short-term effects related to onsite and offsite construction employment and other industries that support the construction. The long-term consequences of a project are the operational phase impacts. These include employment, earnings and expenditures that recur over the long-term.

The different types of economic impacts are known as direct, indirect, and induced, according to the manner in which the impacts are generated. For instance, direct employment consists of permanent jobs held by the project employees. Indirect employment is those jobs created by businesses that provide goods and services essential to the operation or construction of the project. These businesses range from manufacturers (who make goods) to wholesalers (who deliver goods) to janitorial firms who clean the buildings. Finally, the spending of the wages and salaries of the direct and indirect employees on items such as food, housing, transportation and medical services creates induced employment in all sectors of the economy.

Economists have developed multipliers that are used to estimate the indirect and induced impacts of various economic activities. These indirect and induced ripple effects occur as the wages of direct employees are respent in local businesses on retail goods and services. In response to this spending, local businesses hire more staff and expand their operations, creating additional jobs in retailing, wholesaling, manufacturing, transportation and other service sectors. These secondary effects are captured in the analysis conducted in this study.

Multipliers have been developed by both public and private organizations for each state and county in the country. The Minnesota IMPLAN Group developed the multipliers

used in this study. The IMPLAN multipliers are used to estimate the impacts of project expenditures on a region (gross receipt or sales), earnings (the sum of wages and salaries, proprietors income, and other labor income), and employment (number of jobs).

4.2 Economic Impact of Duke Energy Electric Generating Station

As noted previously, the local economic impact of the construction of the generating station is significantly less than its full cost since most of the major components are manufactured out-of-state. The local construction contract is estimated at approximately $67 million, spent during 2001 and 2002. Duke Energy projects that 25 direct jobs will be permanently created for the operation of the plant. Plant operators are expected to earn the typical wage for public utility employees in Maricopa County of about $39,000 annually. From this data, the IMPLAN economic multipliers are used to calculate the total impact of the project.

The economic impact of the Duke Energy generating station is substantial, resulting in the creation of nearly 643 total direct and indirect jobs annually during the two year construction period and 67 total direct and indirect jobs yearly during its operation (see Table 3). Local economic output during construction is $61.7 million annually and about $5 million per year thereafter. The project supports 577 households during construction and 60 households while in operation.

The impacts described above are regional in nature and will affect cities throughout the metro Phoenix area. For instance, construction materials will be purchased from local vendors and construction employees might commute long distances to work on the plant. Most likely, these workers and their families will purchase their daily needs at stores close to their place of residence, helping to disperse the Duke Energy generating station's impact throughout many local cities. Full-time workers who operate the plant after construction will most likely live on the west side of Maricopa County, once again distributing the impact among a number of communities.

Table 3

Economic Impact on Maricopa County
Duke Energy Electrical Generating Station
(In Inflated Dollars)

Inflation rate: 3.0%

	Construction		Operations							
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Local Economic Output										
Direct output	$33,500,000	$33,500,000	$3,488,000	$3,592,000	$3,700,000	$3,811,000	$3,926,000	$4,043,000	$4,165,000	$4,290,000
Indirect output	$28,225,000	$28,225,000	$1,346,000	$1,386,000	$1,428,000	$1,471,000	$1,515,000	$1,560,000	$1,607,000	$1,655,000
Total output	$61,725,000	$61,725,000	$4,834,000	$4,979,000	$5,128,000	$5,282,000	$5,440,000	$5,604,000	$5,772,000	$5,945,000
Employment										
Direct jobs	298	298	25	25	25	25	25	25	25	25
Indirect jobs	345	345	42	42	42	42	42	42	42	42
Total jobs	643	643	67	67	67	67	67	67	67	67
Wages	$22,718,000	$22,718,000	$1,664,000	$1,714,000	$1,765,000	$1,818,000	$1,873,000	$1,929,000	$1,987,000	$2,046,000
Population										
Population supported by project	1,512	1,512	158	158	158	158	158	158	158	158
Households supported by project	577	577	60	60	60	60	60	60	60	60

Sources: IMPLAN; Duke Energy; Elliott D. Pollack & Co.

5.0 Fiscal Impact of Generating Station

5.1 Background

Fiscal impact analysis studies the public revenues associated with a particular economic activity. The primary revenue sources of local, county, and state governments (i.e. taxes) are analyzed to determine how an activity may affect the various jurisdictions. This section will only evaluate the impact on the governmental entities. The impact on local school districts will be analyzed in Section 6.0.

Fiscal impacts are categorized by type in this study, similar to economic impact analysis. Construction impacts relate to the revenues generated from construction of the power plant. The primary sources of revenue are the state, county, and local sales taxes levied on the value of construction activity. In this particular case, the project is not located in a municipality, so local sales taxes will not be applicable. Operation phase fiscal impacts result from payment of employee wages and expenditures related to operating the generating station. One of the most important on-going revenues are the property taxes that will be paid by Duke Energy.

In addition to the direct revenues described above, secondary fiscal effects also occur as a result of spending by construction and operations employees. For instance, employees of the plant will live in all parts of Maricopa County, benefiting those communities from their spending on housing, retail goods and services. Indirect and induced employment supported by the plant will also create fiscal impacts resulting from the spending of their wages. Examples of the types of secondary fiscal impacts that will be generated include State income taxes paid on wages and sales taxes paid on retail sales.

5.2 Revenue Sources

This section outlines the applicable tax rates of the various jurisdictions and the types of taxes that will be collected from construction and operation of the Duke Energy electric generating station.

- <u>Tax On Construction Materials</u>
  The State and County levies a sales tax on materials used in the construction of land or building improvements. That tax is calculated by State law under the assumption that 65% of the construction cost of the facility and its land improvements are related to construction materials with the remaining 35% devoted to labor. The sales tax rate is then applied to the 65% materials figure. The sales tax on construction materials is a one-time collection by the governmental entity.

  The State currently levies a 5.0% sales tax on construction activity. Maricopa County levies two sales taxes totaling 0.7%. The freeway tax, which is used to fund the County's freeway program, is levied at a 0.5% rate until 2006 when it

expires. In November 1998, the electorate approved a 0.2% levy for the construction of prison facilities that is schedule to expire at the end of 2007.

- Property Taxes

  Real estate taxes are typically based on the assessed value of real property as determined by County Assessor. In the case of an electrical generating station, however, the Arizona Department of Revenue conducts the valuation in accordance with State Statute. The market value of the power plant is established as the original cost less accumulated depreciation. For this report, the plant was depreciated over 30 years, straight-line. Pollution control equipment is provided a 50% exemption from taxation.

  The assessed value of the plant is calculated by multiplying the assessment ratio, determined by the property's use, by its full cash value. The assessment ratio for an electric utility plant is 25%; vacant land is assessed at 16%. Assessed value is expressed by the following equation:

  market value X assessment ratio = assessed value

  The property tax rate, expressed in dollars per $100 of assessed value, is then applied to the assessed value to determine the amount of property tax. There are two types of property taxes – primary taxes used to finance general government operations, and secondary taxes used to finance general obligation bonded debt, budget overrides and special districts. The primary tax is based on what is known as the limited property value, calculated under a formula spelled out in State law. Secondary taxes are based on full cash value of property. The limited value cannot exceed full cash value. For an electrical utility, the limited and full cash values are the same.

  The combined Maricopa County property tax rate (primary and secondary) for 1999 is $3.4250 per $100 of assessed value comprised of the following taxing entities or districts:

  - general County tax,
  - Community College tax,
  - Flood Control District tax,
  - Fire District Assistance tax,
  - County Free Library tax,
  - Central Arizona Water Conservation tax.

  In addition, direct and indirect employees supported by the construction and operation of the plant will also pay city property taxes on homes they occupy. The tax rate used for this analysis is the weighted average rate of the eight largest cities in the metro area or $1.4380 per $100 of assessed value. The value of a typical Maricopa County housing unit has been calculated at approximately $105,000. This value assumes that employees will occupy units in a pattern similar to the current inventory of housing in the Valley. Today,

single family homes account for 66.1% of the housing stock, townhouses 8.1%, and apartments 25.8%. The current average sale price of these units is $131,000, $85,000, and $43,800 respectively, with the weighted average of all units at $104,776.

- Sales/Use Tax.
  The electric generating station will consume a large quantity of natural gas, estimated at $50 million per year. The State and County will charge a use or sales tax on this consumption at the 5.0% rate for the State and 0.7% rate for the County.

  Fiscal impacts also result from the spending by direct and indirect employees supported by the construction and operation of generating station. Most of the employees supported by the project will reside within one of Maricopa County's cities or, at the very least, purchase goods from retailers located within a local municipality. Based on data from the U. S. Consumer Expenditure Survey, the projected extent of retail spending and resulting sales tax receipts was calculated.

  State and County sales tax rates for employee spending are the same as cited previously (5.0% for State and 0.7% for County). The retail sales tax receipts for local cities are based on the weighted average tax rate for all cities in Maricopa County or 1.38%.

- State Income Tax
  The State of Arizona collects taxes on personal income. The tax rate used in the analysis averages about 1.7% of gross income for construction-related wages and 1.3% for operations-related earnings. These percentages are based on the most recently available income tax data from the State and the projected wage levels of jobs created by the project. This tax will apply to the wages and earnings of direct and indirect employment resulting from construction and operation of the generating station. Portions of this tax are redistributed through revenue sharing to cities throughout Arizona based on population.

- State Unemployment Tax
  Unemployment insurance tax for employees is 2.7% on the first $7,000 of earned income. This factor is applied to the projected wages and earnings of direct and indirect employees involved in construction and operation of the project.

- Gas Tax
  The State of Arizona collects a motor vehicle fuel tax of $0.18 per gallon. The tax revenue is calculated based on a vehicle traveling 12,000 miles per year at 20 miles per gallon. Portions of this tax are distributed to cities and counties throughout Arizona based on a formula that includes population and the origin of gasoline sales.

- Vehicle License Tax
  The vehicle license tax is a personal property tax placed on vehicles at the time of annual registration. The average tax in Maricopa County is $148 and funds are shared between the cities, county and state in accordance with population based formulas.

The above tax categories represent the largest sources of revenues that will be generated to city, county and state governments.

5.3 Fiscal Impact of Duke Energy Electric Generating Station

One of the major benefits of the generating station is the increase in the assessed value of the County and other taxing districts within which the plant is located. The projected assessed value of the generating station and land, when first placed in operation and before deducting depreciation, is $62 million (see Table 4). This represents approximately 0.3% of the total $18 billion 1999 assessed value of the County, a fairly significant figure given the size of the metro area. A project of this magnitude is equivalent to a new regional shopping mall or manufacturing plant from the standpoint of property tax revenue, even though the generating station's value will slowly decline over the years as it is depreciated.

Table 4
Projected Market and Assessed Values
Duke Energy Electric Generating Station
(in Inflated Dollars)

	Projected Market Value				
	Plant Value	P.C.E.*	Land	Total Value	Assessed Value
2001	$0	$0	$1,680,000	$1,680,000	$268,800
2002	$0	$0	$1,680,000	$1,680,000	$268,800
2003	$73,333,333	$1,527,778	$5,000,000	$79,861,111	$19,515,278
2004	$240,000,000	$5,000,000	$5,150,000	$250,150,000	$62,074,000
2005	$232,000,000	$4,833,333	$5,304,500	$242,137,833	$60,057,053
2006	$224,000,000	$4,666,667	$5,463,635	$234,130,302	$58,040,848
2007	$216,000,000	$4,500,000	$5,627,544	$226,127,544	$56,025,407
2008	$208,000,000	$4,333,333	$5,796,370	$218,129,704	$54,010,753
2009	$200,000,000	$4,166,667	$5,970,261	$210,136,928	$51,996,909
2010	$192,000,000	$4,000,000	$6,149,369	$202,149,369	$49,983,899

*Pollution Control Equipment

Sources: AZ Dept. of Revenue; Maricopa County Assessor; Elliott D. Pollack & Co.

Table 4 shows the projected depreciated value of the plant over time. The analysis assumes there will be no additional capital improvements to the site in the future. The value of the land to be acquired by Duke Energy has been inflated at a 3.0% rate given historical land appreciation trends in the area.

As shown on Table 5 on page 17, the electric generating station will produce significant positive effects for the State of Arizona and Maricopa County totaling nearly $45 million

dollars between 2001 and 2010. About 90% of the revenue is derived from taxation of real property, construction contracts and natural gas consumption. Impacts resulting from employment spending and wages contribute another $4.5 million over the 10 years. During construction of the plant, approximately $5.8 million per year accrues to governmental entities. After completion of the generating station, total revenues reach $5 million annually.

The State of Arizona reaps most of the rewards of the plant, accounting for $27.4 million in revenue or 62% of the total. Maricopa County also gains about $16.7 million in tax revenue, primarily from property taxes. It should be noted that most of these revenues do not flow directly to the County's general fund, but rather to county-wide taxing jurisdictions such as the Community College District and Flood Control District. Cities in the county gain the least because the plant is located in a rural area. Any impact on local cities is the result of spending of wages by persons supported by the generating station.

It needs to be emphasized that the above revenue figures are based on the current tax structure of the State and County. Any increase in sales or income tax rates would produce even greater benefits. The high tax valuation of the plant also provides a significant boost to the assessed valuation of the County, helping to stabilize or even reduce County property tax rates. In addition, the figures do not include corporate income taxes that may be paid to the State by Duke Energy.

Table 5

Fiscal Impact on Arizona and Maricopa County
Duke Energy Electrical Generating Station
(In Inflated Dollars)

Inflation rate: 3.0%

Fiscal Impact of Project	Construction 2001	Construction 2002	Operations 2003	2004	2005	2006	2007	2008	2009	2010	Total
State of Arizona											
Construction sales tax	$1,089,000	$1,089,000									$2,178,000
Sales tax on fuel consumption			$2,500,000	$2,575,000	$2,652,000	$2,732,000	$2,814,000	$2,898,000	$2,985,000	$3,075,000	$22,231,000
Maricopa County											
Construction sales tax	$152,000	$152,000									$304,000
Sales tax on fuel consumption			$350,000	$361,000	$371,000	$382,000	$113,000	$0	$0	$0	$1,577,000
Property tax	$9,000	$9,000	$668,000	$2,126,000	$2,057,000	$1,988,000	$1,919,000	$1,850,000	$1,781,000	$1,712,000	$14,119,000
Fiscal Impacts of Employees											
State of Arizona											
Retail sales tax[1]	$483,000	$483,000	$44,000	$45,000	$47,000	$48,000	$49,000	$51,000	$52,000	$54,000	$1,356,000
Income tax[1]	$393,000	$393,000	$22,000	$23,000	$23,000	$24,000	$25,000	$26,000	$26,000	$27,000	$982,000
Unemployment tax	$122,000	$122,000	$13,000	$13,000	$14,000	$14,000	$14,000	$15,000	$15,000	$16,000	$358,000
Gas tax[1]	$69,000	$69,000	$7,000	$7,000	$8,000	$8,000	$8,000	$8,000	$9,000	$9,000	$202,000
Vehicle license tax[1]	$95,000	$95,000	$10,000	$10,000	$11,000	$11,000	$11,000	$12,000	$12,000	$12,000	$279,000
Maricopa County											
Retail sales tax	$80,000	$80,000	$7,000	$8,000	$8,000	$8,000	$2,000	$0	$0	$0	$193,000
Property tax	$166,000	$166,000	$17,000	$18,000	$18,000	$19,000	$20,000	$20,000	$21,000	$21,000	$486,000
Local Government											
Retail sales tax	$158,000	$158,000	$14,000	$15,000	$15,000	$16,000	$16,000	$17,000	$17,000	$18,000	$444,000
Property tax	$70,000	$70,000	$7,000	$8,000	$8,000	$8,000	$8,000	$8,000	$9,000	$9,000	$205,000
Total Impact											
State of Arizona	$2,251,000	$2,251,000	$2,596,000	$2,673,000	$2,755,000	$2,837,000	$2,921,000	$3,010,000	$3,099,000	$3,193,000	$27,586,000
Maricopa County	$407,000	$407,000	$1,042,000	$2,513,000	$2,454,000	$2,397,000	$2,054,000	$1,870,000	$1,802,000	$1,733,000	$16,679,000
Local Government	$228,000	$228,000	$21,000	$23,000	$23,000	$24,000	$24,000	$25,000	$26,000	$27,000	$649,000
Total All Impacts	$2,886,000	$2,886,000	$3,659,000	$5,209,000	$5,232,000	$5,258,000	$4,999,000	$4,905,000	$4,927,000	$4,953,000	$44,914,000

[1] A portion of these taxes are shared with cities, towns and counties under revenue sharing.

Sources: IMPLAN; Duke Energy; Arizona Department of Revenue; Maricopa County Assessor's Office; Elliott D. Pollack & Co.

6.0 Impact of Generating Station on School Districts

6.1 Background

The Duke Energy electric generating station is located in the Arlington Elementary and Buckeye Union High School Districts. Arlington Elementary (kindergarten through eighth grade) is a small district of approximately 155 students who are fed to the Buckeye Union District for secondary eduation. Buckeye Union has slightly over 1,000 students and serves a wide rural area of southwest Maricopa County.

The history of assessed values of the two districts is shown on Table 6. Arlington's assessed value has been declining since 1991 as a result of the large percentage of utility company investments within the District. For 1999, over 50% of the District's assessed value is attributable to utility and pipeline company improvements. Since these properties depreciate over time, the assessed value declines as well. Buckeye Union's assessed value has been growing since the end of the local real estate depression in 1995. Utilities account for about 31% of Buckeye Union's assessed value.

Table 6

Assessed Valuation History

Arlington Elementary and Buckeye Union High School Districts

Arlington Elementary #47

	Primary Property Tax		Secondary Property Tax		Property Tax Revenue	
	Valuation	Tax rate	Valuation	Tax rate	Primary	Secondary
1991	$34,673,905	$2.2854	$37,110,165	$0.0000	$792,437	$0
1992	$33,854,336	$2.4430	$35,455,605	$0.0000	$827,061	$0
1993	$32,074,642	$2.3907	$32,670,713	$0.0000	$766,808	$0
1994	$31,496,043	$2.2549	$32,099,408	$0.1973	$710,204	$63,332
1995	$32,562,122	$1.9804	$33,388,798	$0.3933	$644,860	$131,318
1996	$30,589,918	$2.3780	$31,139,091	$0.2090	$727,428	$65,081
1997	$30,271,539	$2.2309	$31,006,780	$0.4229	$675,328	$131,128
1998	$29,622,791	$2.3097	$30,632,190	$0.4192	$684,198	$128,410
1999	$27,601,070	$2.2040	$28,536,546	$0.4816	$608,328	$137,432
Compound annual change 1996-99	-3.37%		-2.87%			

Buckeye Union High School #201

	Primary Property Tax		Secondary Property Tax		Property Tax Revenue	
	Valuation	Tax rate	Valuation	Tax rate	Primary	Secondary
1991	$115,410,114	$2.5579	$129,471,406	$0.7654	$2,952,075	$990,974
1992	$119,897,053	$2.1808	$127,640,825	$0.5166	$2,614,715	$659,393
1993	$109,944,995	$2.5032	$113,431,370	$0.5817	$2,752,143	$659,830
1994	$107,249,347	$2.6897	$109,847,874	$0.6343	$2,884,686	$696,765
1995	$105,322,499	$2.0479	$109,517,107	$0.5521	$2,156,899	$604,644
1996	$101,996,864	$2.3267	$104,597,699	$0.7058	$2,373,161	$738,251
1997	$102,860,395	$2.5973	$106,842,353	$0.6617	$2,671,593	$706,976
1998	$104,992,419	$2.5043	$109,689,634	$0.7414	$2,629,325	$813,239
1999	$109,037,307	$2.1337	$114,684,129	$0.7171	$2,326,529	$822,400
Compound annual change 1996-99	2.25%		3.12%			

Sources: Maricopa County Assessor; Elliott D. Pollack & Co.

The financing of public education in Arizona is a complex matter. Funding comes from a variety of local, state, and federal sources based on complicated formulas. For fiscal year

1997-98, local property taxes provided 47% of total public school funding within Maricopa County while the State contributed 45%. Federal and County sources contributed the remaining revenue. Two types of property taxes accomplish funding at the local level:

- Primary taxes used to finance school operations; and
- Secondary taxes used to finance general obligation bonded debt and budget overrides.

According to the Arizona Department of Education, local property taxes provided about 86% and 62%, respectively, of the Arlington and Buckeye Union Districts' total budgets during fiscal year 1997-98. The proposed Duke Energy electric generating station will increase the assessed value of the school districts and provide two primary benefits:

- Funding for schools can be increased without raising tax rates or, alternatively, current funding levels can be maintained while reducing the tax rate; and
- The districts' bonding capacities will be increased to support new capital improvements.

Both of the above benefits are subject to spending and debt limitations provided in State law. In addition, the financing of public school capital facilities and the future of the secondary property tax is currently in a state of flux due to the passing of the Students FIRST bill by the State Legislature in July 1998. A discussion of the implications of Students FIRST is included in the last part of this section.

6.2 Impact of Duke Energy Generating Station on School Districts

A large capital investment such as that proposed by Duke Energy will have a significant impact on the assessed value and tax rates of a school district. With the high assessment ratio of 25% for utility companies, the financing of schools is transferred in many respects from local residents to private business. The analysis contain in this section will illustrate the potential impact of the power plant on local school property taxes.

When the plant is completed and added to the tax rolls in 2004, its estimated assessed value will be $62 million. Comparatively, this represents 125% of Arlington Elementary's 1999 primary assessed value and 57% of Buckeye Union's 1999 value. Clearly, the generating station should have an immediate positive effect, resulting in lower school tax rates.

Chart 4

Comparison of Assessed Values
Arlington Elementary District, Buckeye Union H. S. District, Duke Generating Station

Sources: AZ Dept. of Revenue, Maricopa County Assessor, Elliott D. Pollack & Co.

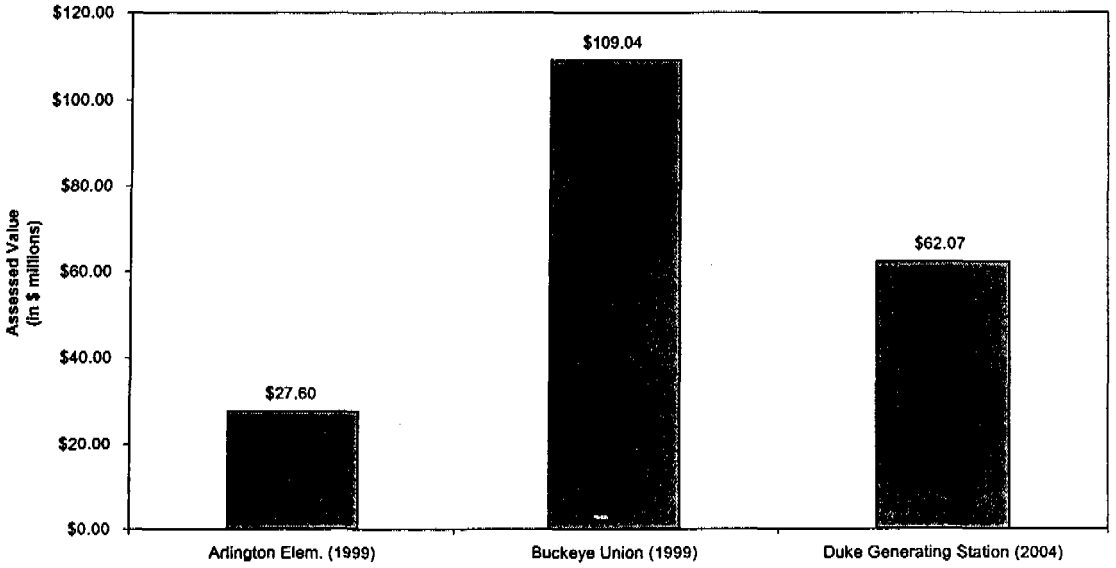


Table 7 has been developed as an example of the effect of the plant on primary tax rates. The primary rate has been used because of the uncertainty on the future of the secondary rate due to Students FIRST. The assumptions are the following:

- The existing primary property tax base for Arlington Elementary continues to decline in the future at the rate of 3.37% per year, similar to the rate experienced between 1996 and 1999. Buckeye Union's primary tax base is assumed to grow at a 2.25% annual rate.

- The Duke Energy generating station is added to the tax rolls in 2003 as partially completed. In 2004, the full value of the completed plant takes effect.

- The "desired revenue" column represents the 1999 primary tax revenue generated to each school district, increased by 3% per year thereafter.

- The "projected tax rate" column is the primary rate that would need to be levied to achieve the desired revenue.

As noted on Table 7, the projected tax rate for both Arlington Elementary and Buckeye Union should experience significant decreases. For instance, Arlington Elementary's rate should drop by about 63% between 1999 and 2004 when the plant is completed. The rate declines from the current $2.2040 to $0.8187. However, if the need for revenues increases at 3% per year, the tax rate would rise to $2.6692 by 2002 before the effects of

the generating station are noticed, then drop to $0.8187 by 2004. This represents a decline of about 69%.

Table 7

Impact of Duke Energy Electric Generating Station On Local School Districts' Primary Tax Rate

(In Inflated Dollars)

Arlington Elementary District

	Projected Assessed Value	Desired Revenue	Projected Tax Rate*
1999	$27,601,070	$608,328	$2.2040
2000	$26,671,153	$626,577	$2.3493
2001	$25,772,566	$645,375	$2.5041
2002	$24,904,253	$664,736	$2.6692
2003	$44,419,531	$684,678	$1.5414
2004	$86,139,195	$705,218	$0.8187
2005	$83,311,460	$726,375	$0.8719
2006	$80,511,783	$748,166	$0.9293
2007	$77,739,265	$770,611	$0.9913
2008	$74,993,042	$793,730	$1.0584
2009	$72,272,276	$817,541	$1.1312
2010	$69,576,162	$842,068	$1.2103

Buckeye Union High School District

	Projected Assessed Value	Desired Revenue	Projected Tax Rate*
1999	$109,037,307	$2,326,529	$2.1337
2000	$111,490,505	$2,396,325	$2.1494
2001	$113,998,897	$2,468,215	$2.1651
2002	$116,563,724	$2,542,261	$2.1810
2003	$136,079,002	$2,618,529	$1.9243
2004	$181,260,257	$2,697,085	$1.4880
2005	$181,924,846	$2,777,997	$1.5270
2006	$182,650,509	$2,861,337	$1.5666
2007	$183,438,623	$2,947,177	$1.6066
2008	$184,290,601	$3,035,593	$1.6472
2009	$185,207,884	$3,126,660	$1.6882
2010	$186,191,949	$3,220,460	$1.7296

*Expressed in dollars per $100 or assessed value.

Sources: AZ Dept. of Revenue; Maricopa County Assessor; Elliott D. Pollack & Co.

Likewise, Buckeye Union's rate declines by 30% between 1999 and 2004 and then continues to grow slowly as the desired revenue figure grows by 3% per year. The tax rate falls from $2.1337 in 1999 to a projected $1.4880 in 2004.

Residents of the area will, therefore, see a large decline in their property tax bills for the school districts over the next five years as the burden shifts to the power plant. The impact on County property taxes will not be noticeable because of the large size of the County's tax base. However, as noted previously, the power plant will help to stabilize County tax rates and relieve some of the burden on local residents.

To illustrate the fiscal impact of the power plant on individual property owners, Table 8 outlines the projected school district tax savings for three property types in the Arlington Valley area. The properties include a residence on a one acre lot, a 40 acre vacant, desert parcel and a 160 acre site currently in cultivation. The residence is assessed at a 10% assessment ratio while the larger, unimproved properties have a 16% ratio. Homeowners also receive a 35% discount on the primary school tax under current State law. The projected market values of the properties have been confirmed with the County Assessor's office and through sampling of property tax records. The calculations do not include County property taxes or any special district taxes that may apply to certain parcels.

Table 8

Estimated Annual School District Property Tax Savings Resulting From Duke Energy Electric Generating Station

Property type	Residence on 1 acre lot	40 acre vacant parcel	160 acre parcel in agriculture
Market value	$70,000	$23,280	$103,200
Assessed value	$7,000	$3,725	$16,512
1999 combined school property tax[1]	$282	$206	$914
Projected 2004 combined school property tax[2]	$153	$111	$493
Tax savings	**$129**	**$95**	**$421**
Percentage tax decrease	**45.7%**	**46.0%**	**46.0%**

[1]Combined Arlington Elementary and Buckeye Union tax rate of $5.5364; reduced homeowner rate of $4.0341.

[2]Projected combined rate of $2.9887; reduced homeowner rate of $2.1899.

Note: Tax calculations do not include County or special district property taxes.

Sources: AZ Dept. of Revenue; Maricopa County Assessor; Elliott D. Pollack & Co.

The table shows that property owners should see a 46% decline in school district property taxes between 1999 and 2004 as a result of the construction of the electric generating station. The annual savings range from $95 for the 40 acre vacant parcel to $421 for the agricultural parcel. While these savings seem small for each property owner, the effect across both the Arlington Elementary and Buckeye Union Districts is substantial. Based on the projected future assessed values for the plant and expected property tax rates, Duke Energy will be absorbing over $1.8 million in school district property taxes each year, once the plant is in service. These are expenses that previously accrued to all other property owners located within the school districts.

6.3 Students FIRST Legislation

In July 1998, the State Legislature passed the Students FIRST bill that dramatically reformed the way public schools are constructed. Passage of the bill was in response to the State Supreme Court's finding that Arizona's capital school finance system was unconstitutional. The basis for school construction financing until 1998 had been bonded indebtedness, i.e. the local secondary property tax. The system was found by the courts, however, to be unconstitutional since it failed to treat all school children equally.

Students FIRST establishes that the State must provide the funding for building adequate schools. The use of bonding is still permitted, but only to go above and beyond the minimum standards provided by the State. Capital overrides must be approved in an election.

Students FIRST will eventually have an impact on the revenues that are generated locally for school construction. Previously approved capital improvement bonds will continue to be paid by school districts, but will be phased out as bonds are retired. The extent of override bonds that will be issued in the future to augment the State capital funding is, obviously, unknown.

There are misconceptions by the public that Students FIRST will eventually do away with school property taxes. Nothing could be further from the truth. Students FIRST only affects the secondary school property tax that is used to construct capital facilities. The primary tax levy, representing the majority of the property tax, will continue to provide support for school operations as in the past.

In addition, existing outstanding debt carried by a school district will continue to be paid by the secondary levy in the future. According to the 1997-1998 Annual Report of the Arizona Superintendent of Public Instruction, Arlington Elementary has no outstanding debt while Buckeye Union has $3.25 million. Therefore, even with Students FIRST, Buckeye Union will need to levy a secondary property tax in the future. Students FIRST also permits the issuance of local school district debt to enhance the State's capital improvement funding. Bonding is limited to a maximum of 10% of the district's assessed value compared to a 30% limit prior to Students FIRST.

The financing of public education is an extremely complex and emotional issue. It is too early to tell whether Students FIRST will be able to address all the needs of districts throughout the State. Changes in the system will undoubtedly occur in the future as experience is gained. In the meantime, the local school district property tax will continue to be a primary source of funding.